THOROUGHFARE COMMENTS

- Keep Tecumseh speeds down
- Add bike lanes on Tecumseh
- Reduce Tecumseh spd limit east of 12th Ave E.

Must have complete streets on all road sections

Complete James Garner (front st) N. to Robinson

Connect Tecumseh from 48th East to 12th.

E SPECIAL CORRIDOR FROM McGEE TO EAST ON LINDSEY.

CONNECT E LINDSEY BETWEEN 84TH + 96TH - FIRE RE

TRANSIT COMMENTS

- Brooks Rail Station full-time station
- Update the transit routes to the latest version, please
- Brooks station needs to be transit & pedestrian oriented — needs NOT to be a park & ride

2011 Norman Community Transportation Survey

Appendix B – Transportation Conditions and Trends

Transportation Conditions and Trends

Population and Employment

The following is a discussion of historic and projected growth patterns for both population and employment.

Population Growth Trends

Examining Norman's growth rate over the past sixty years indicates that the City has continuously experienced steady growth increasing from a population of 27,000 in 1950 to a population of over 110,000 in 2010. The highest growth occurred between 1960 and 1970 where the City grew by over 50 percent. The highest numeric increase also occurred between 1960 and 1970 where the City grew by over 17,000 people. While the overall percentage of growth continues to decline due to the larger overall population, the annual numeric increase has remained relatively steady since 1970 with the City generally adding between 12,000 and 17,000 residents each decade.

Compound annual growth rate (CAGR) is an effective method of examining long-range growth. Rather than focusing on the percentage growth rate between a starting and ending year, it indicates the rapid and slow growth, providing an average that can be used for long-range projections. incremental growth rate that occurred annually between the starting and ending years. This annual growth rate is advantageous when calculating population projections because it accounts for periods of

Between 1950 and 2010, the City experienced a 2.4 percent CAGR growth rate. Comparatively speaking, this growth rate is reflective of moderate growth. When focusing on more recent growth trends, a relatively consistent CAGR is reflected as the five, ten and twenty year CAGRs are between 1.5 percent and 1.7 percent. Over the past five years, growth within Norman has increased, indicated by a higher CAGR over that time frame.

Table B-1: Historic Population Growth

Year	Population	Numeric Change	Percent Change
1950	27,006	-	-
1960	34,412	7,406	27.4%
1970	52,117	17,705	51.5%
1980	68,020	15,903	30.5%
1990	80,071	12,051	17.7%
2000	95,694	15,623	19.5%
2010	110,925	15,231	15.9%

Table B-2: Compound Annual Growth Rate

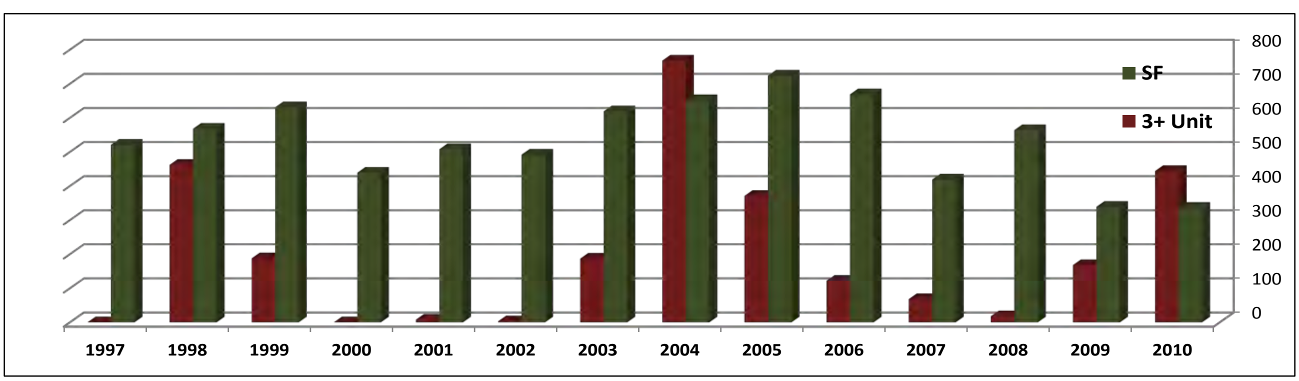
Compound Annual Growth Rates	
5 Year Growth Rate	1.71%
10 Year Growth Rate	1.49%
20 Year Growth Rate	1.64%
60 Year Growth Rate	2.38%

Residential Building Permit Trend (1997-2010)

Building permit data from 1997 to 2010 was examined in order to compare building trends with annual development patterns. The City experienced the highest additions of single-family residential units between 2003 and 2006, with the peak occurring in 2005. In 2005, over 700 new single-family residential permits were issued. The robust growth gradually decreased in conjunction with nation-wide housing trends reaching a low in 2009. While single-family housing permits decreased with time, over 300 building permits a year were still issued after 2007. This is significant because it reveals that growth was still occurring in Norman during the nation-wide housing crisis.

Multi-family building permits generally experienced its highest consistent growth between 2003 and 2005, but there were also significant approvals in 1998 and 2010. The highest number of approved multi-family building permits occurred in 2004, followed by 1998 and 2010. In all three of these years, over 400 multi-family building permits were approved.

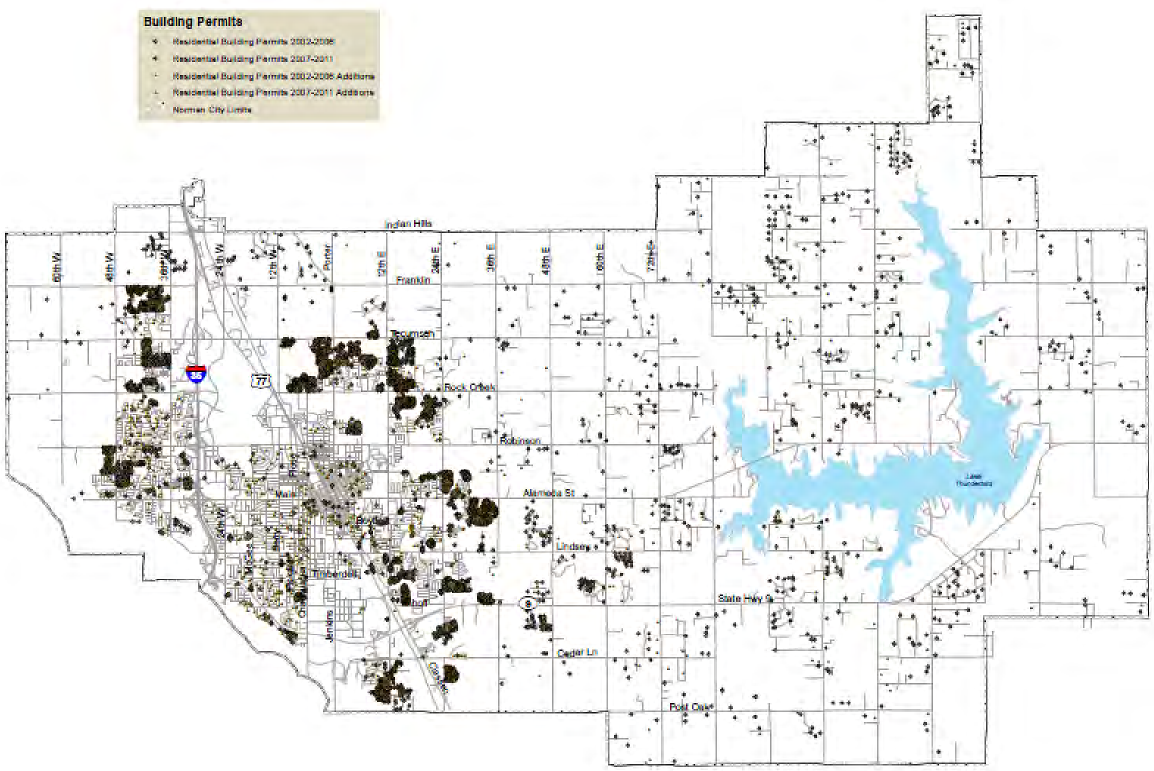
Figure B-1: Building Permit Data (1997-2010)



2002-2011 Residential Permits

Using building permit data between 2002 and 2011, a map depicting the exact location of each residential building permit was created. These maps help to establish locational growth patterns. The figure below indicates that rapid growth has occurred in the northeastern area of the City. While this area accounts for a significant portion of residential building permits, the periphery of the City as a whole experienced growth as a significant number of new building permits were issued in the northwestern and southeastern areas. Physical growth barriers limited growth on the southwestern side of the City.

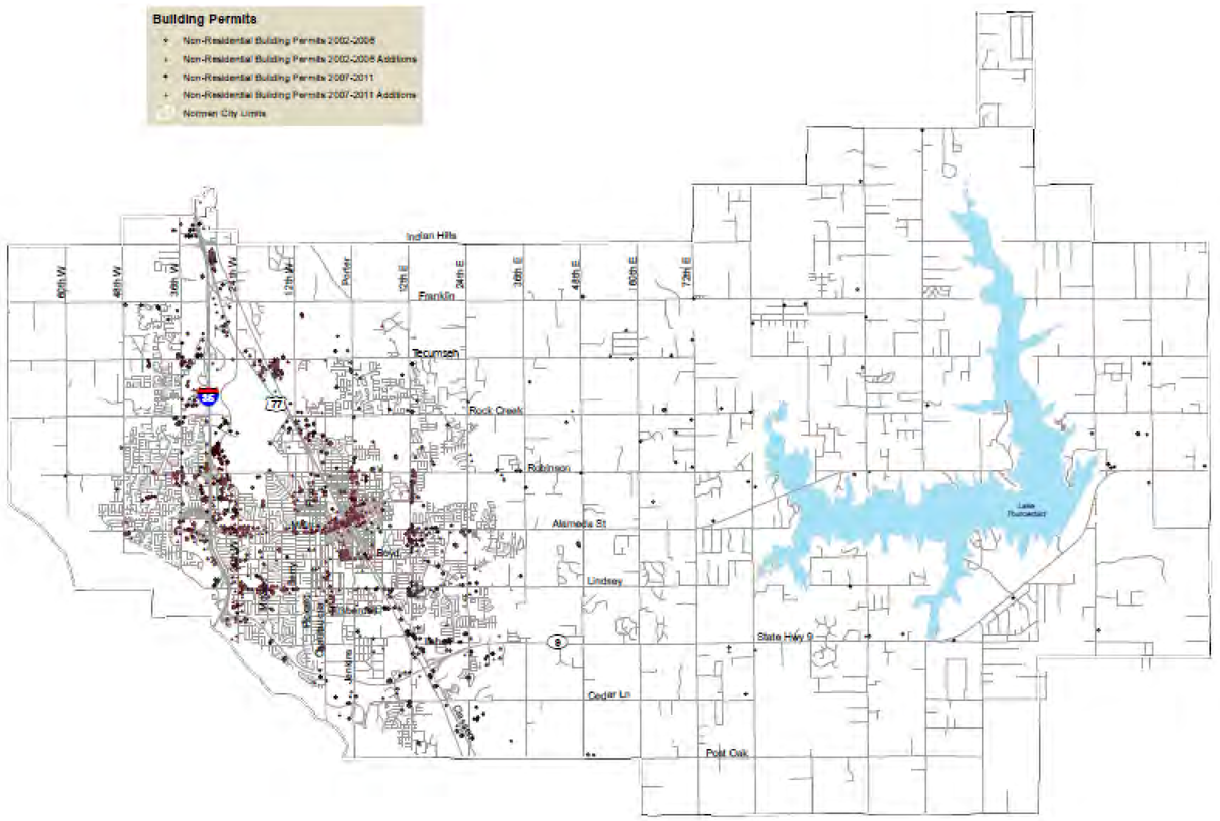
Figure B-2: 2002-2011 Residential Permits



2002-2011 Commercial Building Permits

The locations of issued commercial building permits between 2002 and 2011 were examined to establish non-residential growth trends. Generally speaking, commercial building permits occurred along Lindsey Street, Main Street, Porter Street and Interstate 35. The downtown area, in particular, had a significant number of new building permits, as did Interstate 35.

Figure B-3: 2002-2011 Commercial Permits

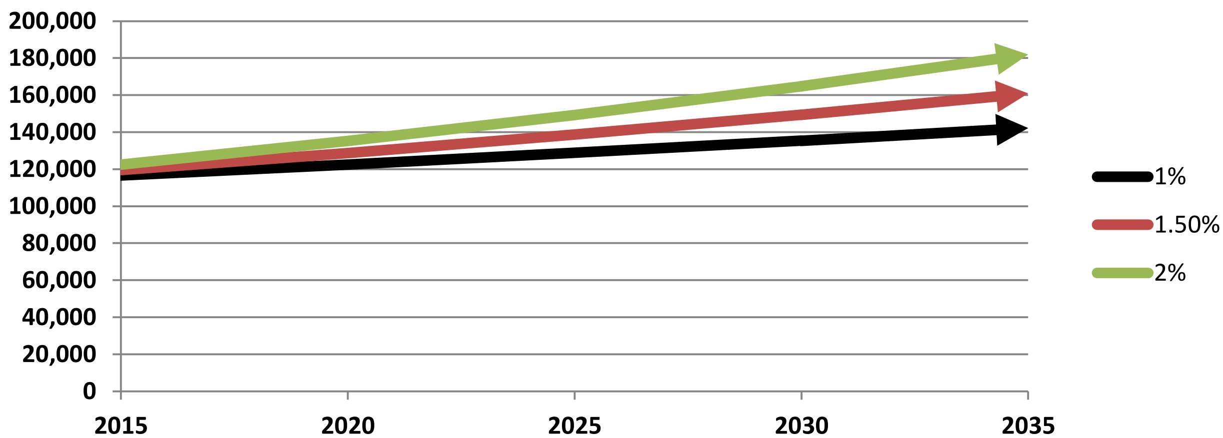


Projected Population Growth

Population projections from the Norman 2025 Plan and Association of Central Oklahoma Governments (ACOG) were compared. The two sources provided numbers that reflected a very high level of consistency. Historic growth trends in Norman were relatively consistent, particularly since 1960.

As part of this analysis, three different projected growth rates were examined. A 1.5 percent growth rate is reflective of historic population growth that has been relatively consistent. The 1 percent CAGR is reflective of a lower rate of growth than what has historically been seen. The 2 percent CAGR is reflective of a higher growth rate than historically has been seen. A CAGR of 1.5 percent is believed to be a relatively solid projection for future growth. This 1.5% projected growth rate is also consistent with projections by the Norman 2025 Plan and ACOG projections.

Figure B-4: Population Growth Projections



Employment Growth Trends

ACOG provides employment projections in conjunction with its Metropolitan Transportation Plan. ACOG provides data for 2005, 2015 and 2035. The CAGR between 2005 and 2035 was used to establish linear employment projections. Overall, ACOG projects steady employment growth to occur in Norman over the 30 year period, increasing from a 2005 employment of 59,000 to over 100,000 by 2035.

Table B-3: Population Projection Comparison

Year	1.50%	Norman 2025	ACOG
2015	119,497	120,152	121,120
2025	136,682	137,147	137,548
2035	160,946	156,518	156,173

Table B-4: ACOG Employment Projections

Year	Employment	CAGR
2005	59,002	1.85%
2015	70,872	
2025	85,130	
2035	102,298	

Land Use and Development Trends

In order to assess and prioritize transportation needs, it is important to examine land use and development trends. These trends help to show where population and employment growth is projected to occur within Norman and where the most significant transportation needs may exist.

ACOG has conducted population and employment projections in conjunction with its Metropolitan Transportation Plan. These population and employment projections were utilized in the following discussion of population and employment growth trends.

In general, population and employment growth is expected to occur within Norman over the next 20 years. The vast majority of this growth is expected to occur within the Development Service Area, an area designated by the City as a higher priority area for infrastructure improvements.

The following is a discussion of population growth and density projections by Traffic Analysis Zone (TAZ) as well as employment growth and density projections by TAZ.

Population Growth by Traffic Analysis Zone

The Association of Central Oklahoma Governments provides population growth projections per TAZ. The images **Figure B-5** reflect where the most numeric population growth is projected to occur between 2005 and 2035. Population growth is primary focused in the central portion of Norman, with significant growth occurring on the northern and western sides of the City. Overall, population growth is expected to occur in eastern areas although not in the same capacity as is occurring elsewhere.

Population Density by Traffic Analysis Zone

In addition to population growth projections, ACOG also has provided population density projections for the 2005-2035 time period, and shown in **Figure B-6**. Different from population growth which is based upon expected numerical increase, population density is focused on the number of people per square mile. Projections indicate that the most of the increase in density is expected to occur in the central area of Norman, in conjunction with the majority of the population growth. Density increases appear to be the greatest on the northern side of the City, north of Robinson Street, with only slight density increases outside the Development Service Area.

Employment Growth by Traffic Analysis Zone

ACOG has prepared employment growth projections in conjunction with the Metropolitan Transportation Plan. Projections are between the 2005 and 2035 time period. Employment growth projections represent the numeric increase of jobs expected within each TAZ. Robust employment growth is projected to occur within Norman, with the vast majority of employment growth being located along the Interstate 35 corridor. Additionally, significant employment growth is expected to occur on E Lindsey Street and along Highway 9. These trends are depicted in **Figure B-7**.

Employment Density by Traffic Analysis Zone

Based upon the numeric employment projections, ACOG has projected overall employment density increases between 2005 and 2035, as shown in **Figure B-8**. Similar to population, employment density is indicative of jobs per square mile per TAZ. The most significant and noticeable employment density increases are along Interstate 35, in conjunction with projected rapid numeric increases in jobs along the corridor. In generally, areas within the Development Service Zone are projected to have slight increases in employment density.

Figure B-5: ACOG Population Growth Projections by TAZ (2005 and 2035)

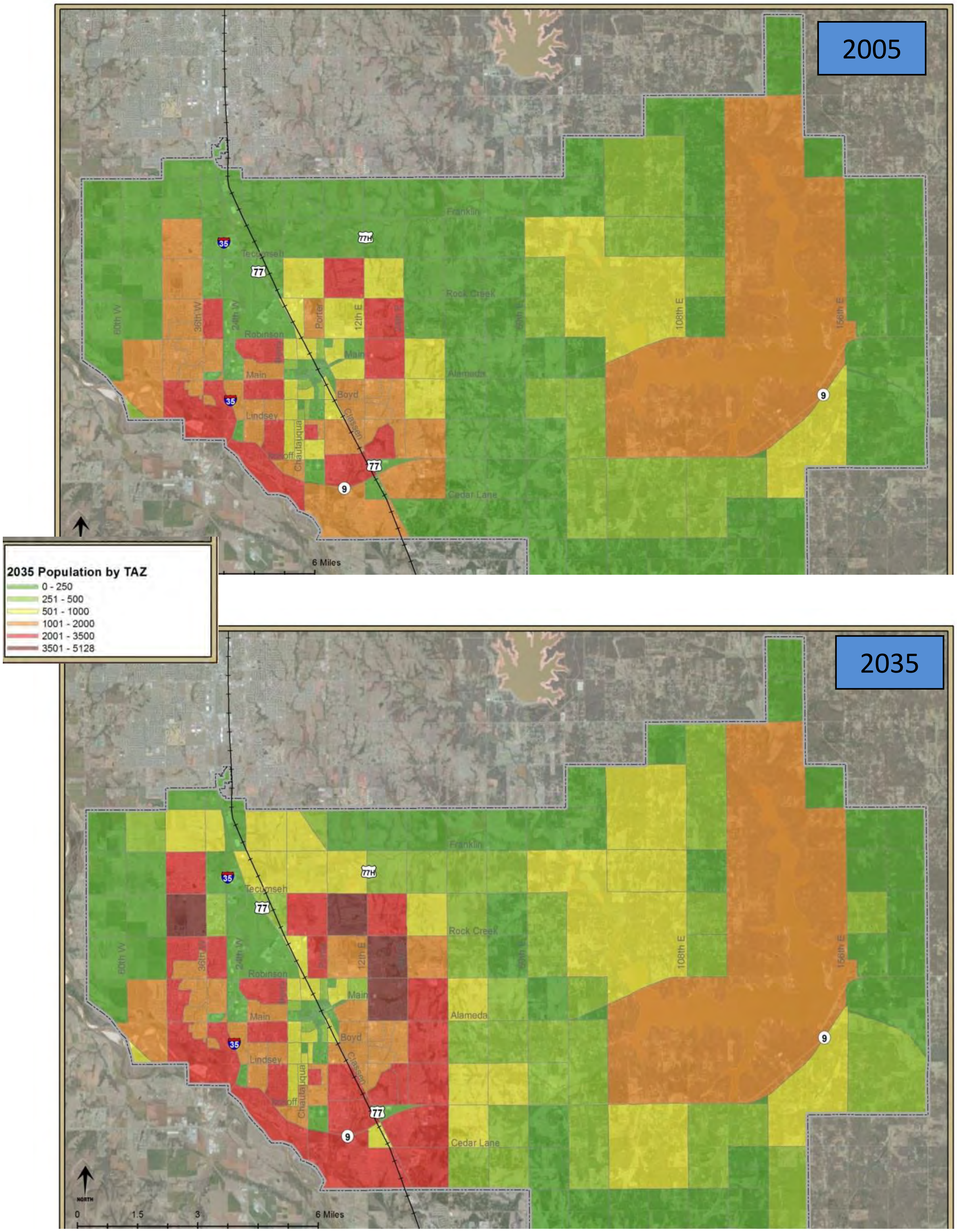
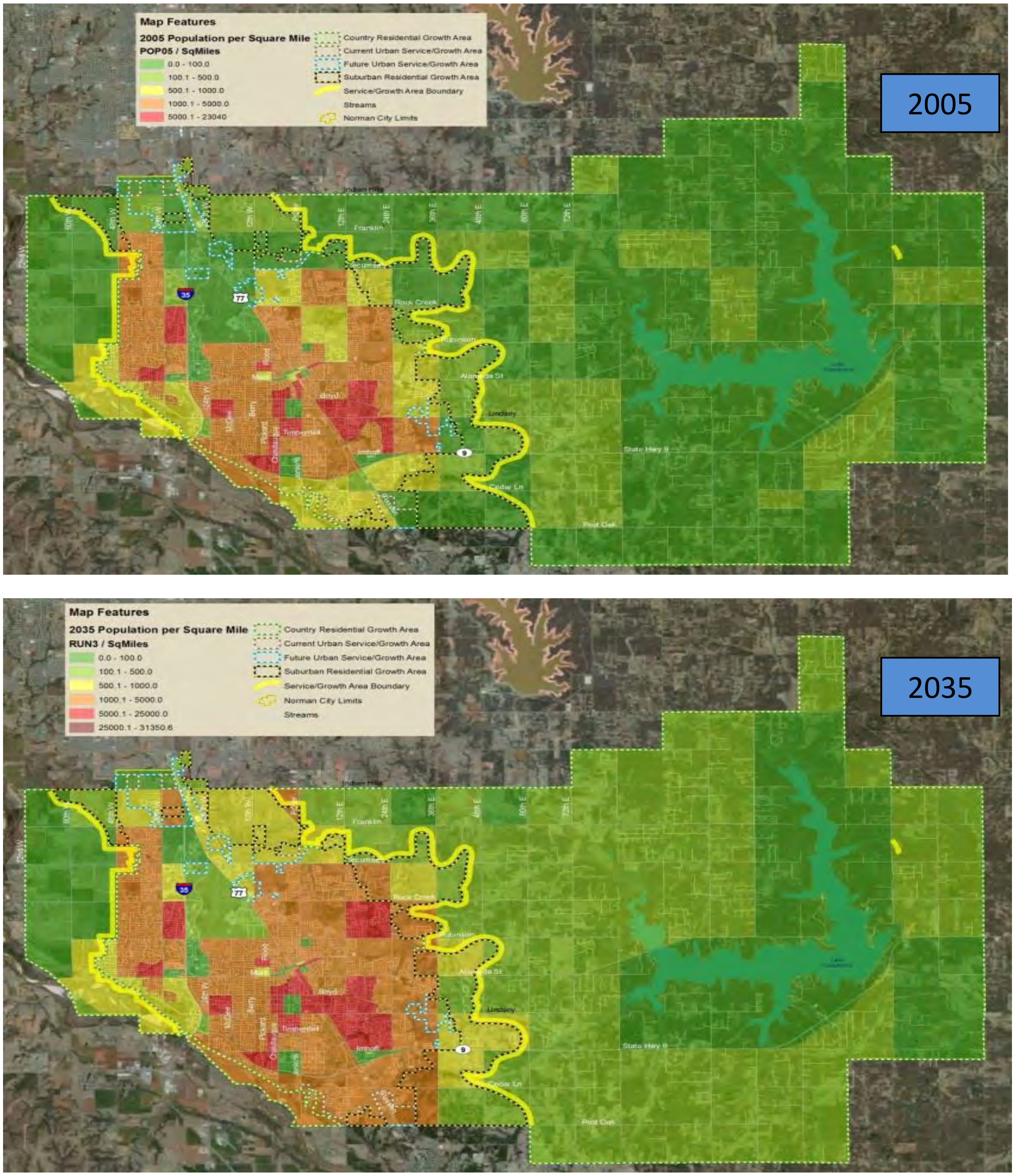


Figure B-6: ACOG Population Density Projections by TAZ (2005 and 2035)



Transportation Conditions and Trends

Figure B-7: ACOG Employment Growth Projections by TAZ (2005 and 2035)

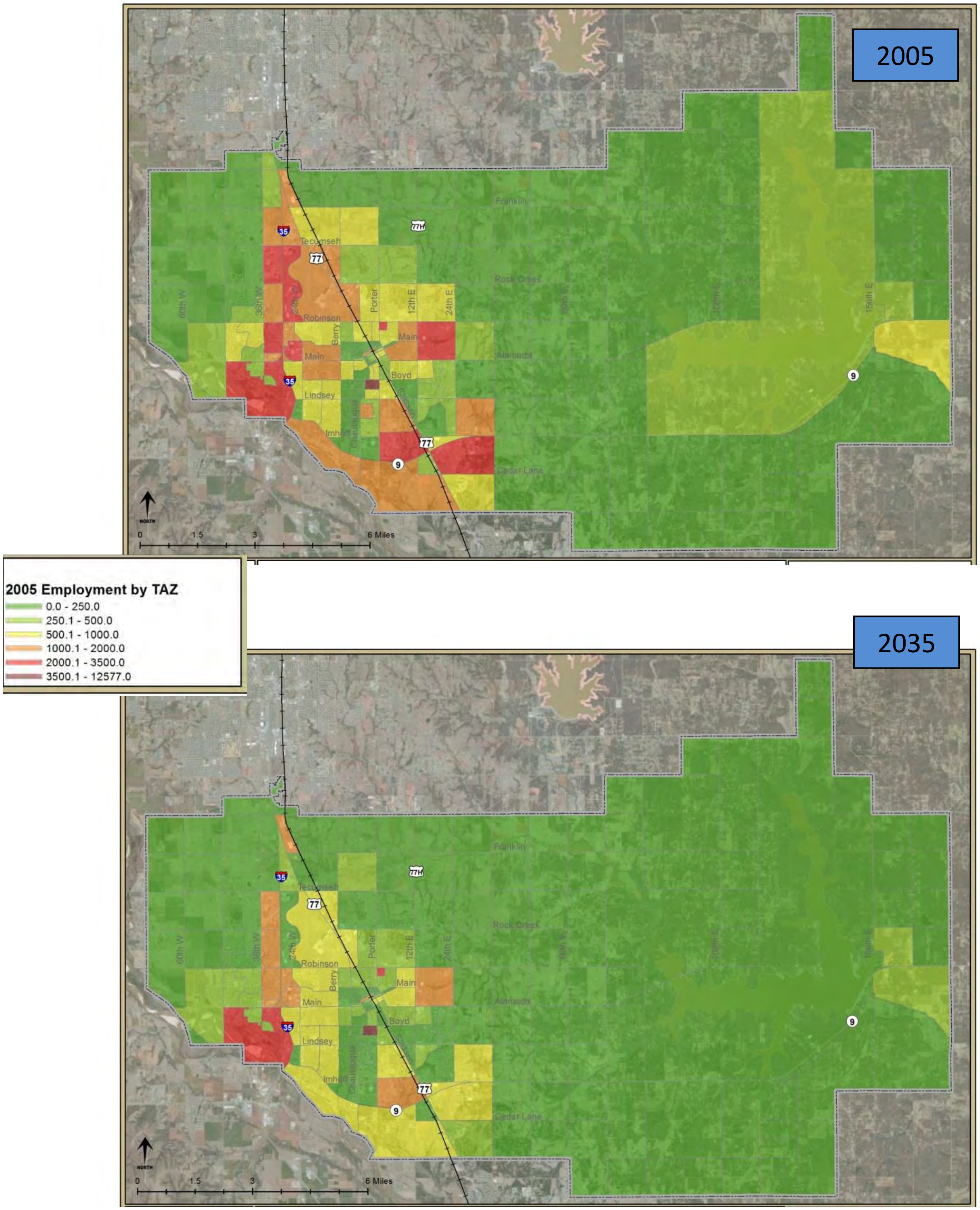
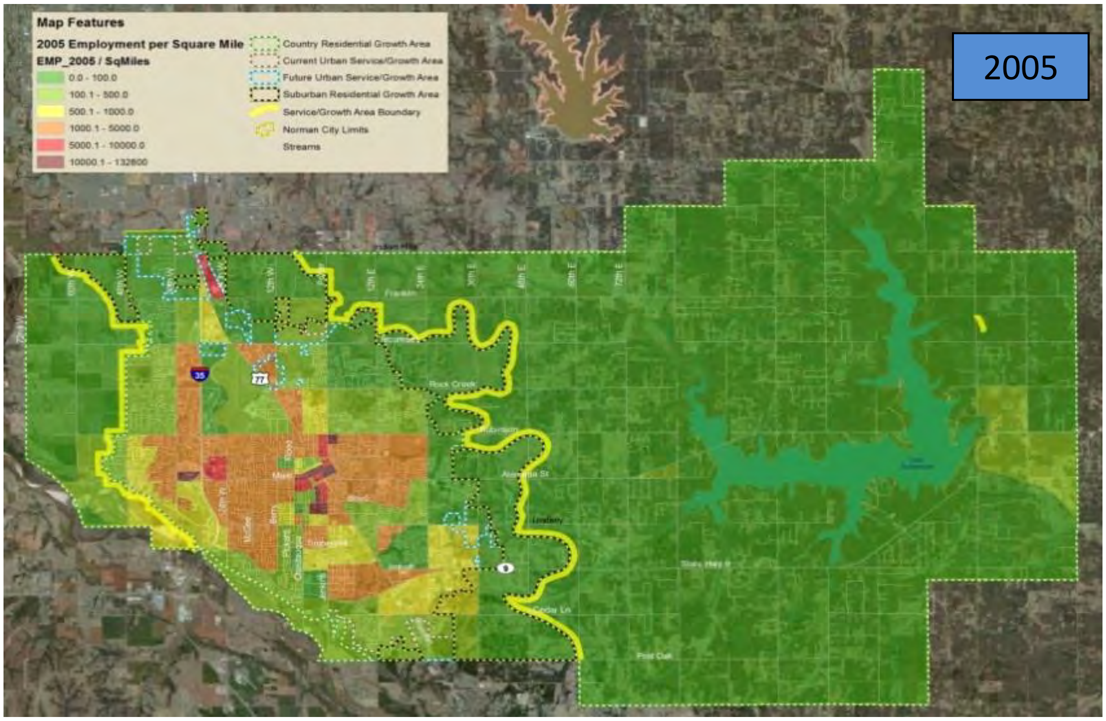
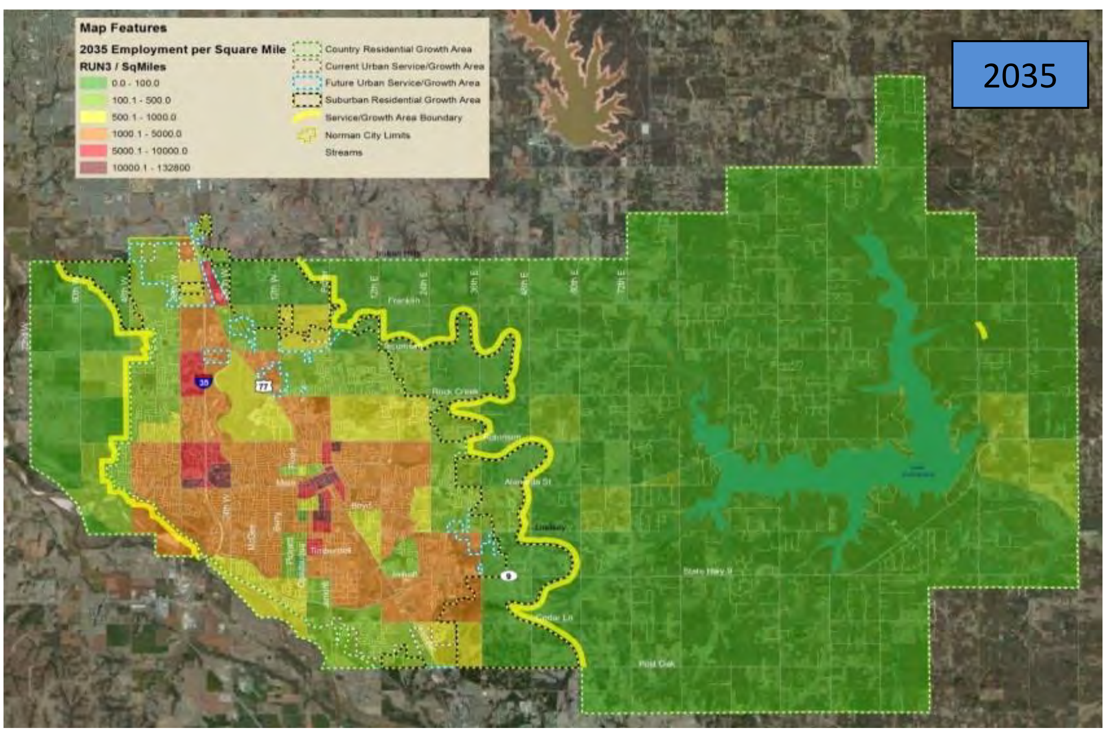


Figure B-8: ACOG Employment Growth Projections by TAZ (2005 and 2035)





Transportation System Conditions

Major Street/Highway System

The Norman street system provides access to and/or circulation within the city limits and to other destinations within the region. The street network is set up primarily in a grid configuration with major routes located at one mile intervals. Routes are classified by direction according to locational quadrant, and, major north-south routes are numbered (in increments of 12) and repeated in equal intervals moving laterally from the central city.

Roadway Functional Classification

Functional classification is the hierarchy by which routes are arranged into groups according to the nature of intended service (mobility and access). Higher functional classifications limit access but provide enhanced mobility (long distance, high speed trips). Lower functional classifications provide limited mobility but ample access to adjacent land uses.

Functional classification designations have been made for Norman's street network by two entities. The Oklahoma Department of Transportation (ODOT) publishes urban/rural functional classification maps for the Norman area with approval from the Federal Highway Administration (FHWA) and the ACOG. These maps are based on 2000 Bureau of Census data and are an important factor in Federal-aid highway programs. In addition, the *Norman 2025 Land Use and Transportation Plan*, adopted by the city in October 2004, also includes functional classifications for the roadway network.

Overall, many similarities exist between the classification plans – both include urban/rural distinctions and break the roadway network into arterials, collectors and local streets. The primary differences between the schemes include more specific cross-section requirements (number of lanes, shoulder type, right-of-way width) for each of the classifications under the city plan. The ODOT plan has no specific cross-section requirements but is more focused on overall route connectivity, travel speed, and regional function (the Norman criteria is more focused on local function and connectivity within the city limits). The city's plan tends to break routes into segments with multiple classifications depending on cross-section while the ODOT plan rarely changes route classification. In rural areas, the ODOT plan classifies all non-state routes as rural collector facilities while the city plan makes finer distinctions.

Since the city's plan is recognized as the local standard and is used for development purposes, the discussion below and **Figure B-9** reflects the city's functional classification for Norman's urban service area. The following are descriptions of the functional classes as designated by the city:

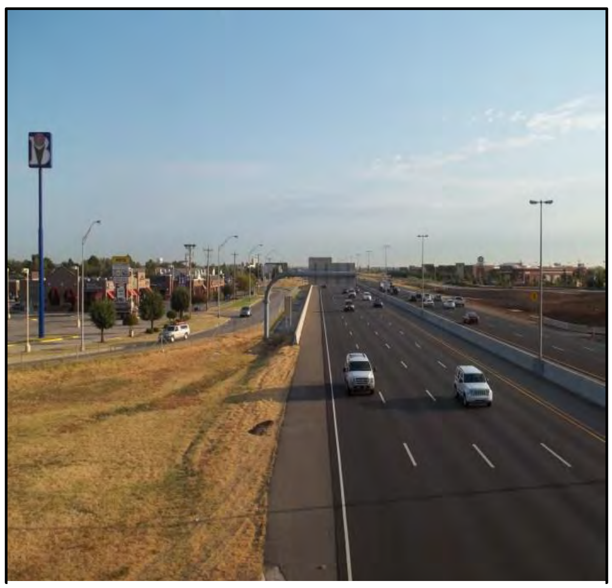
Highways

Highways include all ODOT-maintained facilities - conventional state routes and freeways. These routes accommodate long trips within Norman and connect to areas outside of Norman. Highways may also function as urban principal or minor arterial routes (see below).

Freeways are grade-separated with the highest level of mobility and full control of access (via interchange ramps only). Norman is served by Interstate 35 (I-35), an important corridor of international significance connecting Laredo, Texas near its border with Mexico to Duluth, Minnesota (100 miles from the Canadian border). Within Norman, I-35 provides access to suburban Oklahoma City and has local interchanges at the following locations (with current exit numbers provided):

- Exit 114 – Indian Hills Road
- Exit 113 – Flood Avenue
- Exit 112 – Tecumseh Road
- Exit 110 – Robinson Street
- Exit 109 – Main Street
- Exit 108B – Lindsey Street
- Exit 108A – SH 9 East

Other routes designated as highways by the city include all of the state route system – the entirety of SH 9, US 77 (consisting of portions of Flood Avenue, Tecumseh Road, 12th Avenue E, and Classen Boulevard), and highway 77H (12th Avenue E north of Tecumseh Road). In addition, non-state route portions of Tecumseh Road (60th Avenue W to Flood Avenue) and 60th Avenue W (north of Tecumseh Road) are classified as highways.



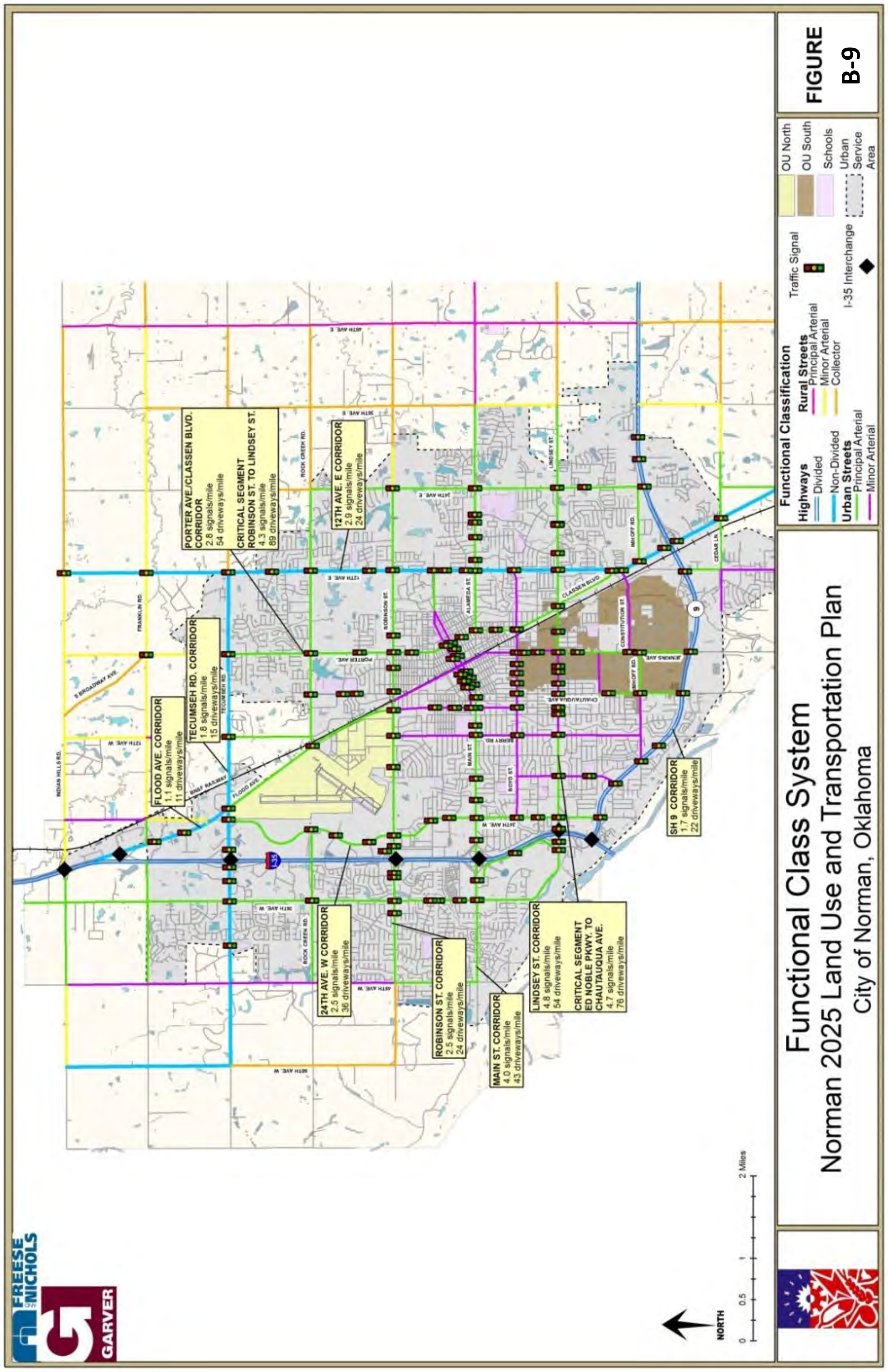
I-35 provides freeway access in Norman

Urban Principal Arterials

These routes serve major traffic movements within urbanized areas connecting Central Business Districts (CBDs), outlying residential areas, major intercity communities, and major suburban centers. Principal Arterials typically offer higher travel speeds, but these routes may have a limited number of traffic signals, at-grade intersections, and driveways. According to the *Norman 2025 Land Use and Transportation Plan*, the city requires principal arterials to have a minimum of four travel lanes, curb and gutter, and 100 feet of right-of-way. Within the Norman urban service area, the following routes are classified as Principal Arterials:

- 36th Avenue W
- Rock Creek Road
- Robinson Street
- Main Street

- Alameda Street
- Flood Avenue (north of Robinson Street)
- Porter Avenue / Classen Boulevard
- 24th Avenue W
- 24th Avenue E
- Lindsey Street (excluding Berry Street to Jenkins Avenue)
- Ed Noble Parkway and portions of Imhoff Road, Jenkins Avenue, Chautauqua Avenue, Cedar Lane Road, 12th Avenue W, Franklin Road, Indian Hills Road, 48th Avenue W, and 12th Avenue E



The routes listed in the last bullet point meet the minimum design requirements for an Urban Principal Arterial designation; however, the connectivity, travel speed, and trip type of these routes are not typically indicative of principal arterial facilities and are more commonly associated with minor arterial or collector routes.

Urban Minor Arterials

Minor arterials place more emphasis on land access and typically have closer spacing for crossing streets, driveways, and traffic signals. These routes typically serve trips of moderate length at a somewhat lower travel speed than principal arterials. According to the *Norman 2025 Land Use and Transportation Plan*, these routes typically consist of two travel lanes with turn lanes provided at key intersections. Minor arterial routes in Norman the following facilities (refer to **Figure B-9** for location map):

- Boyd Street
- McGee Drive
- Berry Road
- Main Street / Gray Avenue (one-way pair)
- Jenkins Avenue / James Garner Blvd
- 48^{th} Avenue W
- Flood Avenue (south of Robinson Street)
- Lindsey Street (between Berry Road and Jenkins Avenue)
- Portions of Imhoff Road, Timberdell Road, Constitution Street, Cedar Lane Road, 12^{th} Avenue E, and 24^{th} Avenue W

The routes listed in the last bullet point meet the minimum design requirements for an Urban Minor Arterial designation; however, the relatively short segment length is not typically associated with minor arterials and more commonly associated with collector routes.

Table B-5 – City Design Criteria Based on Functional Classification

	Facility Type	Minimum Right-of-Way	Minimum Pavement Width (excluding curbs/shoulders)	Required Number of Lanes	Curb & Gutter or Shoulder Type	On-Street Parking Allowed?	Minimum Sidewalk Width Required (both sides of street)
URBAN	Principal Arterial	100 feet	52 feet	4	C & G	No	5 feet
URBAN	Minor Arterial	Varies	Varies	2 or 3 (w/ turn lanes as needed)	C & G	No	5 feet
URBAN	Collector	60 feet	34 feet	2 or 3 (w/ turn lanes as needed)	C & G	Yes	4 feet
URBAN	Local Road	50 feet	26 feet	2	C & G	Yes	4 feet
RURAL	Principal Arterial	100 feet	24 feet	2	10-ft. Paved Shoulders	No	5 feet
RURAL	Minor Arterial	100 feet	24 feet	2	6-ft. Paved Shoulders	No	5 feet
RURAL	Collector	100 feet	24 feet	2	6-ft. Earthen Shoulders	No	4 feet
RURAL	Local (section line)	80 feet	22 feet	2	4-ft. Earthen Shoulders	Yes	4 feet
RURAL	Local (interior)	50 feet (w/ 25-ft. Esmt.)	22 feet	2	4-ft. Earthen Shoulders	Yes	4 feet

Source: City of Norman Design Criteria

Urban Collector Streets

The urban collector street system features facilities that collect traffic from local streets in neighborhoods and channel traffic to the arterial system. These routes typically provide access to private property, offer lower travel speeds, and serve trips of shorter distances. According to the *Norman 2025 Land Use and Transportation Plan,* these routes typically have two travel lanes, with turn lanes required at some intersections, including all arterials. The 2025 plan does not specifically call out any routes as collector facilities, though corridors such as Brooks Street and Acres Street serve collector purposes.

Urban Local Streets

The local street system offers the least mobility and the most land access service. These two-lane streets include all facilities not classified under a higher system.

Rural Routes

The *Norman 2025 Land Use and Transportation Plan* also identifies functional classification criteria for rural facilities outside of the urban service area. These classifications are described below.

Rural Principal Arterial routes provide intra-county service and link large traffic generators to rural areas. These routes have high travel speeds and require 100-feet of right-of-way, two 12-foot paved lanes, 10-foot shoulders, 4 to 1 slide slopes, and, in some cases, turn lanes at intersections. Rural Principal Arterial routes include Alameda Street, 48th Avenue E, and a small segment of 12th Avenue W.

Rural Minor Arterial routes are the second tier of the rural system and share many of the goals as Rural Principal Arterials. Key differences include more moderate overall travel speeds and only 6-foot shoulder requirements. Rural Minor Arterial routes in Norman include portions of Indian Hills Road, Franklin Road, 120th Avenue E, 156th Avenue E and small segments of 12th Avenue W, Porter Avenue, 36th Avenue W, Robinson Street, and Cedar Lane Road.

Rural Collector routes are those designed to serve shorter travel distances with lesser speeds. These routes connect local streets to arterials. According to the 2025 plan, the only cross-section requirement that separates a rural collector from a rural arterial is that the 6-foot shoulder requirement does not need to be paved. Rural Collector routes in Norman include portions of 60th Avenue W, Robinson Street, 36th Avenue E, Rock Creek Road, 24th Avenue E, Tecumseh Road, Broadway Avenue, Indian Hills Road, Lindsey Street, Franklin Road, Cedar Lane Road, 60th Avenue E, 72nd Avenue E, 84th Avenue E, 108th Avenue E, 120th Avenue E, 156th Avenue E, and 168th Avenue E.

Rural Local routes are those designed to provide access to adjacent land and provide service over short distances. These routes require 80-feet of right of way, two paved lanes with 11-feet width, 4-feet earthen shoulders, and 4 to 1 side slopes.

Freeway Access and Local Connectivity

Access to the freeway system is an important part of regional travel for trips to, from, and through Norman. With seven interchanges within the city limits, sufficient access is provided to I-35. In addition, a recently completed project along W Rock Creek Road provides a local connection across I-35, which is the only bridge crossing of I-35 without an interchange within the city.

As mentioned, the City of Norman street network forms a basic grid, which, theoretically, allows for orderly east/west and north/south travel. Connectivity is generally good on the outer edges of the city as Tecumseh Road, Robinson Street, and SH 9 provide contiguous east/west access, and several routes (36th Avenue W, 12th Avenue E, 24th Avenue E, etc.) provide sufficient north/south access. However, within central Norman, the layout of the city and historic land uses makes cross-city trips difficult, which puts additional strain on the outer routes. With the CBD, the University of Oklahoma, the Max Westheimer Airport, the BNSF railroad, and many older neighborhoods located near the center city, the mobility offered on portions Lindsey Street, Main Street, Berry Road, Alameda Street, and Porter Avenue/Classen Boulevard is compromised by the need to provide access, lower travel speeds, and accommodate other travel modes. Thus, longer trips across the central city are difficult.

Table B-6: Driveway/Signal Density

Route	Segment	Distance	# of Signals	Signals / Mile	# of Driveways	Driveways / Mile
SH 9	I-35 to S Jenkins Road	2.5	6	2.4	12	4.8
	S Jenkins Road to 24th Ave E	2.2	2	0.9	10	4.5
	Total	**4.7**	**8**	**1.7**	**22**	**4.7**
Lindsey Street	Ed Noble Parkway to S Berry Rd	1.4	6	4.3	101	72.1
	S Berry Rd to Chatauqua Ave	0.5	3	6.0	43	86.0
	Chatauqua Ave to Classen Blvd	1.1	8	7.5	23	21.5
	Classen Blvd to 24th Ave E	1.4	4	2.8	69	48.3
	Total	**4.4**	**21**	**4.8**	**236**	**53.6**
Main Street	48th Ave W to 36th Ave W	1.0	1	1.0	27	27.0
	36th Ave W to 24th Ave W	1.0	3	3.0	33	33.0
	24th Ave W to University Blvd	1.6	7	4.3	97	59.9
	University Blvd to Porter Ave	0.6	6	10.0	23	38.3
	Total	**4.2**	**17**	**4.0**	**180**	**42.7**
Robinson Street	48th Ave W to 36th Ave W	1.0	2	2.0	26	26.0
	36th Ave W to 24th Ave W	0.8	4	5.0	16	20.0
	24th Ave W to Porter Ave	2.2	6	2.7	47	21.4
	Porter Ave to 24th Ave E	2.0	3	1.5	53	26.5
	Total	**6.0**	**15**	**2.5**	**142**	**23.7**
24th Ave W	Tecumseh Rd to Robinson St	2.3	5	2.2	18	8.0
	Robinson St to SH 9	2.6	7	2.7	154	60.4
	Total	**4.8**	**12**	**2.5**	**172**	**35.8**
12th Ave E	Tecumseh Rd to Robinson St	2.0	5	2.5	32	16.0
	Robinson St to Alameda St	1.0	4	4.0	27	27.0
	Alameda St to Classen Blvd	1.7	3	1.8	45	27.3
	Classen Blvd to SH 9	0.9	4	4.7	26	30.6
	Total	**5.5**	**16**	**2.9**	**130**	**23.6**
Porter Ave / Classen Blvd	Tecumseh Rd to Robinson St	2.0	4	2.0	63	31.5
	Robinson St to Alameda St	1.1	5	4.8	97	92.4
	Alameda St to Lindsey St	1.1	4	3.8	89	84.8
	Lindsey St to 12th Ave	0.9	1	1.1	21	23.3
	Total	**5.0**	**14**	**2.8**	**270**	**54.0**
Flood Ave	I-35 to Robinson Street	3.6	4	1.1	38	10.7
	Total	**3.6**	**4**	**1.1**	**38**	**10.7**
Tecumseh Rd	48th Ave W to 36th Ave W	1.0	1	1.0	30	30.0
	36th Ave W to 12th Ave W	2.0	6	3.0	30	15.0
	12th Ave W to 12th Ave E	2.0	2	1.0	14	7.0
	Total	**5.0**	**9**	**1.8**	**74**	**14.8**

Impediments to Maintaining Functional Classification and Access Management

At higher levels of the functional classification system, mobility is favored over providing local access to adjacent land uses. Relatively high travel speeds are expected from arterial type routes though many impediments exist that reduce travel speed and increase the probability of stopping (and crashes). These impediments include the number and spacing of traffic signals, inefficient signal timings, a high number of access points, a lack of turn lanes or median presence, and poor geometrics.

As a basic measure of functionality, the number of signalized intersections and access points on the city's most heavily traveled arterial routes were measured on a per mile basis (refer to **Table B-6 and Figure B-9**). Though necessary to allow safe and equitable traffic flow, signalized intersections limit capacity along a corridor due to the allocation of green time to competing movements. In addition, the presence of signalized intersections can cause an increase in vehicle crashes due to additional stops. Likewise, the cumulative effect of multiple unsignalized access points reduces capacity (and increases crash probability) due to the slowing of vehicles to either complete turns or allow entering vehicles to join the traffic stream. **Tables B-7 and B-8** depict information on signal and access point density gathered from FHWA, the Highway Capacity Manual (HCM), and National Cooperative Highway Research Program (NCHRP) Report 420. As shown, as traffic signal and access point density rise on arterials, mobility deteriorates and crashes tend to increase.

Lindsey Street has high driveway density

Table B-7 – Signal Density Influence on Travel Time and Crash Rate

Signals Per Mile	Increase in Travel Time (%)	Crashes Per Million Vehicles Miles Traveled
2	--	3.53
3	9	6.89
4	16	
5	23	7.49
6	29	
7	34	9.11
8	39	

Source: FHWA Access Management Brochure and *NCHRP Report 420*

Table B-8 – Access Point Density Influence on Free Flow Speed and Crash Rate

Access Points per Mile (Bi-Directional)	Reduction in Free-Flow Speed (mph)	Crash Rate Index
0	0	1
20	2.5	1.4
40	5	2.1
60	7.5	3
80 or more	10	3.5

Source: *Highway Capacity Manual* and *NCHRP Report 420*

Comparing these standards to the city's arterials, several routes appear to be negatively influenced by signal and driveway density. Critical segments along Lindsey Street and Porter Avenue both feature more than 70 driveways and four signals per mile. In addition, while not shown in **Figure B-9**, critical portions of Main Street (through the CBD) and Robinson Street (near I-35) have signal densities of approximately five signals or more per mile. Arterial routes on the periphery –SH 9, Flood Avenue, and Tecumseh Road – tend to have signal and access point densities that are supportive of their arterial function.

Access management is a proven method to maintain arterial integrity while also lowering the number of vehicle crashes. Common access management techniques include median treatments, traffic signal spacing requirements, shared access and corner clearance requirements, restricting left turns or through movements, and adding turn lanes. While the City of Norman has incorporated components of access management in isolated areas (Main Street near I-35, 24th Avenue W near Robinson Street) and maintains standards for driveway placement of new developments, no formal comprehensive access management policies exist on a city-wide basis. Two recent studies completed for the city, *West Lindsey Street Widening Conceptual Plan* (2012) and *Porter Avenue Corridor Study* (2009), each considered access management principles to enhance safety and operations as part of larger rehabilitation/reconstruction projects. Both of these corridors would benefit from access management measures, with selection based on estimated cost, circuitousness of travel, and need to provide customers safe access to adjacent properties.

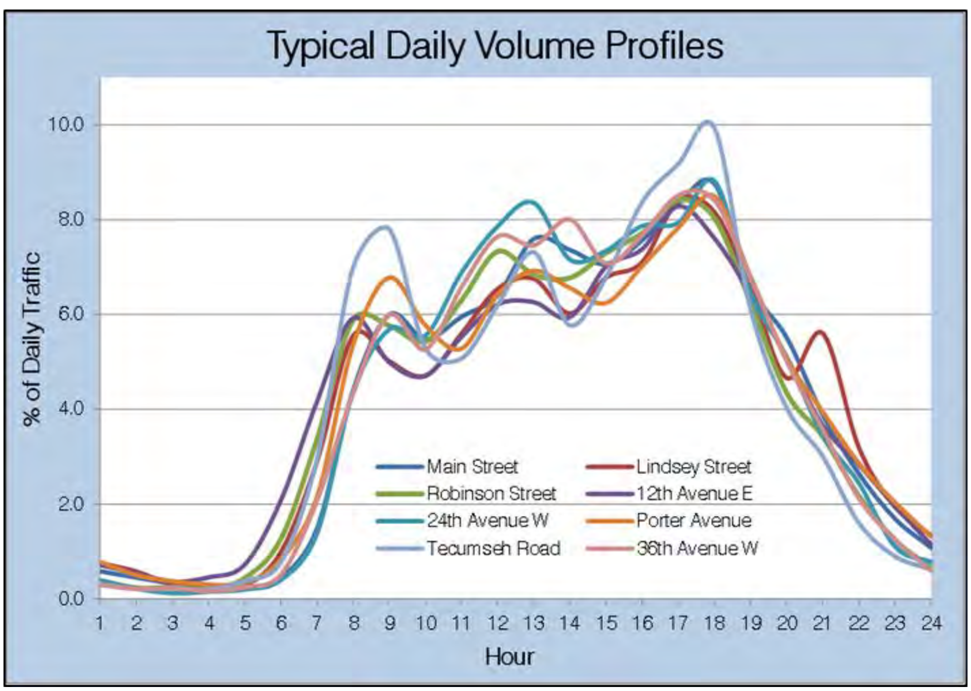
Traffic Volumes & Congestion

According to US Census data, approximately 92% of all Norman work trips are automobile-based with an average commute time of 21 minutes. This commute time varies based on the length of trip and chosen route as some areas of Norman undergo more congestion than others. The performance of the local roadways (and resulting congestion) can be linked to many factors – including the number of lanes, speed limit, daily traffic volumes, local peaking characteristics, traffic signal parameters, driver types, signage, pavement conditions, road design elements, and access control. In this section, traffic volumes are compared to generalized route capacities as a measure of system performance.

Traffic Volumes

Average annual daily traffic (AADT) volumes were gathered from the ACOG's online traffic count database and other published studies. As depicted in **Figure B-10**, the most heavily traveled route in Norman is I-35, which carries 97,400 vehicles per day north of Flood Avenue. In terms of arterial routes, Robinson Street, Main Street, and 12th Avenue E have the highest AADT's with segments averaging over 30,000 vehicles per day. Other busy route segments include SH 9 and Lindsey Street between I-35 and Jenkins Avenue.

The hourly volume profiles shown below depict the percentage of daily traffic experienced on city roadways throughout a typical 24-hour period. The graphs indicate that the peaking characteristics of many arterial routes in Norman differ from the conventional AM/PM commuter pattern seen in many cities (where 10-12% of daily traffic occurs during these peak hours). Rather, at many locations within Norman, AM peak period volumes are relatively low (less than 6% of the daily total) and steadily increase through the day until a PM peak period of 8-9% is achieved. This spreading of the peak hour is often found in college towns like Norman where school and retail trips contribute a larger portion of the daily traffic and tend to have a less defined spike (but moderate congestion exists for longer periods of the day). The one exception found in the volume profiles is Tecumseh Road, which has the largest percentages of daily traffic in the defined AM/PM commuter peak periods. This route is relatively far removed from the University of Oklahoma and major retail centers and subject to more traditional peaking characteristics.



Roadway Level of Service

Roadway capacity refers to the quantity of traffic that a facility can process before excessive delay and queuing restrict throughput and diminish operations. To simplify the process of describing the traffic congestion on a roadway, traffic engineers typically assign a letter grade corresponding to the Level of Service (LOS) to categorize the operating characteristics of a route. LOS is a concept defined by the HCM to qualitatively describe operating conditions within a traffic stream. LOS is stratified into six categories (A through F). These range from LOS A indicating the highest quality of service to LOS F representing breakdown in traffic flow (LOS D is commonly used as the minimum acceptable standard). **Table B-9** includes a brief description of each LOS grade as well as the corresponding planning-level volume to capacity (v/c) ratio to gauge the roadway congestion.

The daily traffic volumes of the major routes in Norman were compared against LOS E capacity thresholds obtained from ACOG's 2035 Encompass Plan to identify deficiencies within the roadway network. **Table B-10** depicts the ACOG capacities according to route type. These capacity thresholds are based on generalized solution sets to HCM procedures and are useful for planning purposes (though lacking parameters such as turning volumes, signal timing and phasing, and queue spillback needed for detailed operational analysis). With capacities established, v/c ratios were determined for the major routes in Norman and compared to the LOS criteria.

As seen in **Figure A-2**, several facilities in Norman are presently operating at LOS E conditions or worse according to the generalized ACOG volume thresholds. The routes at or over capacity include 12th Avenue E / Classen Boulevard between Robinson Street and SH 9, I-35 between Main Street and SH 9, and Lindsey Street from I-35 to Jenkins Avenue. In addition, routes currently operating at LOS D conditions that are likely to degrade in the near future include Robinson Street, SH 9, and Jenkins Avenue.

Table B-9 – Level of Service and Nominal V/C Ratios

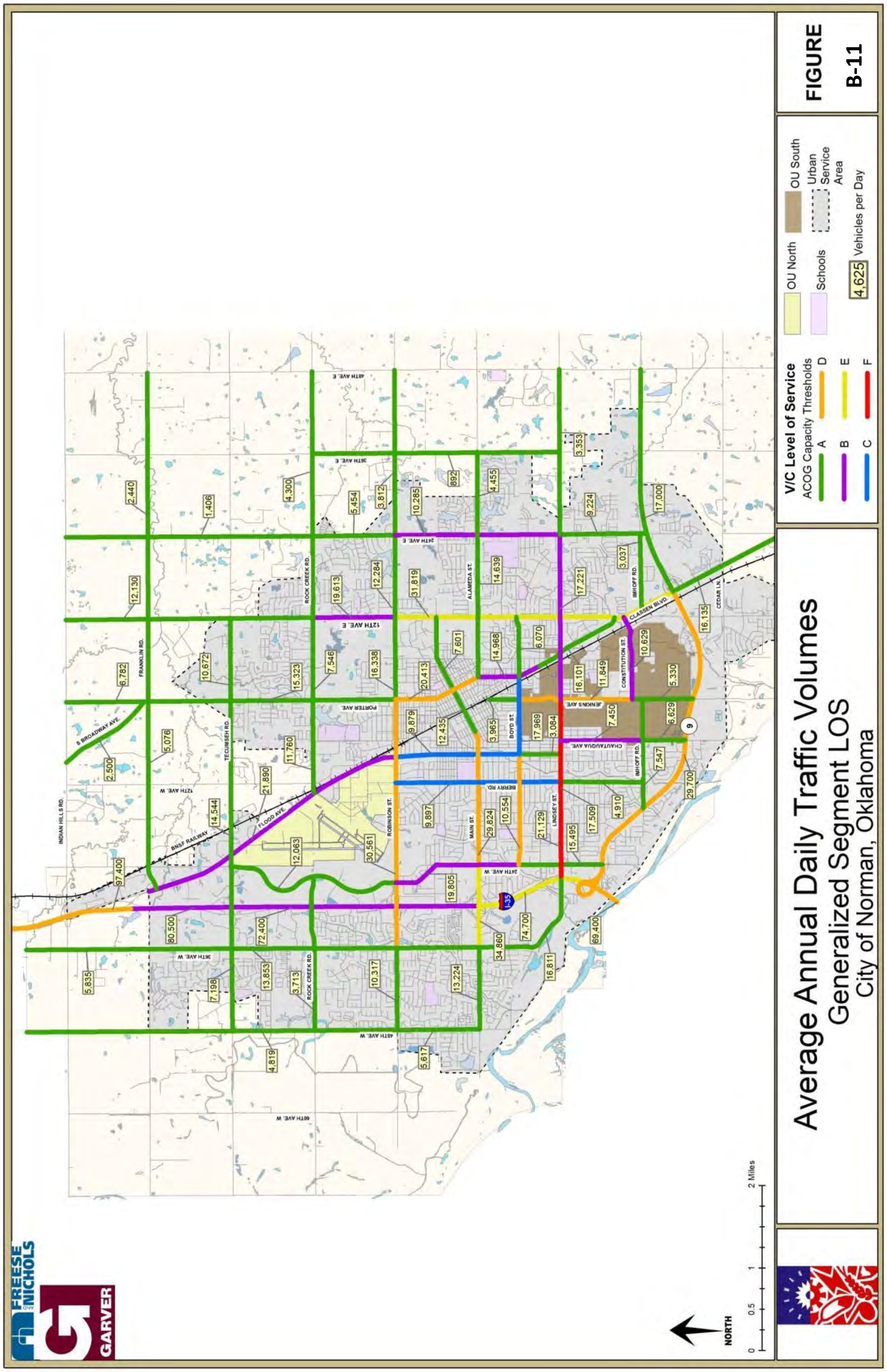
Level of Service	Interpretation	Volume to Capacity Ratio Range
A	This LOS is a free flow condition, with vehicles acting nearly independently to one another. There is little or no delay.	0.0 - 0.5
B	This LOS is similar to LOS A, but drivers have slightly less freedom to maneuver.	0.5 - 0.65
C	At LOS C, density becomes more noticeable with the ability to maneuver limited by other vehicles. Speeds are at or near free flow speed.	0.65 -0.75
D	This LOS is often a common goal for urban streets during peak periods and represents the lower end of stable flow. This LOS is typified by increased density and delay and severely restricted maneuverability.	0.75 - 0.9
E	At this LOS, the route approaches capacity and few usable gaps in the traffic stream exist. Vehicle density increases such that traffic flow is unstable and speeds vary greatly.	0.9 -1.0
F	At this LOS, the route has more demand than capacity. Flow is forced and movement within the traffic stream is stop and go. Minor incidents or disruptions cause queuing that extends significant distances upstream along the roadway.	>1.0

Table B-10 – ACOG LOS E Capacity Thresholds by Route Type

Route Type	Lanes	LOS E Capacity
Freeways	4 lane freeway	80,000 vpd
	6 lane freeway	125,000 vpd
	8 lane freeway	165,000 vpd
City Arterials	2 lane arterial[1,2]	17,100 vpd
	4 lane arterial (undivided)[1]	34,200 vpd
	4 lane arterial (divided)	38,000 vpd
	5 lane arterial (center turn lane)	36,000 vpd
	6 lane arterial (undivided)	52,300 vpd
	6 lane arterial (divided)	58,000 vpd
	One way street (per lane)	11,000 vpd

[1]Apply 20% reduction if no left turn lanes provided within corridor

[2]Apply 5% increase for continuous center turn lane


Average Annual Daily Traffic Volumes
Generalized Segment LOS
City of Norman, Oklahoma
FIGURE
B-11
V/C Level of Service
ACOG Capacity Thresholds
A
B
C
D
E
F
OU North
OU South
Schools
Urban Service Area
4,625 Vehicles per Day
NORTH
0
0.5
1
2 Miles
FREESE NICHOLS
GARVER

Traffic Signals and ITS Elements

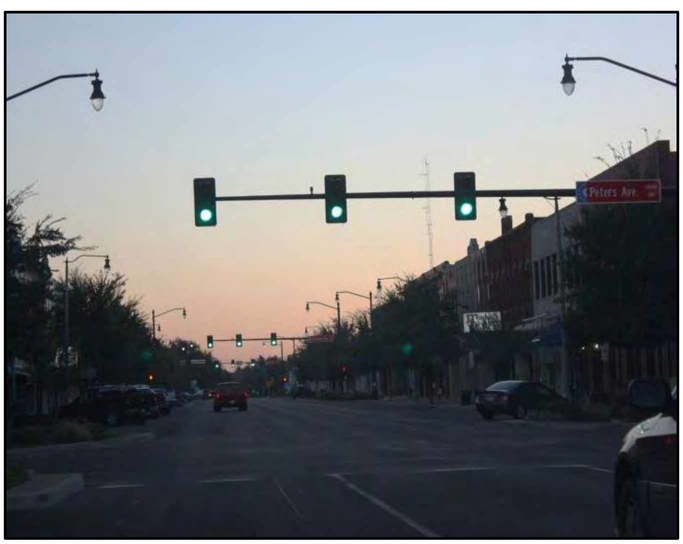
The management of traffic flow can be enhanced through efficient and responsive allocation of green time at traffic signals and employment of Intelligent Transportation System (ITS) technologies to increase data flow and disseminate information. The City of Norman plays an active role in implementing the latest technology to better achieve smooth and safe transportation operations.

Traffic Signals

Traffic signals assign right of way to competing movements at busy intersections. The city currently maintains the operation of approximately 150 signalized intersections. This includes updating all timing elements (splits, cycle lengths, and clearance intervals), maintaining all field devices, and remaining current with all necessary hardware (detection methods, communication systems, and pedestrian and vehicle signal heads).

Nearby signalized intersections are often grouped into coordinated systems. The aim of a coordinated system is to encourage progressive traffic flow for the dominant movements along a busy corridor and to minimize mainline stops where possible. These systems typically involve signal timing plans that vary by time of day, uniform cycle lengths, and a means of communication between signal controllers (hardwire, radio, or clock synchronization). In Norman, the city maintains 15 coordinated corridors (see **Figure B-12** for locations), which encompass 80% of the total number of the city's signalized intersections. All city systems are configured to run the same weekday cycle length by time of day (100 seconds in the morning, 110 seconds for midday/evening).

The city's signalized systems were analyzed to determine which corridors offered coordinated bandwidth. Of the 15 corridors, Robinson Street, 12th Avenue E, Boyd Street, and Alameda Street offer the most progressive opportunity while Porter Avenue/Classen Boulevard, 36th Avenue W, and Lindsey Street allow only limited progressive opportunity on a system-wide basis. Several factors play a role in determining how much "bandwidth" can be offered (and is practical) for a coordinated system – including signal spacing, number of signal phases, mid-block volumes, insufficient turn lane storage lengths, vehicle origin-destination, priority of intersecting signal systems, and need to allocate additional green time to service crossing streets. Thus, some systems within the city are unable to provide through progression between successive signals despite good localized operation.



Coordinated signal systems provide bandwidth to minimize stops on arterial routes

As an additional measure of performance, the "Urban Street" LOS for all coordinated signal corridors was determined. Urban Street LOS is a concept defined by the *Highway Capacity Manual* as a measure of the degree of mobility provided by the facility, and, for automobiles, is measured as travel speed as a percentage of base free-flow speed. The LOS for the critical PM peak for each coordinated corridor is provided in **Figure B-12**. As shown, the Porter Avenue/Classen Boulevard, Robinson Street, and 36th Avenue W corridors all operate at LOS E/F. On the Porter Avenue/Classen Boulevard corridor, the lack of left turn lanes on the mainline and required signal phasing contribute to the poor LOS. On Robinson Street, heavy turning movements and irregular signal spacing create the LOS issues. 36th Avenue W suffers from poor LOS mainly due to limited green time being available to the mainline after higher priority corridors at Main Street and Robinson Street are serviced.

ITS in Norman

The goal of ITS is to maximize the performance of existing transportation networks to increase traffic safety and mobility. In 2003, in response to a growing need for regional guidance on ITS policy, ODOT and ACOG commissioned the *Intelligent Transportation System Architecture and Implementation Plans* for the Oklahoma City transportation management area (which includes Norman). These broad documents outlined the communication flows and identified several potential ITS projects of regional significance including a regional traffic management center, statewide fiber optic cable expansion, and additional field devices (dynamic message signs and cameras for traffic monitoring) to be located along major freeways. The majority of these devices were planned for locations outside the Norman area.

Though Norman has not completed any formal planning documents since the 2003 regional plan, the city has been active in updating its infrastructure to support more efficient utilization of the existing transportation system. The city's ITS elements – implemented via the use of local funds, ACOG funds, and larger transportation improvement projects – include the following:

- **Flashing Yellow Arrow (FYA):** The city's FYA signal head projects to date have largely addressed those eligible intersections with protected-permissive left turn (PPLT) phasing. FYA signal heads have also been installed at intersections that were previously protected-only (converting to PPLT) and some that were permissive-only (converting some to PPLT and installing permissive FYA at others). This device allows for better signal coordination by allowing left turns to lead or lag while increasing driver safety over the traditional five-section signal head.

FYA signal heads have been installed on a city-wide basis

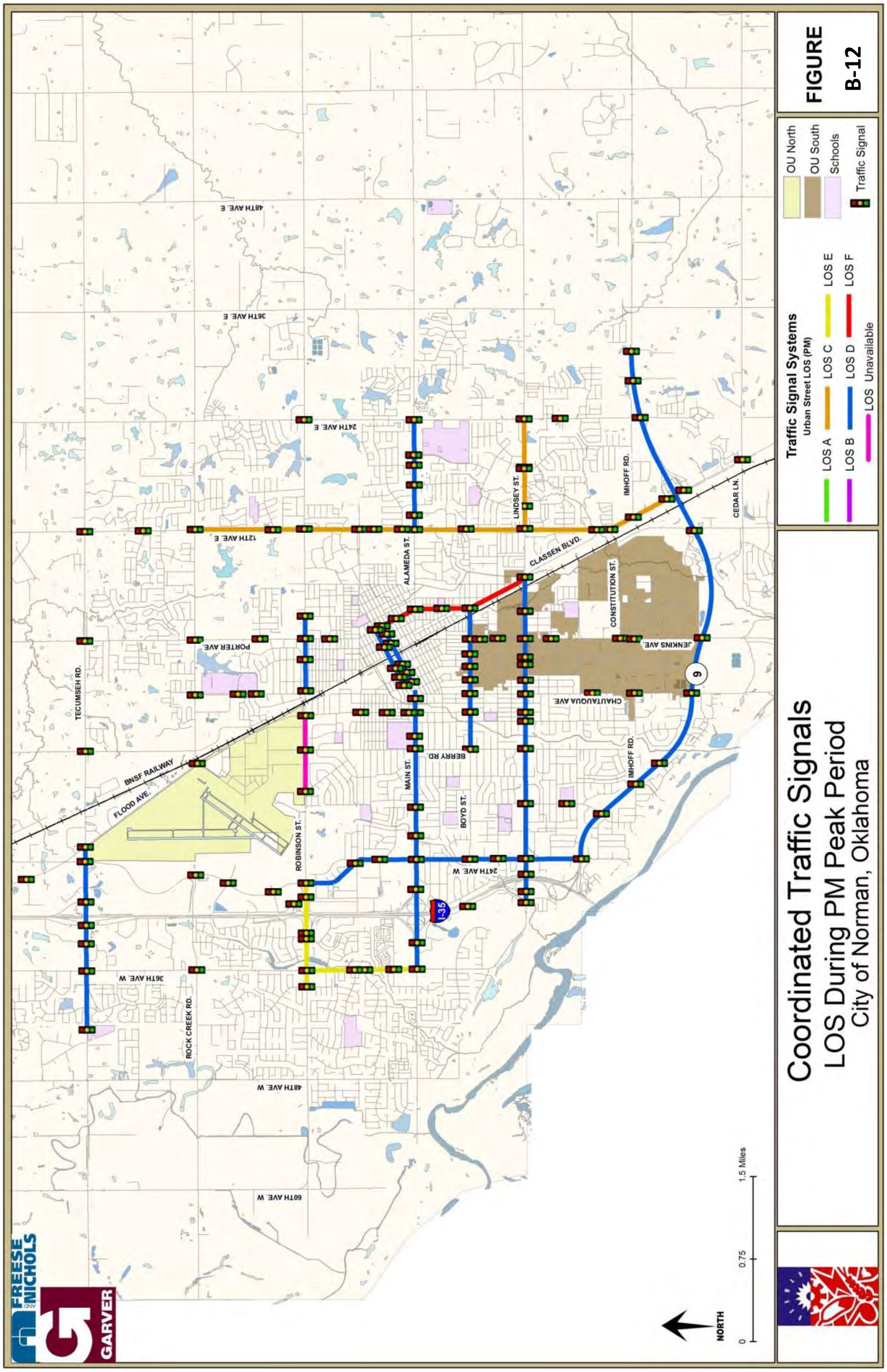


FIGURE
B-12
Coordinated Traffic Signals
LOS During PM Peak Period
City of Norman, Oklahoma
Traffic Signal Systems
Urban Street LOS (PM)
LOS A
LOS B
LOS C
LOS D
LOS E
LOS F
LOS Unavailable
OU North
OU South
Schools
Traffic Signal
NORTH
0
0.75
1.5 Miles
FREESE NICHOLS
GARVER
TECUMSEH RD.
ROBINSON ST.
PORTER AVE.
MAIN ST.
ALAMEDA ST.
LINDSEY ST.
BOYD ST.
CONSTITUTION ST.
JENKINS AVE.
CHAUTAUQUA AVE.
BERRY RD.
IMHOFF RD.
CEDAR LN.
CLASSEN BLVD.
BNSF RAILWAY
FLOOD AVE.
ROCK CREEK RD.
12TH AVE. E
24TH AVE. E
36TH AVE. E
48TH AVE. E
24TH AVE. W
36TH AVE. W
48TH AVE. W
60TH AVE. W
I-35
9

Signal Pre-Emption: Approximately two-thirds of the signals in Norman are equipped with a device that, when triggered by an emergency vehicle, will cycle to a green phase to allow passage. Plans are in place for the remainder of traffic signals to include pre-emption in 2013.

- **Fiber Optic Communications:** Several of the coordinated traffic signal systems are connected via fiber optic cable, and all future transportation projects involving signalized intersection improvements will incorporate fiber optic interconnect where applicable. This preferred method of communication between signal controllers allows for improved data exchange and the ability to run Advanced Traffic Management Systems (ATMS) software.
- **ATMS:** The city is presently using Centracs ATMS software to manage approximately 50 signalized intersections (those presently communicating via fiber optic cable). The ATMS software reduces the effort involved in signal-retiming, allows traffic flow to be monitored, and improves response time in fixing signal-related errors.
- **Traffic Signal Hardware:** The city has recurring capital projects to upgrade three signal cabinets and six additional controllers annually. In addition, the city employs video detection at most intersections with plans to upgrade the remaining intersections. The city is also active in providing modern pedestrian crossing facilities with audible/countdown signal heads.
- **Traffic Signal Retiming:** The city regularly reviews the operation of the coordinated signal systems and provides periodic updates to the timing plans as land use and travel patterns change. Five corridors have received full updates since 2011.

Future Plans

The city has plans to expand its coordinated signal corridors to include new systems along the outer edges of the urban boundary (24th Avenue E, Rock Creek Road, Tecumseh Road east of Flood Avenue). Plans are also in place to implement FYA installations to existing permissive left turn movements as well as right turn overlaps. In terms of cutting edge technology, the city is exploring the possibility of adaptive signal control along the busy SH-9 corridor. Adaptive signal control uses advanced detection and complex algorithms to constantly adjust signal timing based on actual demand rather than a pre-determined plan based on average volumes. Long term, the city would like to establish a traffic management center with cameras to monitor traffic and dynamic message boards to provide information to motorists and improve incident response.

Parking in the Core of Norman

Parking demand needs and management of the existing parking supply are issues for two locations in central Norman - the CBD and the “Campus Corner” area. These areas are generally pedestrian-oriented with pleasing streetscapes and feature a mixture of land uses at higher densities than other locations within the city. The CBD (roughly bounded by University Boulevard to the west, Porter Avenue to the east, Gray Street to the north and Eufaula Street to the south) includes a mixture of offices, retail, and restaurants. Campus Corner is a boutique shopping, residential, and entertainment district located just north of Boyd Street and the University of Oklahoma’s campus. Both of these locations feature on-street parking and surface lots with limited availability to the general public. No parking structures exist at either location, and nearly all surface lot locations are privately owned.

Norman Parking Study

In 2003, Carter & Burgess completed a comprehensive parking study of the CBD and Campus Corner areas of the city. This study tallied the total public/private parking supply for both areas, tracked peak usage of the supply, determined parking convenience (supply relative to destination), explored the feasibility of city-owned parking structures, and made a series of recommendations to improve both the parking supply and the management/policy of parking resources to improve efficiency. Key findings from the 2003 study include the following:

Parking Supply

- The CBD parking supply includes approximately 4,700 spaces (77% surface lot / 23% on-street). On-street parking is generally unmetered with some locations having a one or two hour limit. Parking meters are in place on the streets bordering the County Courthouse.
- The Campus Corner parking supply includes approximately 1,800 spaces (87% surface lot / 13% on-street). On-street parking in the central activity area of the Campus Corner is generally metered with a one hour limit while on-street parking along the northern periphery of the district is generally unmetered. Several lots in the core area of Campus Corner use a gated entry with merchants providing a "token" to customers for use in exiting the lot.

Parking Utilization

- Parking utilization counts indicated that approximately 50% of CBD spaces and 58% of Campus Corner spaces are occupied at peak loading times. However, the unoccupied parking exists at the periphery of both downtown and Campus Corner, and these spaces are not conveniently located to popular destinations (or restricted to a particular development).
- When analyzed by zone, parking supply in core areas (eastern CBD along Main Street, southern Campus Corner along Asp Avenue and University Boulevard) was found to be insufficient. Much of the convenient parking is restricted to private use or public parking that is occupied by early arriving workers, leaving little public parking for short-term use. The study estimated that approximately 440 additional parking spaces are needed in the CBD core and 300 spaces in the Campus Corner core.

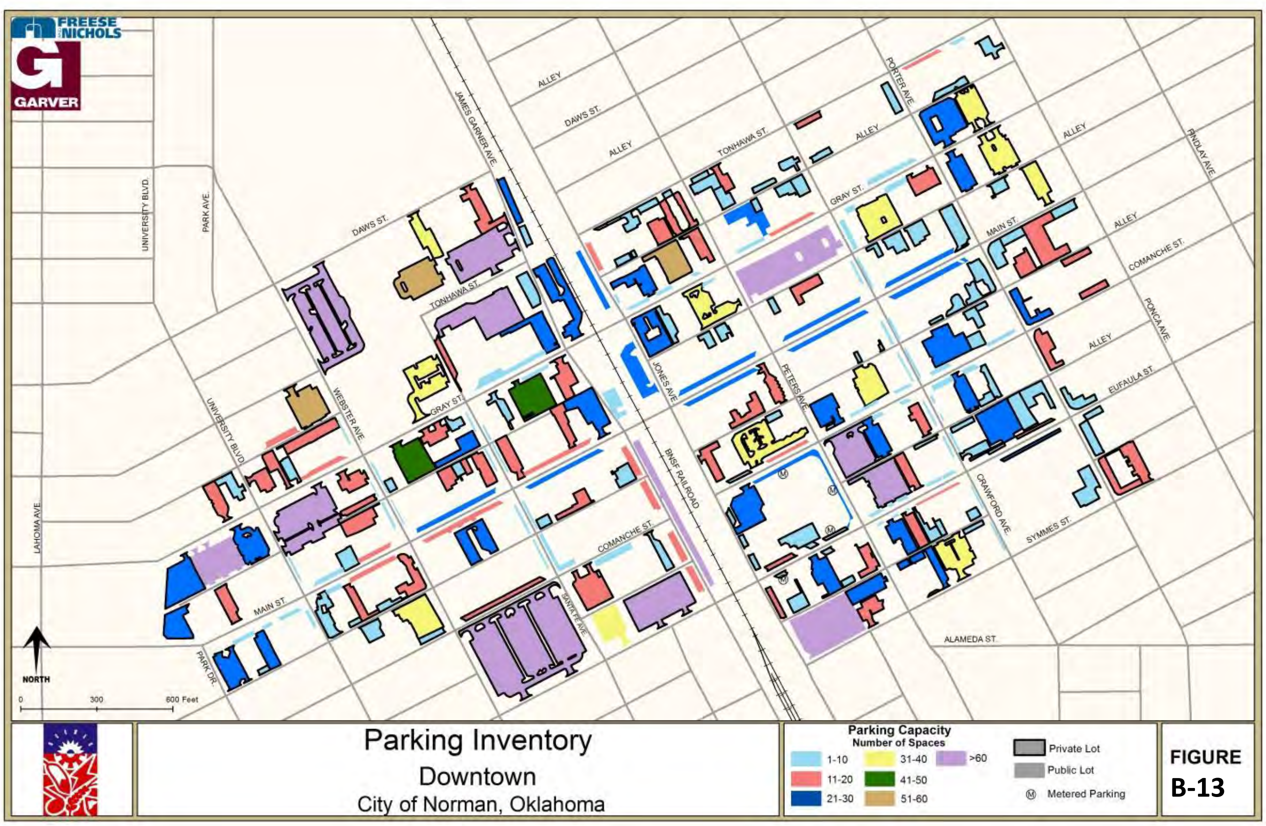
Recommendations

- A detailed financial analysis was performed to determine the feasibility of implementing parking structures in the CBD and Campus Corner. The results indicated that the costs would be prohibitive given current funding mechanisms. However, a city-owned surface lot was recommended near the Gray Street / Peters Avenue intersection.
- In Campus Corner, adjacent private lots could be adjoined to increase the number of spaces and provide easier access.
- Additional parking meters should be installed in the CBD, and meter rates should be increased to $1/hour in the CBD and Campus Corner.
- A parking enterprise fund to manage revenues and support development of needed parking improvements should be formed by the city.
- Downtown merchants should establish a validation program similar to Campus Corner.

On Street Parking on Asp Ave in Campus Corner nears 100%

2013 Parking Update
As an update to the Carter & Burgess study, parking in central Norman was revisited for this existing conditions report. A revised parking supply maps are depicted in **Figures B-13 and B-14**. The overall supply has not deviated significantly since 2003 as approximately 4,900 total spaces exist in the CBD while slightly less than 2,000 spaces are located in Campus Corner. However, field reconnaissance of surface lots in the CBD and Campus Corner indicate that many parking locations previously classified as "publicly available" have since installed restrictive signs to limit the parking supply to patrons of specific businesses. In the 2003 study, approximately 60% of CBD parking and 38% of Campus Corner parking were classified as "public" whereas 2013 data indicates only 25% of the supply is available to all vehicles at either location. This change has made parking more difficult for general purpose customers who may want to visit a number of locations or tourists interested in exploring a broad area.

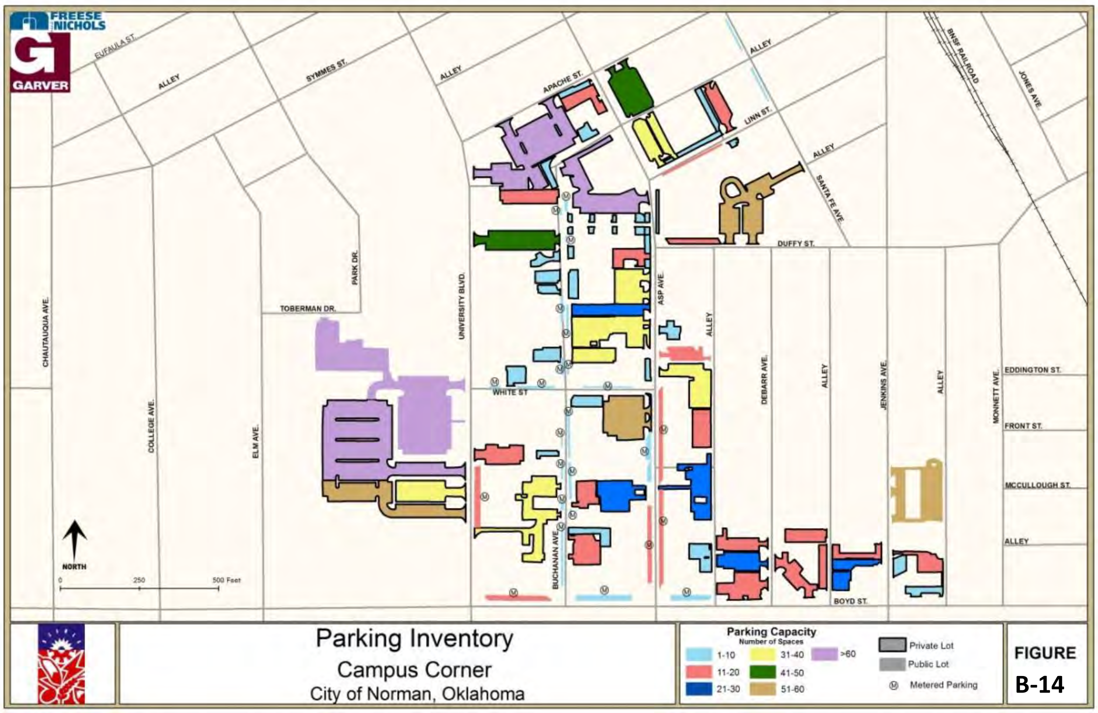
Recent Changes
Since the 2003 study, the city has constructed a 145-space surface lot near the Gray Street/Peters Avenue intersection at a site formerly occupied by one-story buildings. There are no current plans to build a parking structure in the CBD or Campus Corner.



Parking Inventory
Downtown
City of Norman, Oklahoma
FIGURE B-13

As of January 2013, the Gray Street lot features “smart” parking meters as part of a downtown parking management system being implemented by the city. This system includes multi-space meters (a total of three serves the entire lot), hand held enforcement devices, and parking space vehicle sensors. The meters accept cash, credit cards, tokens, and cell phone payments, and could accommodate a validation program by merchants for customer refunds if applicable. The meters offer the advantage of being easily reprogrammed to respond to changes in fee structures or time limits.

The city is currently considering a similar system for the on-street parking in the Campus Corner district in order to increase vehicle turnover and collect additional revenue with likely implementation for the start of the 2013 fall semester. After these updates, a review of downtown parking meters (unchanged since the study) and the establishment of a parking authority will be explored.



Parking Occupancy Sampling

Two surface lots and two on-street locations were sampled in the CBD and Campus Corner areas in January 2013 to determine if the parking shortages described in the Carter & Burgess study were still applicable. Sample lots were chosen in the core areas and on the periphery to determine the extent of the supply shortages. As seen in **Table B-11**, parking in the eastern CBD approaches the 85% practical capacity commonly used for parking supply while the western CBD has excess capacity. In Campus Corner, on-street parking and core off-street parking were scarce during the evening peak period. At the church lot on University Boulevard (one of the few off street locations that is publicly available to all vehicles), parking was available in the evening but scarce during the day as many OU students use this lot.

Table B-11 – Parking Occupancy in CBD and Campus Corner (2013 Sampling)

Region	Lot Type	Street Location	Access	Supply	Percent Occupancy			
					9-10 AM	12-1 PM	3-4 PM	6-7 PM
Downtown	Surface Lot	Peters Ave at Gray St	Public (City owned)	145	72%	88%	88%	56%
		University Blvd at Gray St	Private (Midtown Plaza)	79	29%	18%	30%	10%
	On Street	Main St: Peters Ave to Crawford St	Public (1 HR - Unmetered)	51	37%	84%	57%	73%
		Main St: Sante Fe Ave to James Garner Ave	Public (2 HR - Unmetered)	41	51%	39%	44%	39%
Campus Corner	Surface Lot	Asp Ave at White St	Private (Retail Token)	46	46%	52%	39%	98%
		University Blvd at White St	Public ($2/day - Church owned)	145	90%	94%	83%	45%
	On Street	Asp Ave near Boyd St	Public (Metered)	31	39%	100%	84%	100%
		Buchanan Ave near White St	Public (Metered)	26	12%	46%	42%	96%

In general, many of the parking deficiencies described in the 2003 report still exist. The lack of general use parking in the core areas causes additional traffic and congestion as visitors must circulate in search of an open parking space near their destination, and they cannot park once in a private lot if planning on using a variety of land uses within the area.

Freight Operations in Norman

The movement of freight within Norman is primarily handled through railroad and truck operations. Though no formal truck or rail studies/modeling have been conducted by the City of Norman or ACOG, freight movement is critically important to the local, state, and regional economy.

Rail Operations

According to the *Oklahoma Statewide Freight and Passenger Rail Plan*, performed by Parsons Brinckerhoff for ODOT in May 2012, Norman is serviced by a single railroad - a Class 1 operation owned by BNSF that is subject to heavy traffic and is known as the Mid-Continent (Mid-Con) corridor. Freight traffic on the Mid-Con is dominated by merchandise, manufactured goods, and grain moving between the Midwest and Pacific Northwest to Texas and Gulf of Mexico ports. Through Oklahoma, the Mid-Con roughly parallels the I-35 corridor between Kansas and Texas and carries over 50 million tons of freight through the state. Within Norman, the Mid-Con BNSF line parallels Flood Avenue on the north side of the city, continues southeast through the CBD, and then follows a path parallel to Porter Avenue/Classen Boulevard south to the Cleveland County border. No spurs, short line railroads, switching yards, or intermodal facilities are associated with the Mid-Con through Norman (though a secondary bypass track is provided from north of Rock Creek Road to south of Robinson Street).
Due to the national significance of the line, approximately 24 trains per day pass through the city. This high train frequency can have an impact on local traffic operations as the line features 17 at-grade crossings and two grade-separated crossings within the city limits (refer to **Figure B-15** for specific locations). With the exception of a private driveway south of SH 9, all at-grade crossings have active gates with flashing light assemblies (supplemental cantilevered flashers are provided at eight locations).

Automatic gates are provided for frequent crossings by BNSF's Mid-Con rail line

Truck Operations

Within Oklahoma, truck movement data from the FHWA Freight Analysis Framework (FAF) indicate an average of 8,500 trucks daily along IH-35 carrying 546 ton-miles of freight in 2007. Forecasts from the FAF of total freight flows are projecting an increase to 1,417 ton-miles by 2035. Truck traffic volumes within Norman are generally handled by I-35 and SH-9. As seen in **Figure B-15**, truck estimates, gathered from ACOG data and previous studies, indicate that I-35 traffic is composed of 15% trucks while SH-9 features approximately 6% trucks within the overall traffic stream. Otherwise, all other routes in Norman feature truck compositions less than 5% of the total traffic volume.

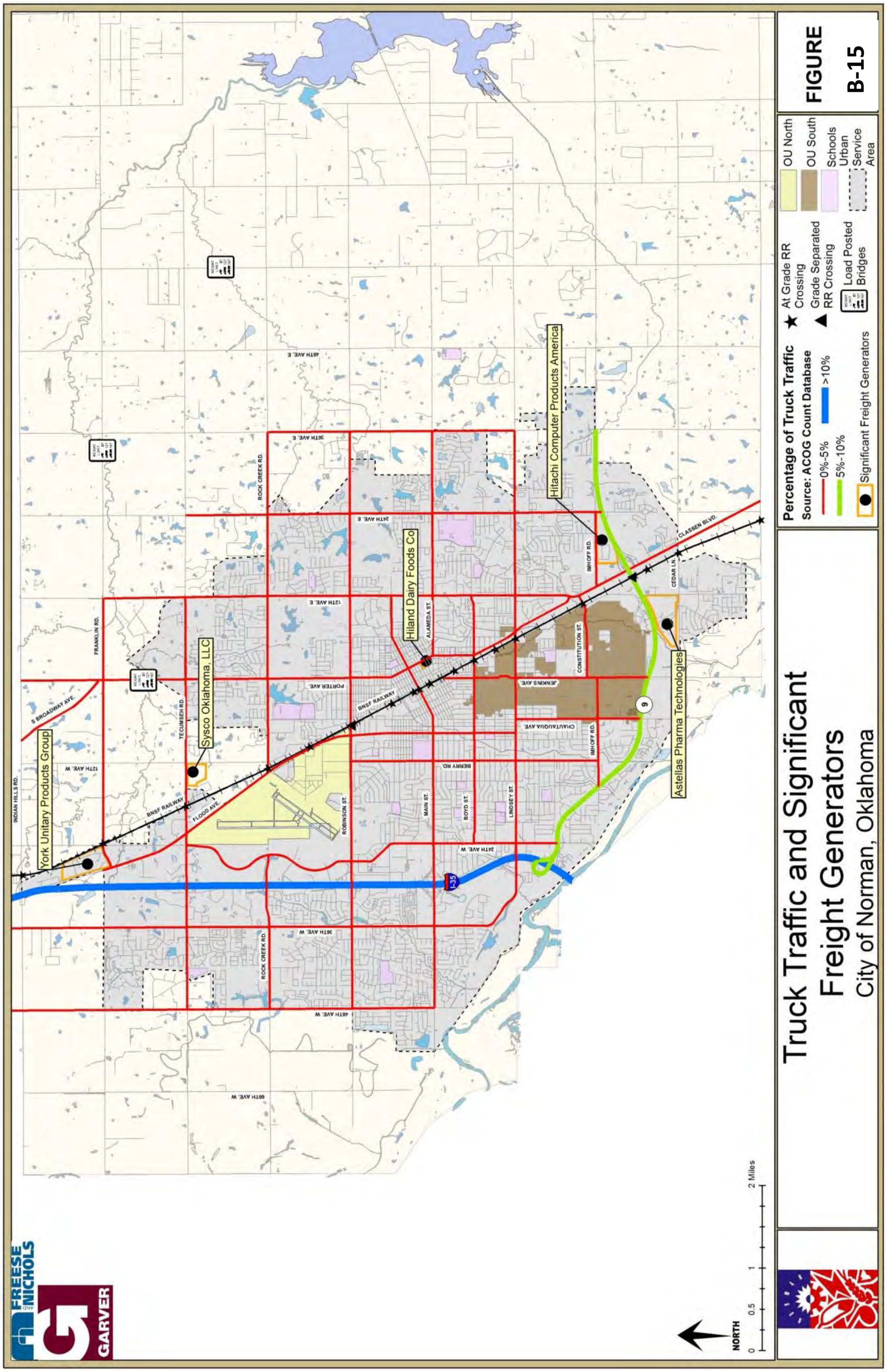
The city does not restrict trucks to specific routes, but 12 load-posted bridges are located in Cleveland County that could potentially influence truck traffic (refer **Table B-12** for complete list). Though most of these locations are located in rural parts of the county on routes with low traffic volumes, four of these locations are located within the city limits. One city location (E Post Oak Road) carries relatively minor traffic volumes in a less developed area, but the other three posted crossings (Porter Avenue, Franklin Road, and 60th Avenue E) are located near industrial areas with opportunities for heavy vehicle traffic (refer to **Figure B-15** for a location map of these more active crossings).

In 2007, ODOT prepared a study to evaluate truck traffic along the IH-35 corridor within Garvin County. The purpose of the study was to examine alternative by-pass routes from IH-35 between Davis and Pauls Valley to IH-40 east of Oklahoma City. While no definitive action resulted from the study, future study should be considered as trucking demands continue to rise within the Norman and OKC metropolitan area.

Norman's economy is centered on the education, services, and professional sectors, which typically do not generate heavy freight needs. However, the city is home to several major manufacturing facilities that are known to generate significant truck volumes (these locations are also depicted in **Figure B-15**). In addition, the prevalence of heavy/light industrial land use zoning along N. Flood Avenue and Tecumseh Road in the northern part of the city is likely to produce increased truck traffic as more development occurs.

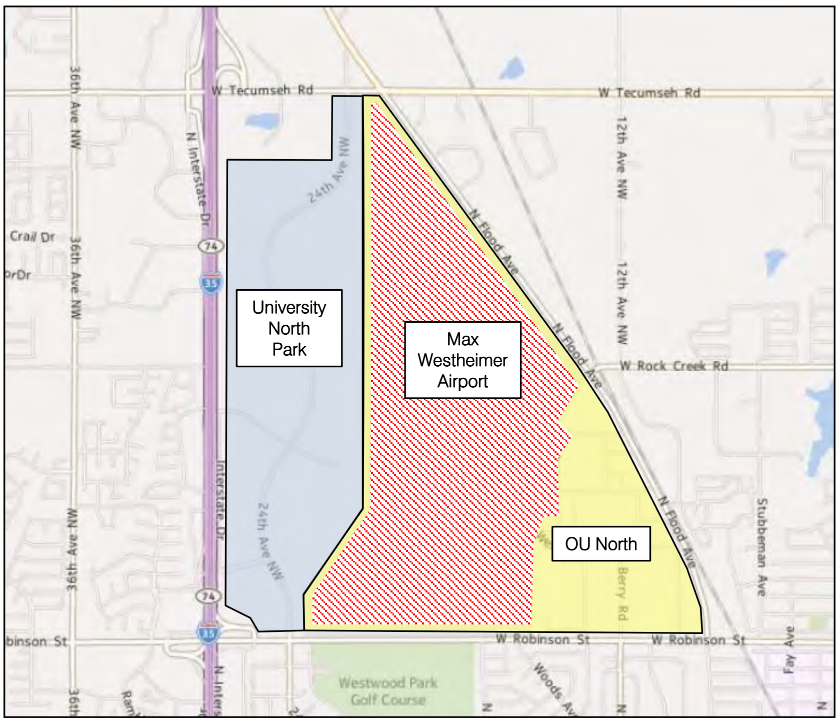
Table B-12: Load Posted Bridges in Cleveland

Bridge Facility	Crossing	Location	Rating (Tons)
N Porter Avenue	Little River	0.6 mile S of Franklin Road	20.0
Franklin Road	Little River	0.1 mile W of 36th Ave NE	14.0
Slaughterville Road	Creek	0.1 mile W of 180th Ave SE	18.0
60th Ave NE	Rock Creek	0.5 mile N of Rock Creek Road	10.0
Duffy Road	Pond Creek	0.1 mile W of 192nd Ave SE	19.0
York Road	Pond Creek	0.1 mile E of 192nd Ave SE	16.2
Moffatt Road	Pond Creek Trib	0.2 mile E of 180th Ave SE	4.0
Moffat Road	Creek	0.4 mile E of 192nd Ave SE	20.0
E Post Oak Road	Creek	0.2 mile E of 96th Ave SE	9.0
192nd Ave SE	Creek	at Lewis Road	15.0
SE 19th Street	N Fork of Little River	0.5 mile E of Bryant Ave	14.0
Sunnylane Road	N Fork of Little River	0.2 mile S of SE 34th Street	21.1


Truck Traffic and Significant Freight Generators
City of Norman, Oklahoma
FIGURE
B-15
Percentage of Truck Traffic
Source: ACOG Count Database
0%-5%
5%-10%
>10%
Significant Freight Generators
At Grade RR Crossing
Grade Separated RR Crossing
Load Posted Bridges
OU North
OU South
Schools
Urban Service Area
York Unitary Products Group
Sysco Oklahoma, LLC
Hiland Dairy Foods Co
Hitachi Computer Products America
Astellas Pharma Technologies
BNSF RAILWAY
CLASSEN BLVD
NORTH
0
0.5
1
2 Miles
FREESE NICHOLS
GARVER

Aviation in Norman

The University of Oklahoma Westheimer Airport (OUN), also known as Max Westheimer Airport, is owned and operated by the University of Oklahoma and located in an area of Norman known as Research Campus North, 3 miles northwest of the Central Business District. The Research Campus North area is delineated by Robinson Street on the south, Tecumseh Road on the north, Flood Avenue on the east, and airport property on the west. The Research Campus North contains approximately 1,120 acres, with 727 acres attributed to airport property and 393 acres attributed to Research Park. Wedged between the western boundary of airport property and Interstate 35, the 580-acre University North Park development area is replete with various types of small to large commercial land uses such as retail, restaurant, hotel, and grocery. It is anticipated the north portion of this area will be developed as an office park with some areas possibly having direct access to the airport through specific right-of-entry agreements.



The airport currently operates as a two runway system. Runway 17/35, the primary runway, is 5,200' in length and 100' in width, while the crosswind runway, Runway 3/21, is 4,749' in length and 100' in width. The airport is classified as a *Reliever* by the Federal Aviation Administration, one of two in the Oklahoma City region (the other is Wiley Post in north Oklahoma City), and is home to 95 based aircraft. Reliever airports provide additional capacity and handling of general aviation flights in areas to assist the operations at larger commercial airports. All commercial activity and flights are handled at the Will Rogers World Airport (OKC), which is located in Oklahoma City approximately 20 miles northwest of Max Westheimer Airport.

The airport operates with a manned Air Traffic Control Tower (ATCT) that accommodates approximately 66,000 aircraft operations per year. The University owns and operates 40 T-hangars and 7 corporate size hangars with an additional 22 hangars that are privately owned. Due to the types and complexities of aircraft operating at the airport, in addition to the significant amount of flight training operations associated with the University's aviation degree program, there is a precision landing system

(Instrument Landing System – ILS) that serves runway 17 and other non-precision approaches serving other runway ends. The City of Norman maintains a Height Hazard Zoning Ordinance which protects the airport from encroaching activities beyond the airport boundary and limits what can be constructed and erected within a certain distance and height.

Primary access to the airport is provided by Berry Road to the south, Lexington Street to the east, and Goddard Avenue to the northeast. In addition to aircraft activity, the airport is a destination point for existing businesses and facilities, which include the YMCA, the National Weather Center Annex, the University's aviation classroom building for aviation students, airframe and power plant maintenance providers, and aircraft owners requiring access to their hangar area. The heaviest aviation traffic occurs during the fall when the University of Oklahoma hosts a football game. These games attract significant business jet operations and increase the volume of traffic in the area until the game day event ends.

While no specific information is available regarding employment and economic activity provided by, or at, the airport, the importance of this asset remains a priority both for the state and the national airspace system. This can be seen as witnessed by the $21 Million in grants the airport has received over the last 40 years. The most recent Airport Master Plan for the airport was completed in 1995 with a follow up Airport Action Plan completed in 2004. In addition to these two reports, a document was produced in 2008 to conceptualize and layout facilities in the North Development area of the airport. This 71 acre parcel is located in the northeast quadrant of the airport and with development plans to accommodate all types, sizes, and complexities of aircraft.

Bicycle and Pedestrian Accommodations and Activities

1996 Bicycle Transportation Plan Prepared under the guidance of a Council-appointed Bicycle Steering Committee and officially adopted by the City in June of 1996, the Bicycle Plan was intended to augment the Transportation Master Plan and the Comprehensive Plan. The Bicycle Plan establishes goals and objectives, programs and routing to address basic needs of bicyclists in Norman and a guide for the development of bicycle facilities. The Plan also proposes three ancillary programs: promotion of bicycling activity, development of an educational program and vehicular law enforcement. The Bicycle Steering committee called the Plan "Bicycle Norman".

Norman Bicycle Advisory Committee (BAC)

Created by City Council action in March, 2007, based on the recommendation of ad hoc bicycle committee charged with reviewing the 1996 Norman Bicycle Plan, the BAC consists of 9 mayor-appointed members each serving 3 year terms. The BAC is administratively housed under the Transportation Committee and meets monthly. The BAC is "charged with reviewing the Bicycle Transportation Development Plan on an ongoing basis and to make and assist in implementation of recommendations to additionally encourage and support biking, both recreational and for transportation, and to consult with and forward those recommendations to the Transportation Committee." (Resolution #R0607-58)

2011 Bike Route Map

The Bicycle Transportation Plan recommends periodic updates, at least once every 5 years. The BAC works to keep the bikeway Routing Plan current and has completed an update to the Bike Route Map most recently in 2011, as shown in **Figure B-16**. A pocket size guide for biking in Norman has been prepared that incorporates the map of bike routes, bike lanes and multiuse paths and on the reverse information about safety rules of the road and other pertinent information.

Oklahoma University Bicycle Advisory Committee

The University of Oklahoma Faculty Senate (Norman campus) Faculty Welfare Committee has adopted a resolution supporting recognition as a Bicycle Friendly University. Specifically, they have stated that "commuting to campus and traveling around campus by bicycle is an option that many find appealing, and the efficiency and prevalence of commuting to campus by bicycle will be enhanced by coordination of campus bicycle routes with City of Norman bicycle routes where feasible, developing programs that provide recognition and encouragement for bicycle commuters, and providing resources to accommodate bicycle commuters such as racks on buses." They also identify that bicycling improves health and fitness, bicycling is ranked among the top three exercises for improving cardiovascular fitness, bicycling to campus provides a sustainable and time-efficient exercise regimen, and a bicyclist-friendly campus is a simple and cost-effective way to promote wellness; construction of bicycle infrastructure actually is a money-saving option when it offsets the need to build and maintain additional infrastructure for motorized vehicles;

increased bicycle commuting reduces traffic congestion and improves the availability of parking for those who need to drive or who prefer to drive a vehicle to campus; bicyclists are easily accommodated in the dense core of the campus since 10 to 12 bicycles can be accommodated in the space required by one car.

OU Bike Patrol

The current bicycle program began in 1990 with the donation of two mountain bikes by a local bike dealer and several volunteer officers who trained themselves as they rode and outfitted themselves and the bikes with whatever they could buy or scrounge. When the benefits of bike officers became apparent in terms of personal contact and interaction with members of the campus community and greatly enhanced mobility, especially in crowd and special event situations, the department administration enthusiastically endorsed the concept and began to solicit support from the University for an expanded program.

The OUPD bike officers have repeatedly demonstrated their value as a rapid response resource at football games, concerts, and numerous other special events on campus. They have developed excellent working relations with the bike squads at the Norman Police Department and Cleveland County Sheriff's Office (many of whose officers we trained in the OUPD bike patrol school), and regularly ride with them in teams for events where the agencies have mutual interests and overlapping jurisdictions.

Bicycle Friendly City

In April 2011, the City of Norman received a Bicycle Friendly Community designation from the League of American Bicyclists. The League of American Bicyclists (LAB) has received 452 applications and designated 179 Bicycle Friendly Communities in 44 states. The BFC program recognizes communities that promote bicycling and provides technical assistance in the form of a roadmap to help cities build great communities for bicycling. The League has identified projects, policies, programs and plans that most effectively improve cycling conditions and make up the foundation of a bicycle friendly community. Bicycle Friendly Communities (BFC) are using these building blocks. The City of Norman moved from previous BFC Honorable Mention to a Bronze award level in 2011. The LAB also has criteria for designation of Bicycle Friendly Universities (BFU). OU is not recognized as a BFU.

Bicycle Friendly Community Bicycle Friendly University

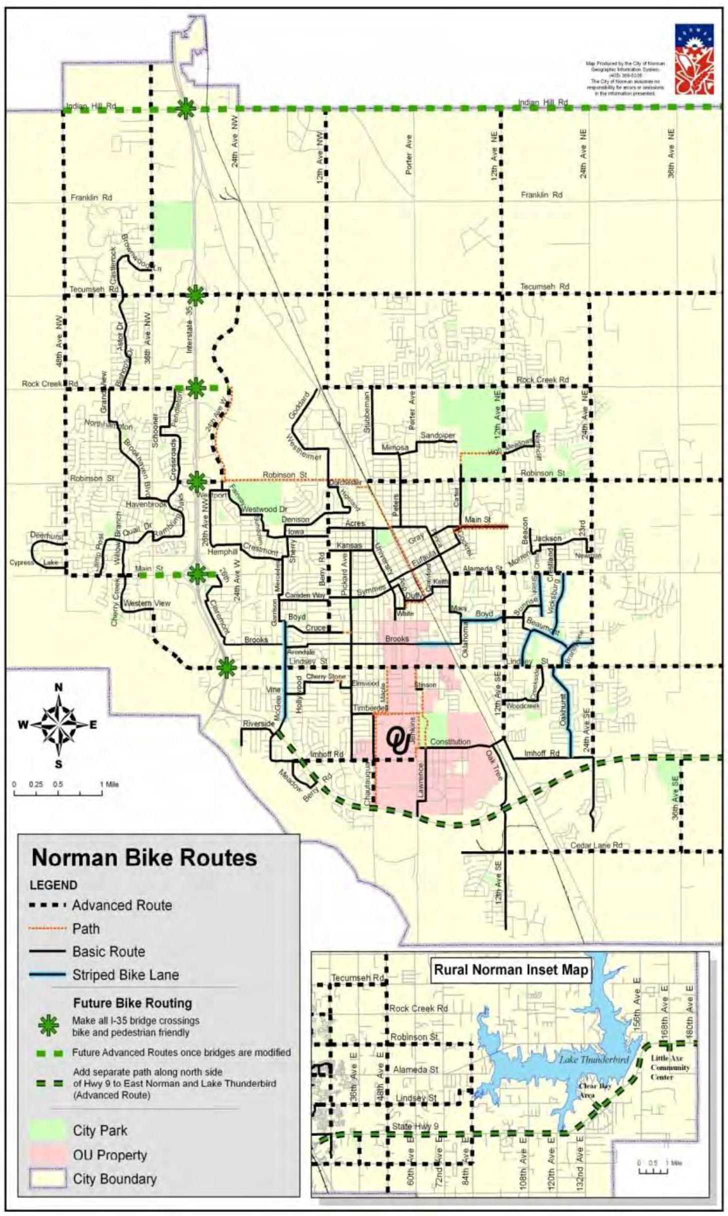


Figure B-16 Current Norman Bike Routes

Pedestrian Accommodations
The City of Norman has ordinances in place that require sidewalks to be included with all new subdivision developments. Sidewalks are also prevalent throughout the core of Norman (see sidewalk inventory). Sidewalks are lacking, however, along many collector and arterial streets that would connect residential development to nearby schools, parks and retail opportunities. Many of the sidewalks are lacking or have substandard accommodations for pedestrians with mobility impairments. As with bicycling, there is a Walk Friendly Community (WFC) organization that recognizes communities for demonstrating a commitment to improving walkability and pedestrian safety through comprehensive programs, plans and policies. Norman has not been recognized as a WFC.

Sidewalk System
Sidewalks are a vital element of the transportation system, providing access and service to activity centers, transit, homes, businesses, schools, libraries, and parks. According to the *2011 Norman Community Transportation Survey*, nearly 40% of Norman residents are dissatisfied with the availability of walkways in the city, indicating that there is some room for improvement to the current system. Approximately 72% of residents are supportive of constructing and repairing sidewalks, and an overwhelming 89% are in favor of improving maintenance of existing roadways, bridges, sidewalks, and paths.

Examples of missing segments and well-worn paths are considered gaps within the existing sidewalk system

Given the size of the existing system, investments in sidewalks are priority-driven based on the needs of the public and the annual capital improvement budgeting process. The City of Norman maintains a list of committed sidewalk projects and potential future projects based on public input and recorded gaps in the sidewalk system (these city-identified projects are depicted in **Figure A-6**). Functional gaps in the sidewalk system occur not only with the absence of paved sidewalk, but also where the existing sidewalk does not meet Americans with Disabilities Act (ADA) guidelines or is otherwise in generally poor condition such that it does not adequately serve all users.

The city's capital improvement budget for sidewalks is determined each year through the funding of designated sidewalk programs that are focused on specific areas of need. Below are the four city programs for sidewalk improvements and a near term representative project for that respective program.

- **Sidewalk Program for Schools and Arterials**: Berry Road from Rebecca Lane to Vine Street (west side) to be completed in 2014.

- **Citywide Sidewalk Reconstruction Program**: Lindsey Street from Biloxi Drive to Oakhurst Avenue to be completed in 2014 (note this program is funded 50% by adjacent property owners).
- **Downtown Area Sidewalks and Curbs Program:** Porter Avenue from Eufaula Street to Apache Street (west side) to be completed in 2015.
- **Sidewalk Accessibility Program:** Gray Street from Lahoma Avenue to University Boulevard to be completed in 2015.

In addition, sidewalks are often upgraded through larger intersection and corridor widening improvement projects. For 2013, additional sidewalk projects were added to the capital improvement budget beyond the four programs in order to more fully address the growing number of requests.

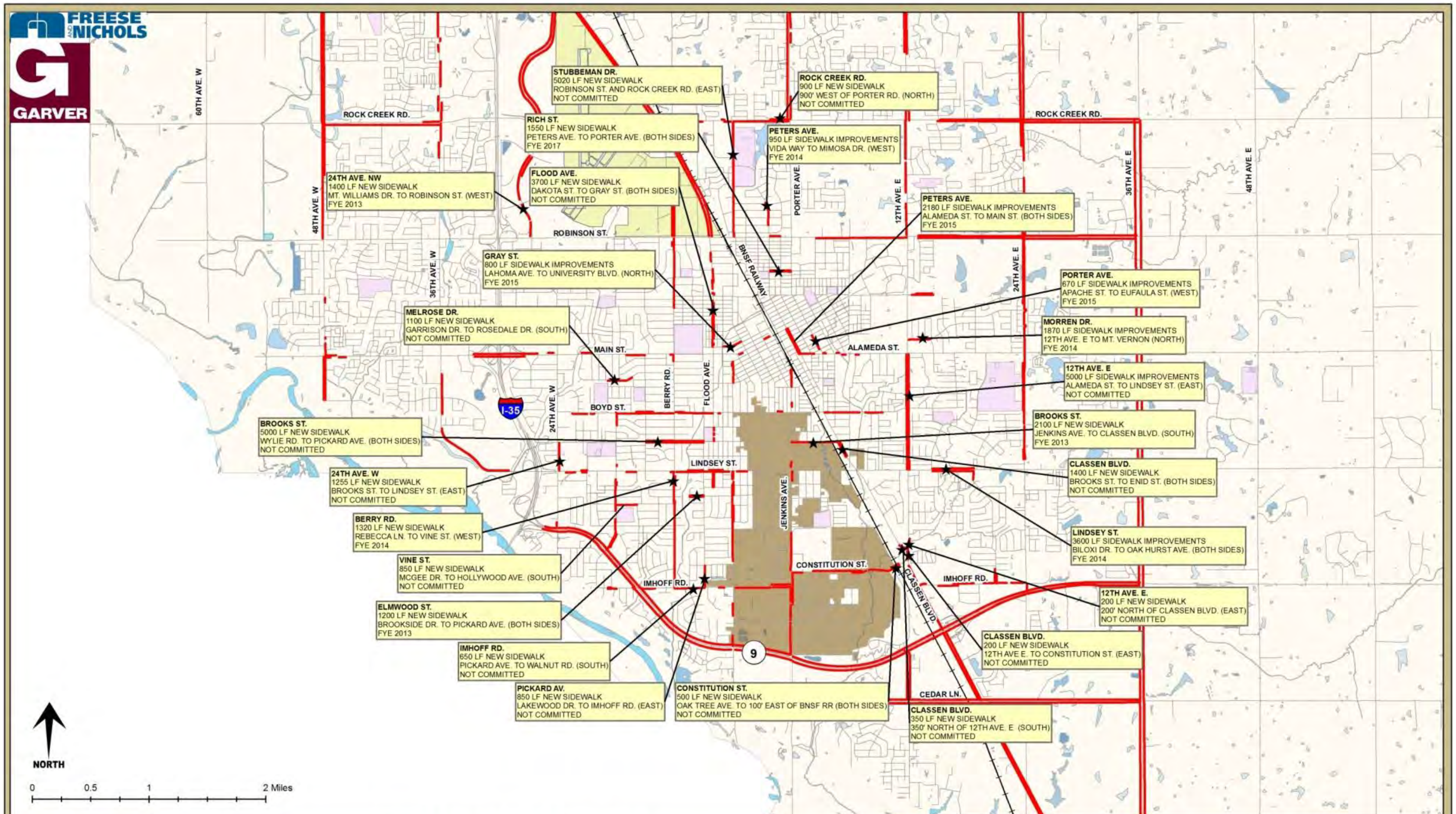
A comprehensive review of arterial and major collector routes using the city's GIS database uncovered some additional gaps in the sidewalk system in addition to those currently on the city's list. In general, the city provides good connectivity along arterial and collector facilities and within the major activity centers (CBD and the University of Oklahoma areas). **Figure B-17** provides a map of missing sidewalk segments along major city routes. As shown, there will still be some gaps in the sidewalk system after the city completes its project list. At the grade-separated I-35 crossings, where sidewalk is especially critical, substandard or non-existent sidewalks are found at the Tecumseh Road, Main Street, Lindsey Street, and SH 9 interchanges. On-going ODOT interchange projects will provide suitable pedestrian accommodations at Lindsey Street and Main Street. However, since SH 9 is a fully-directional trumpet interchange with no connection on the west side (and there is not any sidewalk along SH 9), the SH 9 interchange will not include sidewalk. No current plans exist to provide sidewalk along the Tecumseh Road bridge over I-35.

Multi-Use Trails

In addition to sidewalk, Norman maintains nearly 14 miles of walking/jogging trails located primarily within neighborhood/community parks as detailed in the 2009 *Norman Parks & Recreation Plan*. The city's longest trail, the Legacy Trail, has recently been extended to connect the University North Park retail district to the CBD (via Robinson Street and the active BNSF railroad corridor). The recent extension ended at Duffy Street, approximately three blocks south of the CBD. Future plans call for a further extension from Duffy Street to connect to the popular Campus Corner district adjacent to the University of Oklahoma. Trails offering this kind of connectivity were ranked as the number one priority by citizens in online and mail-in surveys during the formulation of the 2009 plan.

Parks and Recreation Master Plan, Greenways Plan 2011

The Greenway Plan component of the Parks and Recreation Master Plan identifies a system of existing and proposed trails along city streets, within and along parks, using utility corridors and along the greenway corridors of the extensive system of creeks and rivers and Lake Thunderbird. The Greenway Plan is shown in **Figure B-18**. The proposed trails are identified as Short, Medium and Long Term priorities and those anticipated to be provided by developers.



Existing Sidewalks

System Gaps and Planned City Projects

City of Norman, Oklahoma

- Gaps in Existing Sidewalk System (Collectors & Arterials)
- ★ City of Norman Sidewalk Project (Planned)
- OU North
- OU South
- Schools

Note: Other sidewalk gaps will be corrected as part of larger road improvement projects.

FIGURE B-17

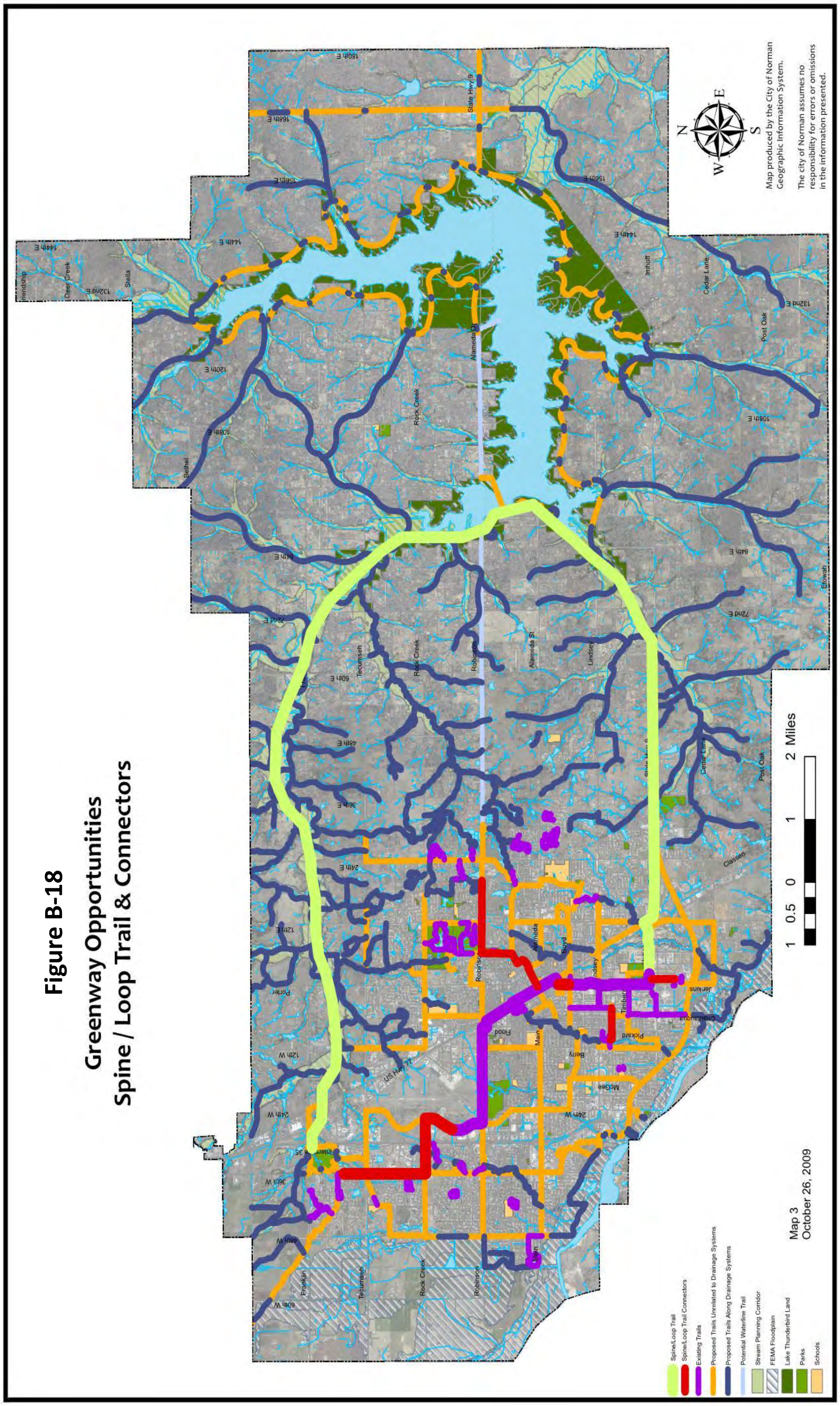


Figure B-18
Greenway Opportunities
Spine / Loop Trail & Connectors

B:5

Roadway Safety

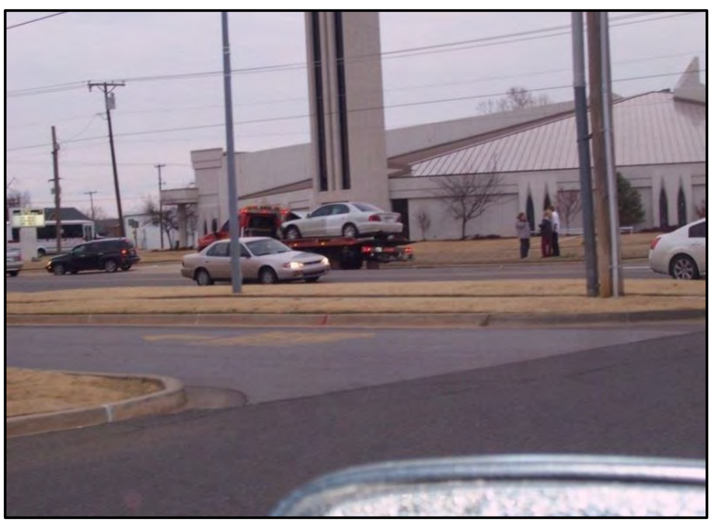
Crash data on Norman streets was analyzed to gauge roadway safety throughout the city. According to the city GIS, between 2007 and 2011, approximately 15,000 crashes occurred on city streets, which included 3,825 injury collisions and 26 fatal collisions. An analysis was performed to determine the most common crash locations as well as the corridors with the highest crash rates.

Intersection Crash Frequency

Figure A-8 depicts all crash locations in Norman for 2011 with the larger circles representing greater crash frequencies. As expected, the intersections with the higher crash frequencies tend to also have higher traffic volumes due to more opportunity for crash exposure. **Table** B-13 provides the statistics at the five intersections with the largest number of crashes (crash type data was provided by ODOT for 2011 only). The majority of crashes at these locations were rear end and angle collisions. These types of crashes are generally attributable to stop-and-go conditions, insufficient turn lanes, poor lines of sight, or high levels of access/development in immediate proximity to major intersections.

Corridor Crash Rates

Crash rates were calculated for select corridors in Norman using 2009-2011 data with the results shown in **Table B-14**. The advantage of considering crash rates rather than raw number of crashes is that rates take segment length and traffic volume into account to identify segments of major corridors that are most susceptible to crashes. Thus, using crash rates can highlight the problematic areas that may appear to have only an average number of crashes but actually generate more crashes than expected due to low traffic volumes or segment length.



The Lindsey Street corridor has a crash rate more than seven times the state average

As seen in **Table B-14**, crash rates, expressed in terms of crashes per 100 million vehicle miles travelled, are often compared to statewide rates on similar facilities. The 2011 data suggests that the Lindsey Street and Berry Street corridors generate crash rates significantly higher than the statewide average for municipal two or three lane facilities. This high crash rate can be attributed to many factors, including the presence of numerous driveways and access points located along these routes as well as intersections with other busy arterial routes. All other corridors listed in **Table B-14** have crash rates greater than the statewide average as well.

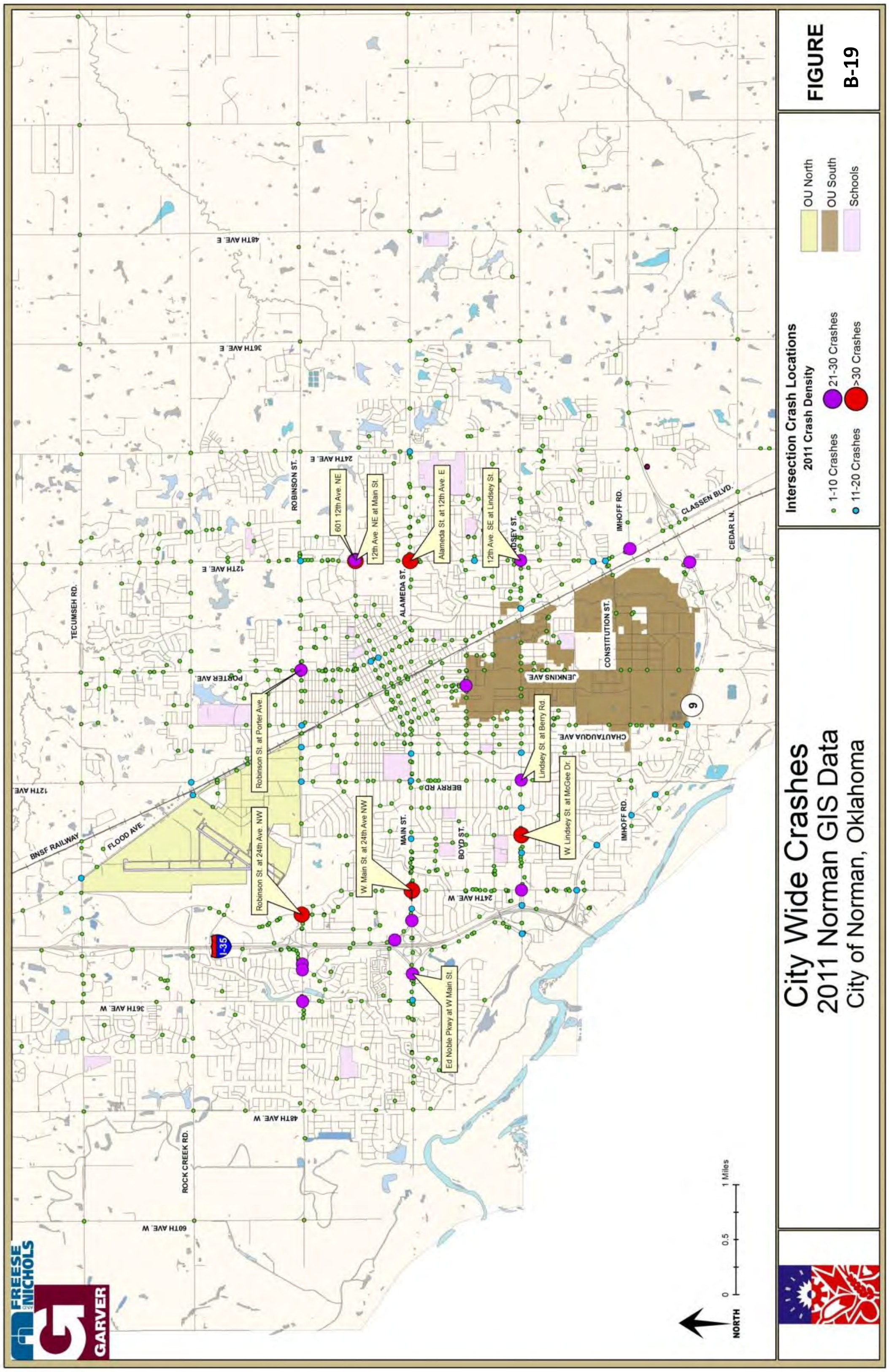
Table B-13: Most Common Intersection Crash Locations for 2011

Intersection	Number of Crashes	% Injuries	% Rear End	% Angle	% Right Angle	% Other
24th Avenue W at Main Street	57	29%	58%	12%	30%	0%
12th Avenue E at Alameda Street	47	24%	52%	28%	4%	16%
24th Avenue W at Robinson Street	38	19%	43%	33%	10%	14%
Lindsey Street at McGee Street	37	42%	83%	9%	8%	0%
12th Avenue E at Main Street	31	27%	45%	55%	0%	0%

Table B-14: Corridor Crash Rates (2009-2011)

Route	Segment	Distance (miles)	Average Segment Volume (vpd)	Average Number of Crashes (2009-2011)	Average Crash Rate (2009-2011)[1]	State Crash Rate[1]	Ratio
Lindsey Street	East of 24th Ave W to East of Asp Ave	1.8	19,319	200	1573	179	8.8
Main Street	Thompson Drive to University Blvd.	1.3	29,824	131	923	378	2.4
Robinson Street	Brookhaven Blvd to 24th Ave W	1.0	30,561	147	1315	378	3.5
Tecumseh Road	36th Ave W to Flood Ave	1.1	14,544	43	736	378	1.9
24th Avenue W	Rock Creek Road to SH 9	3.65	16,291	209	965	378	2.6
Porter Avenue / Classen Boulevard	Robinson St to 12th Ave E	2.95	17,329	187	1000	378	2.6
12th Avenue E	Rock Creek Rd to SH 9	4.55	29,136	372	769	378	2.0
Berry Road	Robinson St to Imhoff Rd	3.0	8,235	104	1150	179	6.4

[1]Crash rates are shown per one million vehicle miles travelled


City Wide Crashes
2011 Norman GIS Data
City of Norman, Oklahoma
FIGURE
B-19
Intersection Crash Locations
2011 Crash Density
1-10 Crashes
11-20 Crashes
21-30 Crashes
>30 Crashes
OU North
OU South
Schools
601 12th Ave. NE
12th Ave. NE at Main St.
Alameda St. at 12th Ave. E
12th Ave. SE at Lindsey St.
Robinson St. at Porter Ave.
Lindsey St. at Berry Rd.
W Lindsey St. at McGee Dr.
W Main St. at 24th Ave NW
Robinson St. at 24th Ave. NW
Ed Noble Pkwy at W Main St.
TECUMSEH RD.
ROBINSON ST.
12TH AVE. E
24TH AVE. E
36TH AVE. E
48TH AVE. E
PORTER AVE
ALAMEDA ST.
LINDSEY ST.
JENKINS AVE
CONSTITUTION ST.
CHAUTAUQUA AVE
IMHOFF RD.
CEDAR LN.
CLASSEN BLVD.
BERRY RD.
MAIN ST.
BOYD ST.
24TH AVE. W
36TH AVE. W
48TH AVE. W
60TH AVE. W
ROCK CREEK RD.
FLOOD AVE.
BNSF RAILWAY
12TH AVE
I-35
9
NORTH
0
0.5
1 Miles
FREESE NICHOLS
GARVER

Traffic Calming Program

In 2003, in an effort to deal with the growing problem of neighborhood speeding, the City of Norman researched what other cities around the country have done about this problem, and created its own Traffic Calming Program to address the issue. The Program is set up as a neighborhood driven initiative that the City of Norman Traffic Control Division guides and administers. The program utilizes a "toolbox" of traffic calming devices (the most popular and effective were speed tables and traffic circles) to cause a discomfort to speeding motorists that would compel them to slow down. By establishing certain 85th Percentile Speeds and Average Daily Traffic thresholds, neighborhood collector streets became the likely targets for traffic calming.

The City Council appropriated about $100,000 per year to fund the Program and, until about 2010, was immensely popular. In February 2009, the City Council formalized a document entitled the Neighborhood Traffic Management and Calming Program (a.k.a. the Calming Manual) which outlined the objectives, the qualifying criteria, the excluded routes, the calming tools, and the process for neighborhoods to pursue traffic calming projects. As part of the process, a "Speeding and Traffic Calming" brochure summarizing the program was written and is distributed to interested parties. Both the Calming Manual and brochure can be found on the city's website at the following links:

http://www.ci.norman.ok.us/sites/default/files/WebFM/Norman/Public%20Works/Traffic%20Calming.pdf

http://www.ci.norman.ok.us/sites/default/files/WebFM/Norman/Public%20Works/TrafficCalmingProgramProceduresManual.pdf

The program was so well received that the funding could not keep up with the eligible projects. The Calming Manual anticipated this problem and contains a procedure for prioritizing eligible projects whenever funding is short. In 2010, however, in response to the many requests for projects, the City Council opted to fund them all. This proliferation of traffic calming projects proved to be "too much, too fast" and the City Council began receiving complaints from citizens who were annoyed by all the calming devices. As this coincided in time with a need for fiscal belt-tightening, the Council chose to not fund Traffic Calming for a couple of years, and to de-emphasize physical traffic calming in favor of non-physical means that were less intrusive, when it resumed. Although no traffic calming projects have been constructed since then, City staff still receives inquiries about traffic calming and still evaluates requesting neighborhoods for eligibility. The Calming Manual remains as the source document for the Program.

Transit Services and Usage

The City of Norman is served by a combination of regional and local public transportation services. Cleveland Area Rapid Transit (CART) provides fixed-route bus, complimentary para-transit, as well as weekday express bus service to Norman citizens. The City of Norman is also presently served by two intercity bus lines, which provide connections to several metropolitan areas within other states. Furthermore, daily Amtrak passenger rail service connects the City of Norman to Oklahoma City and Fort Worth, TX.

The following sections describe the existing conditions of public transportation facilities and services provided within the City of Norman.

Existing Transit Network and Providers

Cleveland Area Rapid Transit

CART transports well over one million passengers per year, providing service to approximately 3,252 transit riders during an average weekday on its fixed-route bus system, which consists of eleven routes. The routes have been designed to connect many popular destinations, such as shopping centers, medical facilities, and the University of Oklahoma (OU) campus.

CART buses run six city routes, four OU campus routes, and one special purpose route to the Social Security Administration office in the neighboring City of Moore. With some exceptions, these routes provide predominately weekday service between the hours of 7 a.m. and 9 p.m. and limited Saturday service on select routes.

In coordination with the Central Oklahoma Transportation and Parking Authority (COTPA), CART also operates a weekday-only commuter route, the Sooner Express (Route 24), to Oklahoma City; COTPA provides one morning and one evening round-trip between Oklahoma City and Norman, and CART offers two morning and two evening roundtrips on this jointly operated route.

In addition, CART runs a weekday Late-Night Flex Route around and near the OU campus once regularly fixed-route service has shut down operations for the evening. Furthermore, CART operates a paratransit service, CARTaccess, for the elderly, disabled, and those unable to ride the fixed-route bus system. Regular fixed-route bus fares are $0.50. Half-price tickets are available to persons with disabilities, Medicare card holders, Americans with Disabilities Act (ADA) car holders, senior citizens, and children between the age of 6 and 17. Children under 6 years of age and OU faculty and students may ride the fixed-route buses for free. A one-way ticket on the Sooner Express costs $2.25 and discounted one-way tickets are not available. An unlimited monthly pass can be purchased for $20 at full price or $10 if discounted. An unlimited monthly Sooner Express pass costs $50, or $25 if discounted. CARTaccess fares are zone-dependent.

Greyhound Bus – Intercity Bus Service

The Greyhound Bus pick-up, located at 506 N Porter, is scheduled to be open from 6 a.m. until 11 p.m. Monday through Sunday, including holidays. Upon request, package express and ticketing services are available.

From the Norman Greyhound station, four direct, daily trips to Dallas, TX are offered with fares ranging from $16.00 (advance purchase) to $66.00 (refundable) for a one-way trip. Three daily, direct connections are also offered to Wichita, KS. Other destinations, such as Tulsa, OK, Amarillo, TX, Little Rock, AK, and Kansas City, MO, can be reached via transfer to another Greyhound bus in Oklahoma City. Greyhound has more than 2,400 service locations in North America.

Megabus – Intercity Bus Service
The Megabus pick-up within the City of Norman is usually located at the Lloyd Noble Center's parking lot bus shelter, with the exception of OU game days, at which time the pick-up occurs at the round-about just off Asp Avenue north of Imhoff Road.

From the City of Norman, Megabus offers two daily connections to Dallas, TX for $12.00 to $21.00, two daily buses to Springfield, MO for $8.00 to $35.00, which continue on to St. Louis, MO for $33.00. The late-evening, St. Louis-bound bus also travels to Chicago, IL for $154.00 per one-way ticket. Overall, Megabus provides daily express bus service to 70 destinations within 28 states.

AMTRAK – Intercity Passenger Rail Service
Within the City of Norman, the Amtrak station is located at 200 S Jones Avenue, near the heart of downtown. Station parking is available just west of the tracks; provisions have also been made for bicycle parking. The station itself offers an enclosed waiting area, but lacks a ticket office, baggage check, restroom, or other amenities.

Amtrak's Heartland Flyer connects Oklahoma City with Fort Worth, TX, providing one daily round-trip between the two metropolitan areas, with the option of connecting to Dallas, TX, San Antonio, TX, and Chicago, IL from the southern terminus of the Heartland Flyer.

The Heartland Flyer departs every day at 8:49 a.m. to its destination in Fort Worth, TX and arrives on its return trip at 9:04 p.m. The trip to Forth Worth is approximately 186 miles and takes less than four hours. The fare cost varies depending on supply and demand, and can range from $25.00 to $36.00 for a one-way ticket. On average, Norman Amtrak riders traveling to Fort Worth account for about 13 percent of the Heartland Flyer's ridership.

It is worth mentioning that the Heartland Flyer has twice been recognized for exceptional service in the recent years, and ridership has risen by 25 percent since 2005 to an annual ridership of 84,039 in 2011.

Airport Express – Airport Shuttle Service
Airport Express offers direct transportation service to Will Rogers World Airport located within Oklahoma City. For a one-way trip from the City of Norman, the fare ranges from $38 to $44, depending on whether the trip to the airport starts from a location west or east of Porter Avenue. Airport Express also offers other personalized transfer and transportation services.

Taxi Operations
Within the City of Norman, public transportation services are supplemented by several privately owned taxi companies, such as A1 Taxi Service, Airport Limo, Boomer Cab, Checker Cab, and Yellow Cab. These taxi companies operate on a 24/7 basis.

GetAroundOK – Carpool Matching Service

The Association of Central Oklahoma Governments initiated an online carpool match website named "GetAroundOK.com" several years ago. The site allows registered users to create a commute profile to search for potential carpool matches. It offers a commute tracking tool that automatically calculates gas savings and reduction in air pollution.

The site also provides additional information and links to anyone interested in commuting by bike, transit, or on foot. The service is free to all residents of the Oklahoma City metropolitan area.

Car Sharing Services

Timecar is a membership-based car sharing service that provides access to vehicles on an hourly or daily basis. The customer submits a yearly membership fee and then only pays for the time the car is used, ranging from $4.25 per hour or $51.00 per day during low-demand periods to $8.50 per hour or $70.00 per day during high demand periods. Timecar offers various plans that discount its services for higher frequency users of the program. Timecar has a dedicated site within the City of Norman, located at the northeast corner parking lot of Stubbeman Place, near Hoover Street and Maple.

WeCar is a car-sharing service promoted by the University of Oklahoma. The service is open to the public, but additional incentives are offered to OU faculty and staff. WeCar is located on 1335 Asp Avenue (Buchanan Hall - parking area). Like Timecar, WeCar offers a membership-based service, with hourly charges ranging from $8 per hour and $55 per day to $12 per hour and $65 per day. Special overnight rates are available as well.

Table B-15 summarizes the basic public transportation service characteristics for the service providers, which were detailed in the preceding sections.

Table B-15 – Existing Public Transportation Options							
Route	Weekday Service Hours (Alternate Schedule)	Weekday Headways (Alternate Schedule)	Saturday Service Hours	Saturday Headways	Number of Weekday Buses	2011-2012 Average Weekday Ridership	One-way Ticket Regular/ Reduced
Cleveland Area Rapid Transit - CART							
N10	7 am – 9 pm	60 minutes	10 am – 7 pm	60 minutes	14	287	$0.50 / $0.25
N11	7 am – 9 pm (7:30 am – 9 pm)	30 / 60 minutes (60 minutes)	10:30 am – 7 pm	60 minutes	27 (14)	513 (N11 & N12 combined)	$0.50 / $0.25
N12	7 am – 8:30 pm (7 am – 8:30 pm)	30 / 60 minutes (60 minutes)	10 am – 6:30 pm	60 minutes	25 (14)		$0.50 / $0.25
N20	7:15 am to 8:45 pm	30 minutes	10:15 am to	30 minutes	26	19	$0.50 / $0.25
N21	7 am – 9 pm	60 minutes	10 am – 7 pm	60 minutes	14	195	$0.50 / $0.25
N32	7 am – 9 pm	30 minutes	10 am – 7 pm	60 minutes	28	445	$0.50 / $0.25
N40	7 am – 9 pm [6 pm on Fridays] (7 am – 6 pm combined with N42)	5-10 /20 minutes (30 minutes)			n/a	1,468	$0.50 / $0.25
N42	7:24 am – 5:54 pm	30 minutes			21	82	$0.50 / $0.25
N44	12:05 pm – 3:55 pm [Tuesdays and Fridays only]	(1 roundtrip)			n/a	n/a	$0.50 / $0.25
N52	7 am – 4 pm (no service during alternate schedule periods)	30 minutes			18	134	$0.50 / $0.25

Table B-15 – Existing Public Transportation Options							
Route	Weekday Service Hours (Alternate Schedule)	Weekday Headways (Alternate Schedule)	Saturday Service Hours	Saturday Headways	Number of Weekday Buses	2011-2012 Average Weekday Ridership	One-way Ticket Regular/ Reduced
N24 (Sooner Express)	6:20 am – 10:05 am 1:50 pm – 6:10 pm	(2 am and 2 pm roundtrips)			8	103	$2.25
Late-Night Flex	9:05 pm – 11:05 pm (9:05 pm pick-up only)	30 minutes			5	n/a	$0.50 / $0.25
CARTaccess	7 am – 9 pm	n/a	10 am – 7 pm	n/a	n/a	112	By Zone: $1.00 or $2.50
Central Oklahoma Transportation and Parking Authority - COTPA							
Route24 (Sooner Express)	6:06 am – 8:05 am 4:25 pm – 6:20 pm	(1 am and 1 pm roundtrip)			4	62	$2.25 / $1.10
Greyhound							
To Dallas	6:50 am; 12:45, 4:30, 9:45 pm	(4 trips daily)	(as weekday service)				$16 to $66
Megabus							
To Dallas and Grand Prairie	4:45 am and 3:15 pm	(2 trips daily)	(as weekday service)				$12 to $21
To Springfield and St Louis	1:55 pm and 10:45 pm [The 10:45 pm bus continues to Chicago. See below.]	(2 trips daily)	(as weekday service)				$8 to $35
To Chicago	10:45 pm	(1 trip daily)	(as weekday service)				$154.00

Table B-15 – Existing Public Transportation Options							
Route	Weekday Service Hours (Alternate Schedule)	Weekday Headways (Alternate Schedule)	Saturday Service Hours	Saturday Headways	Number of Weekday Buses	2011-2012 Average Weekday Ridership	One-way Ticket Regular/ Reduced
Amtrak							
To Fort Worth	8:49 am – 9:04 pm	(1 roundtrip)	(as weekday service)				$25 to $36
Airport Express - Airport Shuttle Service							
To Will Rogers World Airport	24/7 On demand						$38 to $44
Taxi							
	24/7 On demand						
GetAroundOK - Carpool Matching Service							
	24/7 On demand						
Car Sharing Services							
	24/7 On demand						

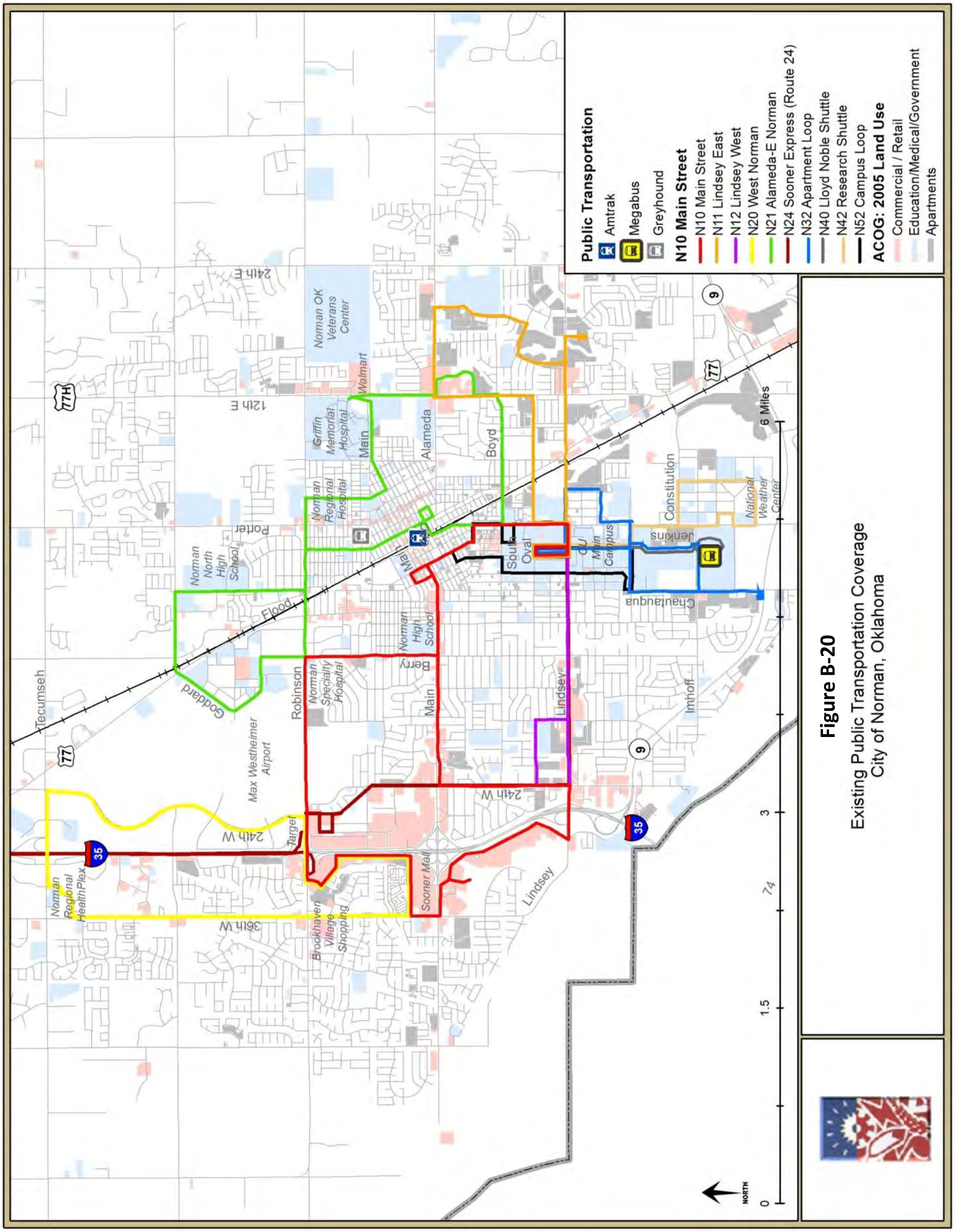


Figure B-20
Existing Public Transportation Coverage
City of Norman, Oklahoma

Maintenance of Infrastructure

The City of Norman annually spends over $2 Million in general operating funds for the maintenance of existing roadways in the city. This amount is often supplemented by funds from the sale of bonds, adding as much as an additional $2 Million to the funding available for transportation facilities maintenance.

Roadway Inventory & Conditions

The City conducts pavement conditions assessments, through a third party agreement, that covers the entire city over the course of a 5 year rotation, resulting in a Pavement Conditions Index (CPI) score for each roadway in the city that is tabulated annually. For the roadways not being assessed each year, the CPI program does artificial aging of the roadways so that the CPI reporting each year represents an approximation of the conditions of all roadways that year. The CPI scores for paved roadways range from a low of 10 to a high of 100, with a better PCI score generally indicating better pavement condition. A score of 70 or higher generally indicates a pavement with over 8 years of remaining life, and possibly needing seal coating or thin overlays as the PCI diminishes over time. The city has identified roadways with a PCI score of under 65 as roadways that should be targeted for improvement. The list of "under 65" roadways is prepared by staff each year and submitted to city management for programming of needed improvements. For the 2010 assessment (last completed CPI reporting), there were 88 roadway segments (of various lengths, widths and classifications) that had a CPI score of under 65, including 34 between 65 and 60, 37 between 60 and 50, 13 between 50 and 40, and 4 less than 40. A map of the Norman roadway CPI scores for 2010 is shown in **Figure B-21**.

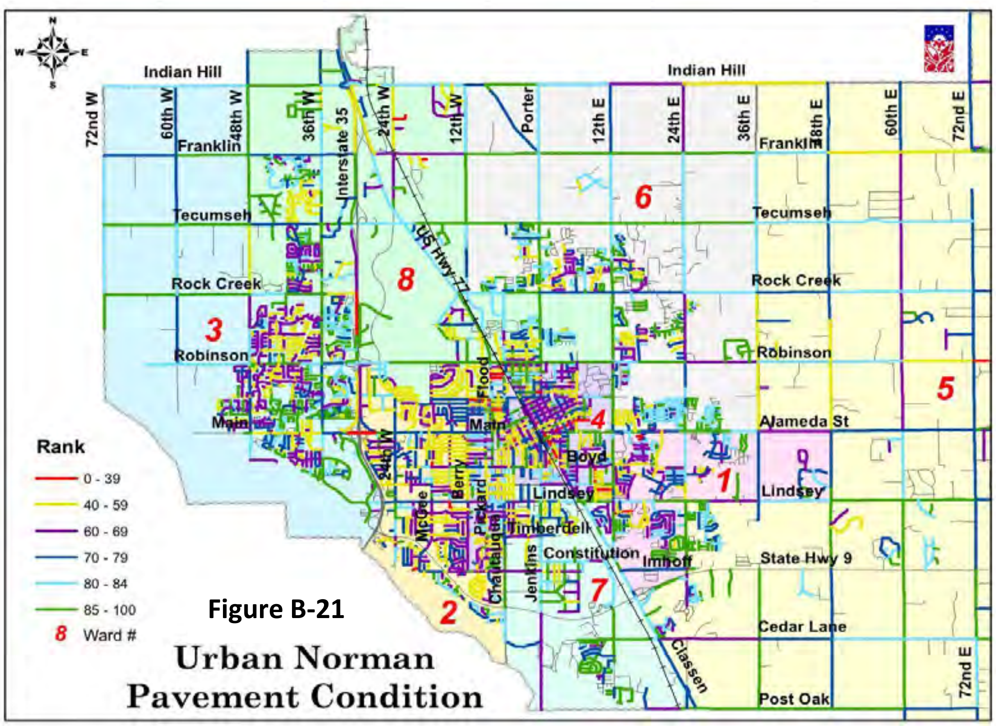


Figure B-21

Bridge Inventory and Conditions

Similarly, the city conducts a conditions inventory of all of its bridges and major culverts every two years. Structural conditions and load bearing capacity deteriorate over time due to aging, general wear and tear, insufficient cleaning or surface protection, subgrade settlement, embankment erosion, and scouring of bridge supports and slope pavement failure at waterways, damage due to collisions or vandalism, and even from repairs and overlays that add dead weight to the bridge. Design standards also change over time and various feature of a bridge may become operationally deficient, such as load ratings, lane widths, shoulders and rails. The usage needs at the bridge location may also change over time, rendering a bridge insufficient to accommodate current and anticipated traffic volumes, design speeds, sight lines, loading, and bicycle and pedestrian activity.

Bridges are considered to be on-system if they are on roadways maintained by the Oklahoma Department of Transportation, otherwise they are considered to be off-system and are the responsibility of the city or county in which they are located. The Bridge Repair Recommendations listing prepared by city of Norman staff in December 2011 included 24 bridges or major culverts that were in need of minor to major repair and are the responsibility of the City of Norman. These repairs range from roadway edge slope failures and deck cracking to the undermining of approach slabs and scouring and eroding of bridge piers. There is no dedicated City of Norman bridge maintenance budget so only urgent repairs are made, with funding drawn from available city budgets. Proper maintenance of the bridges would reduce the lifecycle costs of maintaining operations and safety of the city's bridges.

Committed Improvements

The City of Norman has numerous planned projects to improve transportation access, safety, and mobility. The ACOG *Encompass 2035 Plan* includes 17 committed projects for the Norman area (in addition to many other planned projects that have not yet received a committed funding stream). To assist with the development of these committed projects, the citizens of Norman recently approved the authorization of $42,575,000 in general obligation bonds to fund the local share of eight major transportation projects located throughout Norman (many of which overlap with those found in the ACOG plan). **Figure B-22** shows the location of the ACOG Encompass 2035 projects as well as the Norman Bond projects.

ACOG Encompass 2035 Projects

The ACOG projects can be divided into short range, medium range, and long range projects.

Short Range

The short range (S-R) projects are those committed to be developed by 2015, are part of a Capital Improvement Plan, and thus should be considered part of the existing plus committed infrastructure for baseline comparisons (many of these projects are on-going or completed already). These are City of Norman projects, except as noted, and include:

- **S-R #1 (on-going):** I-35, 1/2 mile either side of Main Street - widen from 4 lanes to 6 lanes (ODOT)
- **S-R #2 (future):** SH 9, from 24th Avenue E to 36th Avenue E - widen from 2 lanes to 4 lanes (ODOT)
- **S-R #3 (on-going):** Porter Avenue, from Tecumseh Road to Rock Creek Road - widen from 3 lanes to 4 lanes
- **S-R #4 (on-going):** 60th Avenue W, from Indian Hills Road to Tecumseh Road - widen from 2 lanes to 4 lanes
- **S-R #5 (complete):** Rock Creek Road, from 36th Avenue W to 24th Avenue W - widen from 2 lanes to 4 lanes
- **S-R #6 (complete):** Rock Creek Road, from Porter Avenue to 12th Avenue E - widen from 2 lanes to 4 lanes

- **S-R #7 (complete):** Lindsey Street, from Jenkins Avenue to Classen Boulevard - widen from 2 lanes to 4 lanes

Medium Range

The medium range (M-R) projects are those committed to be developed by 2025, and may or may not have funding committed to them. However, several of these projects have been identified by the city as being committed as significant projects that will be budgeted for implementation in the near future, and thus should also be considered part of the existing plus committed infrastructure for baseline comparisons in the medium range planning horizon. These are City of Norman projects, except as noted, and include:

- **M-R #1:** 24th Avenue E, from Robinson Street to Lindsey Street - widen from 2 lanes to 4 lanes, plus bike lanes and sidewalks
- **M-R #2:** I-35, Main Street Interchange - reconstruction (ODOT)
- **M-R #3:** I-35, Lindsey Street Interchange - reconstruction (ODOT)
- **M-R #4:** I-35, SH 9 Interchange - reconstruction (ODOT)
- **M-R #5:** Kelley Avenue, from Indian Hills Road to Tecumseh Road - widen from 2 lanes to 4 lanes, plus bike lanes and sidewalks
- **M-R #6:** SH 9, from 36th Avenue E to 72nd Avenue E - widen from 2 lanes to 4 lanes (ODOT)
- **M-R #7:** 12th Avenue E, from SH 9 to Cedar Lane Road - widen from 2 lanes to 4 lanes, plus on-street bike route and sidewalks
- **M-R #8:** Alameda Street, from Ridge Lake Boulevard to 36th Avenue E - widen from 2 lanes to 5 lanes, plus on-street bike route and sidewalks
- **M-R #9:** Cedar Lane Road, from 12th Avenue E to 24th Avenue E - widen from 2 lanes to 4 lanes

Long Range

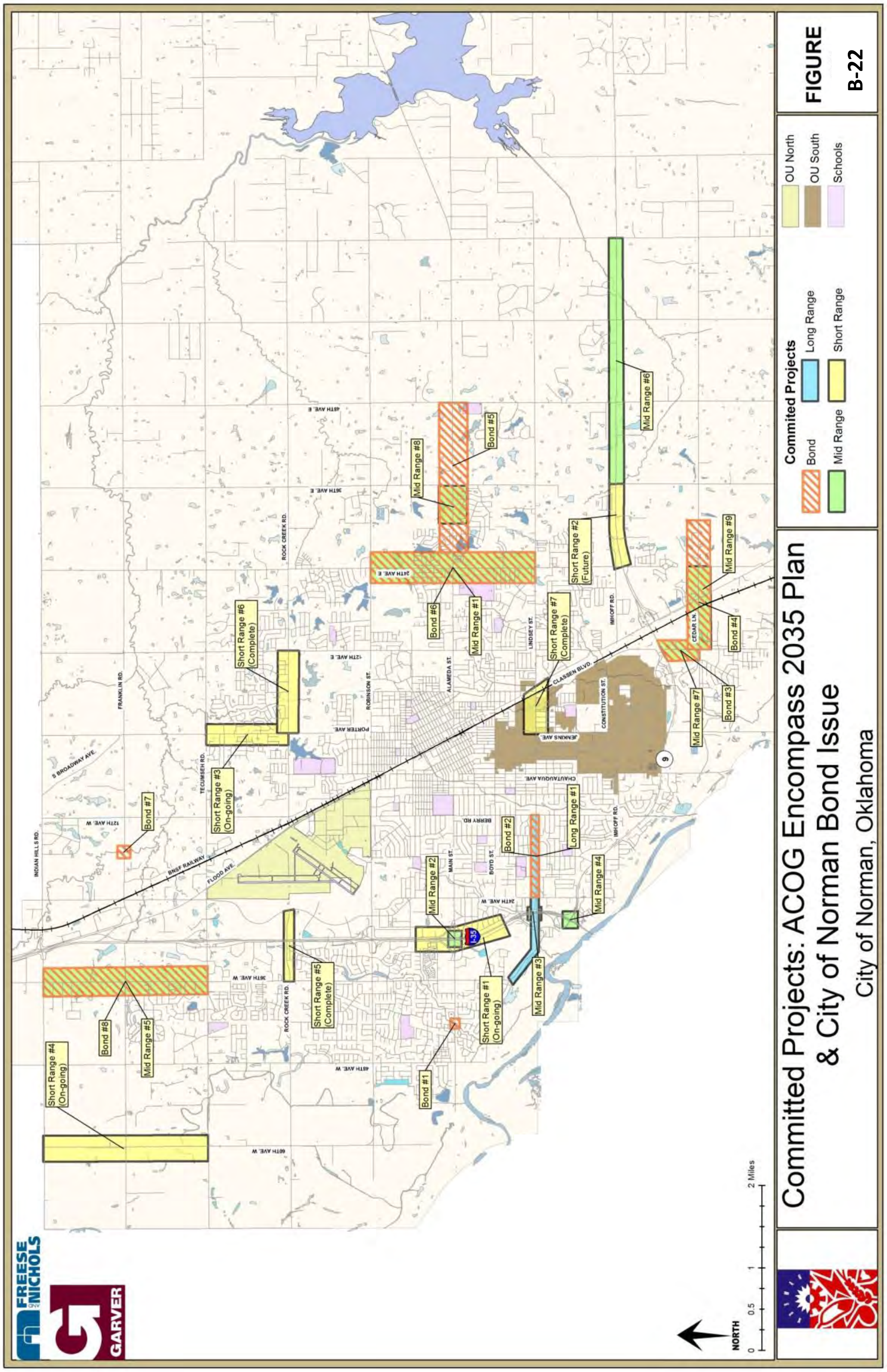
The long range (L-R) projects that are in the ACOG Encompass 2035 Plan are generally beyond current financial planning horizons (2026-2035). However, one project has been identified by the City as being committed for implementation:

- **L-R #1:** Lindsey Street, from 36th Avenue W to Berry Road - widen from 3 lanes to 5 lanes, plus on-street bike route and sidewalks

City of Norman 2012 Bond Projects

The 2012 Bond Program provides eight transportation projects through matching federal funds that could not be fully funded with traditional City resources. The proposed bond projects will provide the local match to gain federal transportation grant funds, levering up to 53% in federal funds for the eight projects. Of the bond projects listed below, only the bridge replacement projects were not listed above in the ACOG medium or long range projects.

- **Bond #1:** Main Street bridge over Brookhaven Creek - 4-lane bridge replacement, local drainage improvements, stabilize stream banks
- **Bond #2:** Lindsey Street, from 24th Avenue SW to Berry Road - widen road from 3 lanes to 5 lanes and major storm water improvements
- **Bond #3:** 12th Avenue SE, from Cedar Lane Road to SH 9 - widen road from 2 lanes to 4 lanes and improve traffic signal at SH 9
- **Bond #4:** Cedar Lane Road, from 12th Avenue to one-half mile east of 24th Ave SE - widen road from 2 lanes to 4 lanes, improved sidewalks and accessibility, new traffic signal at 12th Avenue SE



Committed Projects: ACOG Encompass 2035 Plan
& City of Norman Bond Issue
City of Norman, Oklahoma
FIGURE
B-22
Commited Projects
Bond
Long Range
Mid Range
Short Range
OU North
OU South
Schools
NORTH
0
0.5
1
2 Miles
FREESE NICHOLS
GARVER
Short Range #4 (On-going)
Bond #8
Mid Range #5
Short Range #5 (Complete)
Bond #1
Short Range #1 (On-going)
Mid Range #2
Mid Range #3
Mid Range #4
Bond #2
Long Range #1
Bond #7
Short Range #3 (On-going)
Short Range #6 (Complete)
Bond #6
Mid Range #1
Mid Range #8
Bond #5
Short Range #7 (Complete)
Short Range #2 (Future)
Mid Range #6
Mid Range #7
Bond #3
Bond #4
Mid Range #9

- **Bond #5:** Alameda Street, 24th Avenue E to 48th Avenue E - widen road from 2 lanes to 4 lanes to 36th Avenue E, widen shoulders to 48th Avenue E
- **Bond #6:** 24th Avenue SE, from Robinson Street to Lindsey Street - widen road from 2 lanes to 4 lanes and new traffic signal at Meadowood Boulevard
- **Bond #7:** Franklin Road bridge over Little River Tributary - 2-lane bridge replacement, pavement rehabilitation
- **Bond #8:** 36th Avenue NW, Tecumseh Road to Indian Hills Road - widen road from 2 lanes to 4 lanes and new traffic signals at Franklin Road and Indian Hills Road

Planned Programs and Initiatives

A number of Medium Range and Long Range roadway improvement projects for Norman were included in the ACOG Encompass 2035 Plan for the Central Oklahoma area, but do not have committed funding and have been identified by the City as potential improvements that can be considered along with other alternative improvement concepts during development of the CTP.

Medium Range

The medium range projects that have been identified by the City as being not committed for implementation include the following projects:

- **M-R #1:** 12th Avenue W, from Tecumseh Road to Rock Creek Road - widen from 2 lanes to 4 lanes, plus on-street bike route and sidewalks
- **M-R #2:** James Garner Avenue, from Main Street to Tonhawa Street - realign 2 lanes with on-street bike routes and sidewalks
- **M-R #3:** SH 9, from 24th Avenue W to 12th Avenue E - widen from 4 lanes to 6 lanes
- **M-R #4:** Porter Avenue, from Indian Hills Road to Tecumseh Road - widen from 2 lanes to 4 lanes, plus on-street bike route and sidewalks
- **M-R #5:** University Blvd, from Daws Street to Boyd Street -convert to one-way
- **M-R #6:** Webster Avenue/Asp Avenue, from Acres Street to Boyd Street - convert to one-way
- **M-R #7:** Franklin Road, from 60th Avenue W to I-35 - widen from 2 lanes to 4 lanes, plus on-street bike route and sidewalks
- **M-R #8:** Rock Creek Road, from Grand View Avenue to 36th Avenue W - widen from 2 lanes to 4 lanes
- **M-R #9:** Main Street, from I-35 to Flood Avenue - widen from 4 lanes to 5 lanes
- **M-R #10:** Lindsey Street, from 24th Avenue E to 36th Avenue E - widen from 2 lanes to 5 lanes, plus on-street bike route and sidewalks
- **M-R #11:** Imhoff Road, from Classen Blvd to 24th Avenue E - widen from 3 lanes to 4 lanes, plus on-street bike route and sidewalks

Long Range

The long range (2026-2035) projects that are in the ACOG Encompass 2035 Plan are beyond current financial planning. These have been confirmed by the City as not yet committed for implementation and include the following projects:

- **L-R #1:** Broadway Avenue, from Indian Hills Road to Franklin Road - widen from 2 lanes to 4 lanes

- **L-R #2:** Berry Road, from Robinson Street to Imhoff Road - widen from 2 lanes to 4 lanes, plus on-street bike route and sidewalks
- **L-R #3:** Classen Blvd, from Lindsey Street to 12th Avenue E -widen from 3 lanes to 4 lanes, plus on-street bike route and sidewalks
- **L-R #4:** 48th Avenue E, from Franklin Road to SH 9 - widen from 3 lanes to 4 lanes, plus on-street bike route and sidewalks
- **L-R #5:** Flood Avenue, from Robinson Street to Main Street - widen from 2 lanes to 4 lanes, plus on-street bike route and sidewalks
- **L-R #6:** James Garner Avenue, from Flood Avenue to Robinson Street - widen from 2 lanes to 4 lanes, plus on-street bike route and sidewalks
- **L-R #7:** James Garner Avenue, Robinson Street to Acres Street – new roadway
- **L-R #8:** Jenkins Avenue, from Lindsey Street to Constitution Avenue - widen from 2 lanes to 4 lanes, plus on-street bike route and sidewalks
- **L-R #9:** 48th Avenue W, from Indian Hills road to Robinson Street - widen from 2 lanes to 4 lanes, plus on-street bike route and sidewalks
- **L-R #10:** SH 9, from 72nd Avenue E to 168th Avenue E - widen from 2 lanes to 4 lanes
- **L-R #11:** SH 77, from Indian Hills Road to Classen Blvd - widen from 4 lanes to 6 lanes
- **L-R #12:** Porter Avenue, from Robinson Street to Alameda Street - widen from 4 lanes to 5 lanes, plus on-street bike route and sidewalks
- **L-R #13:** Indian Hills Road, from 48th Avenue W to I-35 - widen from 2 lanes to 4 lanes, plus on-street bike route and sidewalks
- **L-R #14:** Lindsey Street, from Berry Road to Jenkins Avenue - widen from 2 lanes to 4 lanes
- **L-R #15:** Imhoff Road, from SH 9 to Chautauqua Avenue - widen from 2 lanes to 4 lanes, plus on-street bike route and sidewalks
- **L-R #16:** SH 9, from 168th Avenue E to Pottawatomie Road - widen from 2 lanes to 4 lanes

Appendix C: Travel Demand Modeling for the Norman CTP

Overview

The City of Norman is developing a Comprehensive Transportation Plan to provide the framework for the planning and implementation of an efficient and comprehensive multi-modal transportation system within Norman, as shown in Figure 1 below. The Comprehensive Transportation Plan (CTP) will assess and address transportation deficiencies and needs, recommend a prioritized list of capital improvements, and identify policies and programs to assist in the implementation of needed projects. To help with the identification of roadway deficiencies and the assessment of proposed improvements, one of Alliance's tasks was to refine and apply the Oklahoma City Area Regional Transportation Study (OCARTS) travel demand model. The resulting Norman subarea model network was used to forecast year 2035 traffic demand, pinpoint anticipated system deficiencies, and quantify the mobility benefits of proposed roadway improvement scenarios.

The memorandum describes the steps taken to determine the validity of the model, ensure model forecasts are reasonable, and confirm the model could be utilized as a useful planning tool. The memorandum also serves as documentation for coding error corrections and all build-scenario related network improvements.

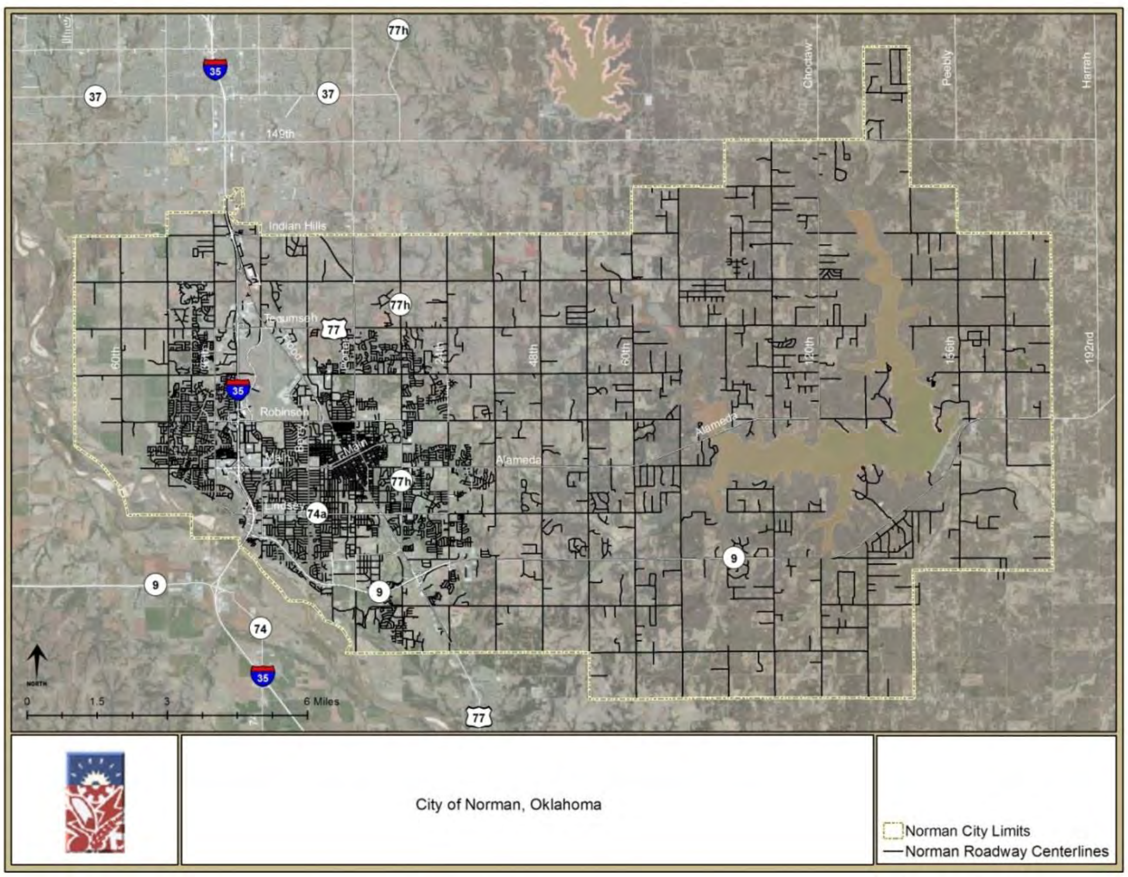


Figure 1: Map of City of Norman - Study Area

Model Setup

In order for a travel demand model forecast to be judged as plausible, the model must be able to produce reasonable traffic volumes. The processes and techniques used to determine the reasonableness of traffic volumes for a model's base year are termed model calibration and validation. They are data heavy processes, and the quality of the traffic counts used in the calibration and validation steps largely influence the validity of and confidence in the modeled volumes. However, since the Norman-specific subarea model was based on an already calibrated and validated regional travel demand model, the validation process for the Norman CTP project was limited in scope.

Source Materials

The City of Norman is located within the Oklahoma City metropolitan area, where the Association of Central Oklahoma Governments (ACOG) is the agency responsible for the planning and programming of regionally significant and federally funded transportation improvements. As the Metropolitan Planning Organization (MPO) for the region, ACOG had developed and utilized a travel demand model that encompasses portions of four central Oklahoma counties - Canadian, Grady, Logan, and McClain, all of Oklahoma County, as well as the full extent of Cleveland County, where the City of Norman is located.

Travel Demand Model Structure

A travel demand model forecasts traffic volumes based upon the relationship between socioeconomic characteristics, including population, (demand) and the transportation system (supply). The same general four steps are found in most travel demand models developed for an urban area: Trip Generation, Trip Distribution, Mode Share, and Multi-Modal Traffic Assignment, which can have a feedback loop for trip distribution through assignment.

Trip Generation

Trip Generation is the first of the four primary steps in the travel demand model process. By definition, a person trip is a person traveling from one place to another for a defined purpose. Consequently, trip generation is closely related to both the characteristics of a place and a person. Socioeconomic attributes of each traffic analysis zone (TAZ), including the population and employment counts, are utilized by the Trip Generation model to determine the number of trips produced by and attracted to each TAZ. The result of the Trip Generation step is a set of trip productions and trip attractions for each TAZ by trip purpose. These productions and attractions are used to populate a seed matrix that is passed to the trip distribution step.

Trip Distribution

Trip Distribution is the second step of the traditional four step model, which identifies the production zone and attraction zone of a trip generated in the Trip Generation Model based on the trip length frequency distribution.

The ACOG TDM applies the trip length frequency distribution through the use of a traditional Gravity Model that distributes trips according to characteristics of land use and the transportation system in the study area. Trip distribution is expressed as the number of trips traveling between any zone pair as a function of the magnitude of the total productions and attractions in the two zones and the travel impedance between them, which included a generalized cost component that applied a composite impedance based on travel time, travel cost, and other factors. The roadway network attributes describe the transportation system characteristics used to measure travel impedance (e.g. distance, travel time, etc.). The model can be mathematically stated as:

$$T_{ij} = P_i \times \frac{A_j \times F_{ij}}{\sum_k A_k \times F_{ik}}$$

Where:

- T_{ij} = forecast flow produced by zone i and attracted to zone j
- P_i = the forecast number of trips produced by zone i
- A_j = the forecast number of trips attracted to zone j
- F_{ik} = friction factor between zone i and zone k (F-Factors)

Travel time is used as the measurement of separation between zones for the purposes of applying the Gravity Model, with trip lengths measured in minutes.

Mode Share

Mode Share is the third step in the travel demand modeling process. Mode Share (sometimes also called Mode Choice) models are used to separate the various person trips identified in the trip distribution step into different modes based upon fixed proportions derived from available survey data, which identified nine different modes (Drive Alone, Shared Ride with 2 people, Shared Ride with 3+ people, Walk to Local Bus, Walk to Premium Bus, Walk to Street Car, Drive to Local Bus, Drive to Premium Bus, and Drive to Street Car). The Mode Choice estimation in the ACOG model was based on the specifically designed household travel and onboard transit surveys that collected information on household income, number of vehicles, and number of persons with driver's licenses. For the transit mode, origin-and-destination information, in-vehicle transit time, access time, wait time, transfer time, and different transit fares were also taken into account. The final Mode Share estimation was further broken out by trip purpose.

Assignment

The Assignment of traffic to the highway network is the final step in the traditional modeling process. It estimates the flow of traffic on a network. The roadway assignment methodology employed by the ACOG TDM is an Equilibrium Assignment model. The procedure incorporates the use of a generalized cost function to address composite time and economic factors, such as the treatment of toll facilities. The transit assignment procedure estimates transit ridership for all available transit routes and was calibrated against known passenger-mile statistics, boarding, alighting, and transfer activities.

The ACOG TDM includes six passenger trip purposes and two commercial vehicle and freight truck trip purposes. The passenger trip purposes are stratified by four household sizes and five income groups. These stratifications result in multiple separate matrices to be assigned in the traffic assignment step.

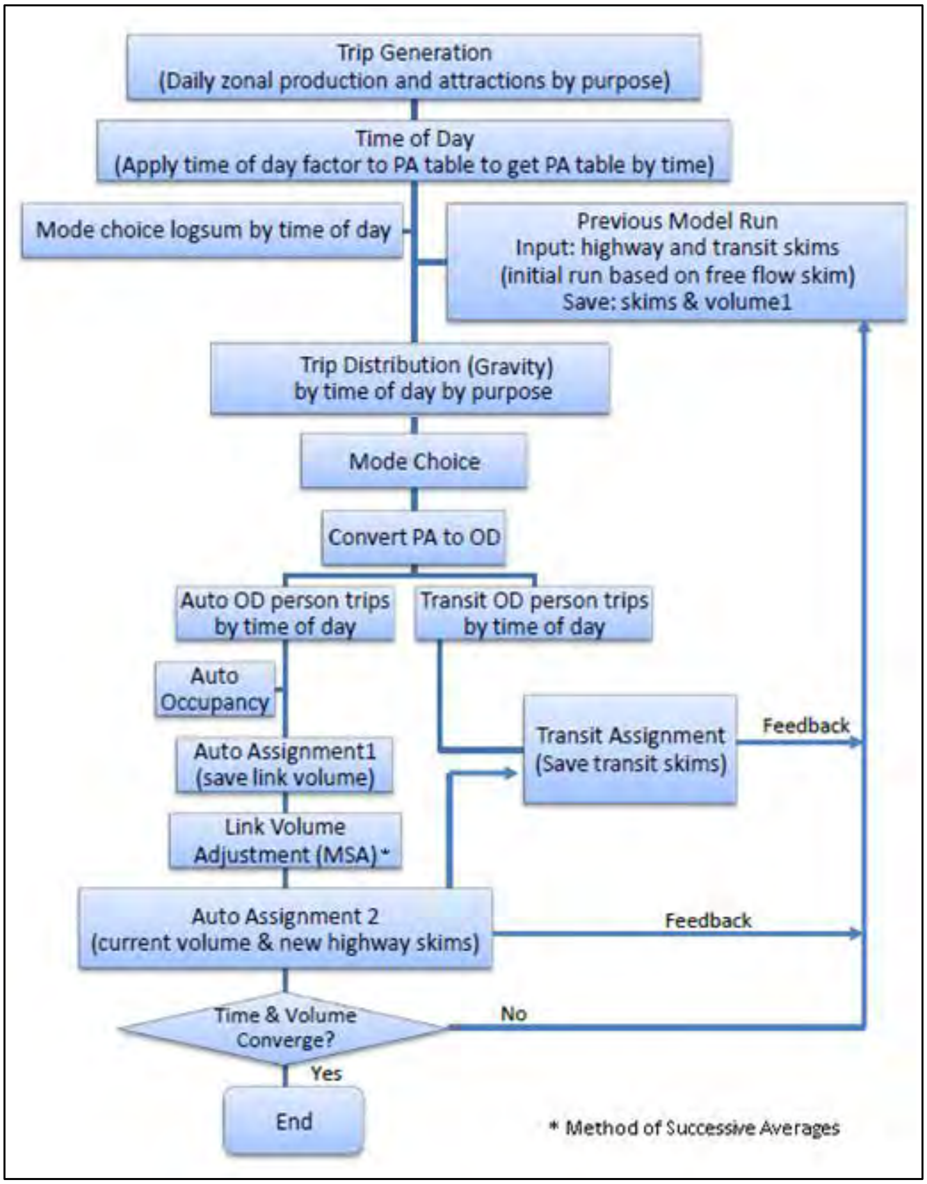
Feedback Loop – The ACOG model contains a feedback loop from traffic assignment to trip distribution. The purpose of a feedback loop is to take congested travel times from the assignment process and supply them for the next iteration of trip distribution to better replicate actual travel conditions for each time period analyzed in the model, which increases the speed and reliability of traffic assignment. During each iteration, a comparison of assigned traffic volumes to previous iterations is performed using the Method of Successive Averages (MSA). The feedback loop will iterate until the convergence criterion is met.

Time of Day

Urban area models commonly produce trips by time of day to increase accuracy. Typical time of day stratifications include either two time periods (a peak and an off-peak period) or four time periods, as used in the ACOG model, where trip distribution was separated into the following four time-of-day periods:

AM – Morning Peak – 7 to 9 a.m.
MD – Midday Off-Peak – 9 a.m. to 3 p.m.
PM – Evening Peak – 3 to 6:30 p.m.
NT – Nighttime Off-Peak – 6:30 p.m. to 7 a.m.

To summarize the overview of the model design, **Error! Reference source not found.** depicts the model flow chart, which shows how passenger trips go through trip generation, distribution, mode choice, and subsequent assignment. The feedback loop from assignment back to trip distribution is also depicted.



PA = Production/Attraction; OD = Origin/Destination

Model Data

The two basic model data building blocks of any travel demand model are the transportation system networks and the socioeconomic data by traffic analysis zones (TAZ).

- The networks represent the multimodal transportation system, and account for different categories of roads (such as freeways, arterials, collectors, ramps, etc.), along with their respective information on facility speed, capacity, travel time from zone to zone, and user cost expressed as tolls or operating cost.
- The TAZs are the geographical areas that link socioeconomic data and land uses with the transportation system. The demographic characteristics of the TAZs are tied to the transportation system using zonal centroids and their associated centroid connectors.

The network and zonal densities should be consistent in order to produce realistic loading of traffic onto the model network. (For additional information regarding the review of the TAZ structure and the base year model network, please refer to the copy of the initial Technical memorandum on the subject, placed at the end of this appendix.)

Networks

The ACOG model did not use a multiyear network for the analysis of travel demand in the Central Oklahoma area; instead, the MPO developed a 2005 base and several 2035 horizon year alternate transportation networks to assist with the forecasting of various transportation scenarios. ACOG's 2005 base year network was provided and subsequently tested in Alliance's dedicated travel demand model lab to ensure that the model processes performed as expected. (Validation information is listed in the following subchapter.) ACOG's Alternate 4, also called 'Encompass 2035' network, is the approved long-range transportation scenario, which was used as a benchmark for comparison with the anticipated Norman-specific model runs.

Alternate 2, ACOG's 'Updated Existing-Plus-Committed (E+C)' network was chosen as the base for City of Norman-specific build scenarios for the 2035 forecast year. Alternate 2 included all regional projects either built, under construction, or with committed funding by September 2010, which provided the ideal starting point for the development of an up-to-date E + C model network for the City of Norman, containing all projects either built, under construction, or with funding committed by April 2013.

Socioeconomic Data

Apart from the roadway and transit networks included in the regional model, another key input to travel demand modeling is socioeconomic data, which for the Norman CTP included 2005 estimates and 2035 projections for population, household, school enrollment, and employment data by traffic analysis zone. Employment estimates and projections were divided into retail and non-retail categories to better capture trip patterns associated with different employment sites. This socioeconomic information was provided by traffic analysis zone, which serves as the primary geographic layer. The ACOG model works with a total of 2450 TAZs, of which 230 are used to describe the City of Norman demographics.

The ACOG-provided socioeconomic 2035 forecast data was analyzed for reasonableness and compared to additional information obtained from the City of Norman. A workshop, which was attended by staff from the consultant team, ACOG, and the City, the Norman, was conducted early in the project in order to evaluate the socioeconomic input data. Future land use was determined to have been adequately represented in the projected ACOG socio-economic data, with the exception of the University North Park development. Specifically, the forecasted employment growth of the University North Park development prompted further analysis, and ultimately resulted in an adjustment of underlying employment and population data for TAZ 2154. (For details, please refer to the description of the development of the “Enhanced E+C” network contained in a later section of this report.)

Model Calibration and Validation

The ability of the travel demand model to forecast future year traffic and other travel behaviors is based on their ability to estimate “known” traffic volumes and travel patterns under base year conditions for which extensive data is available. There are two components to the process of matching model results to the observed base year travel data - calibration and validation.

Calibration

During the model calibration, parameter values are adjusted until the predicted travel matches the observed travel within the region for the base year. Parameters usually addressed during calibration are as follows:

- Trip attraction function, which matches trip attractors, i.e. retail and non-retail establishments, households, or schools with their appropriate number of trips by purpose using the socioeconomic variables as parameters and calibrating coefficients from the household travel survey; the trip attractions are also balanced to the trip productions for each trip purpose;
- Trip distribution, utilizes a gravity-based distribution methodology, which matches trip purpose distribution and modeled trip length to observed trips; and
- Volume delay function, which accounts for roadway and intersection delays by facility class and area type (i.e. CBD, urban, suburban, and rural), taking into account available roadway capacity and intersection control, to best simulate traffic assignments on the model network.

Alliance Transportation Group (Alliance) was instrumental in the original calibration and validation of the base-year network when the regional travel demand model was developed. At that time, Alliance used specifically designed and collected household travel surveys, onboard transit surveys, and regionally collected traffic counts to ensure that the highway and transit assignments were within acceptable ranges of reasonableness in comparison to observed traffic and ridership.

In the absence of TAZ changes or significantly different count volumes, coupled with the fact that no household travel or onboard transit surveys had been conducted since the initial model development in 2010, the ACOG model was determined to still be calibrated. Therefore, a recalibration of the model was not undertaken as part of the Norman Comprehensive Transportation Plan.

Validation

Following the model calibration, model validation is undertaken to further ensure the forecasting ability of a regional travel demand model. The Federal Highway Administration (FHWA) advises that the results of the travel assignment portion of a travel demand model should “tell a coherent story” about how the network behaves. Two methods essential to validating the model and ensuring that the travel assignments are ‘coherent’ are reasonableness checking and sensitivity testing.

Validation generally refers to the process of using a calibrated model to estimate travel assignments for the base year and comparing these travel assignments to observed travel data. The typical comparison, when sufficient data is available, is between roadway traffic assignments and actual traffic volumes derived from traffic count data. Extensive traffic counts must be available to validate a model. Validation of the model to counted traffic flows is important to the model effort for two reasons: First, it shows whether the calibration tools used in the model process and the assumptions made were reasonable; and second, the validation shows what level of confidence the user can have in the forecast results.

Reasonableness Checking

While not standard, the Federal Highway Administration (FHWA) and many states have developed targets that can be used to help determine the validity of a travel demand model. Validation measure can be tested against facility type (functional classification), area type, volume ranges, and screen lines. For example, Table 1 shows the percentage target for daily traffic volumes by functionally classified roadway type.

▶ Table 1: Percent Difference Target for Daily Traffic Volumes by Functional Class

Functional Class	FHWA Recommendation
Freeways/Expressways	±7%
Principal Arterials	±10%
Minor Arterials	±15%
Collectors	±25%

Table 2 below shows how well the ACOG model replicates 2005 base year count data by functional classification of the roadway, as analyzed with the following equation.[1]

$$Percent\ of\ Count = \frac{\sum_{j=1}^{n} Modeled_j}{\sum_{j=1}^{n} Counted_j}$$

▶ Table 2: Difference between Observed Counts and Modeled Volumes by Functional Class

Functional Class	Observed Links	Average Observed Count	Aggregate Observed Counts	Average Modeled Volume	Aggregate Modeled Volumes	Difference	FHWA
Freeways/Expressways	188	40,419	7,598,717	41,282	7,761,066	2.14%	±7%
Principal Arterials	1,834	9,420	17,276,460	9,712	17,810,909	3.09%	±10%
Minor Arterials	4,054	4,364	17,691,588	4,302	17,440,427	-1.42%	±15%
Collectors	1,181	2,567	3,031,708	2,722	3,214,715	6.04%	±25%
Total			45,598,473		46,227,117	1.38%	

Source: 2005 Base Year model run results

[1] *j* represents the individual network link with count, *n* is the total number of links with counts in the network for the specific categories.

Travel Demand Modeling

As mentioned earlier, the targets listed in the table above provide guidance to evaluate the travel demand model. Reviewing the ACOG Base Year model run results, the percent errors for all facility types are within the target ranges, and observed count values and modeled traffic volumes correlate well, which is indicative of the reasonable and reliable traffic forecasting ability of the ACOG model.

Sensitivity Testing

Sensitivity testing refers to using alternative demographic or network data input in order to yield information about the overall behavior of the model. Sensitivity testing is not used to determine whether the model is correct, but rather to assess whether the response from the model in the form of scenario outputs are reasonable based on the inputs provided to the model before further forecasting activities are undertaken. When the model was first developed, Alliance subjected the base year model network to sensitivity testing to ascertain whether or not it would perform as expected when the 2035 forecast year socio-demographic data set was used.

To demonstrate the validated forecasting ability of the travel demand model, staff installed the model components into Alliance's dedicated travel demand model lab and initiated activities related to interpretation and analysis of the provided 2005 and 2035 model alternatives. For that purpose, Alliance tested the assignment procedure for complete functionality of the networks and volume-delay-function components. In particular, Alliance analyzed the Alternative 4 ('Encompass 2035') and Alternate 2 (ACOG's 'Updated E+C') future year scenarios, and prepared several preliminary maps for preliminary review. These maps depicted transportation system characteristics and capacity deficiencies for both alternatives for direct comparison, before beginning with the customization and refinement of the Norman subarea-specific network for the CTP. Figure 2 through Figure 5 on the following pages show the peak-period volume-to-capacity (V/C) ratios for both alternatives.

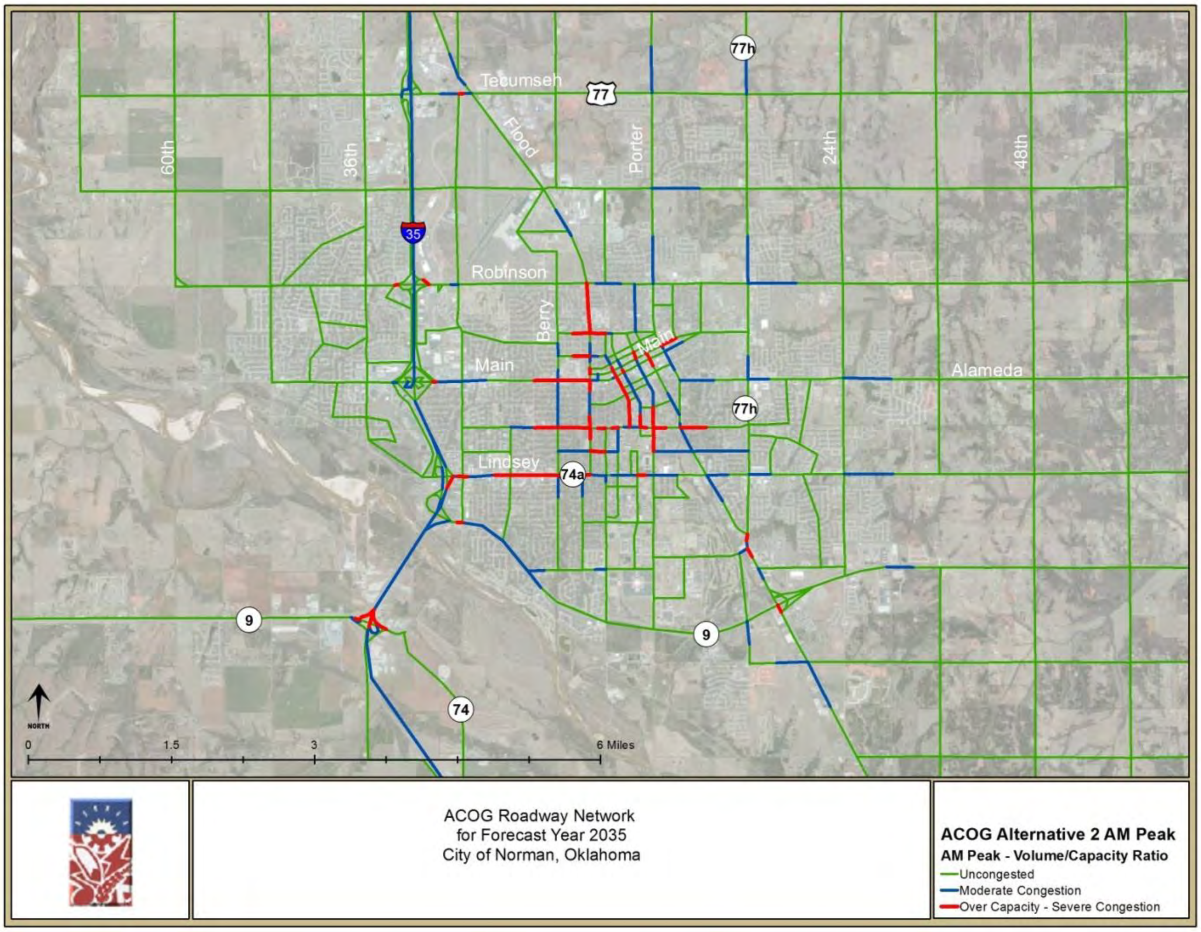
Alliance staff also compared Encompass 2035 model run results that were produced for sensitivity testing to those received from ACOG, in order to determine that the model performed as originally employed by ACOG, as sometimes differences in model results are introduced by the use of a different travel demand model computer set-up. However, no significant differences were found, which again confirmed that the model performed as desired.[2]

As shown in Figure 6 and Figure 7, Alliance staff also prepared 2005 (Base Year) and 2035 (Alternative 4) starburst diagrams, which show overall trips to and from the Norman subarea to all other parts within the Central Oklahoma region. These diagrams were used to help stakeholders better understand regional travel patterns.

---

[2] Please note: The Alliance-run Encompass 2035 model results were shared with City of Norman staff familiar with the ACOG model. The V/C ratios were depicted separately for the morning and evening peak period, as opposed to showing the post-processed 24-hour V/C ratios that ACOG generally shared with its member entities. This difference in graphic output prompted discussion of the 2035 run results, as well as the ACOG-applied post-processing calculations. These different graphical representations are in no way indicative of differences in the traffic assignment results between the ACOG and Alliance model results. It was determined that using the morning and evening peak-period V/C ratios (instead of 24-hour V/C ratios) would be more helpful in identifying specific roadway deficiencies and improvement needs.

Figure 2: ACOG Alternative 2 – AM Peak Congestion Levels



Downtown Inset:

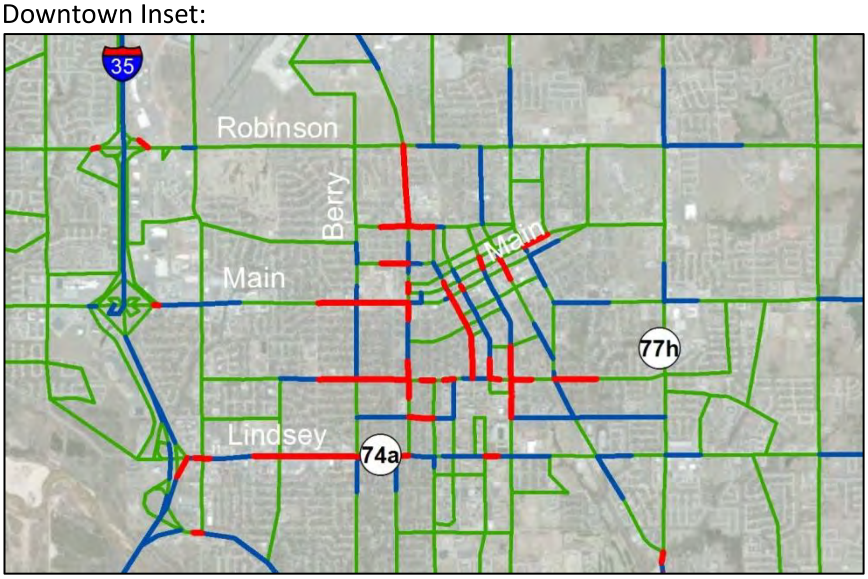
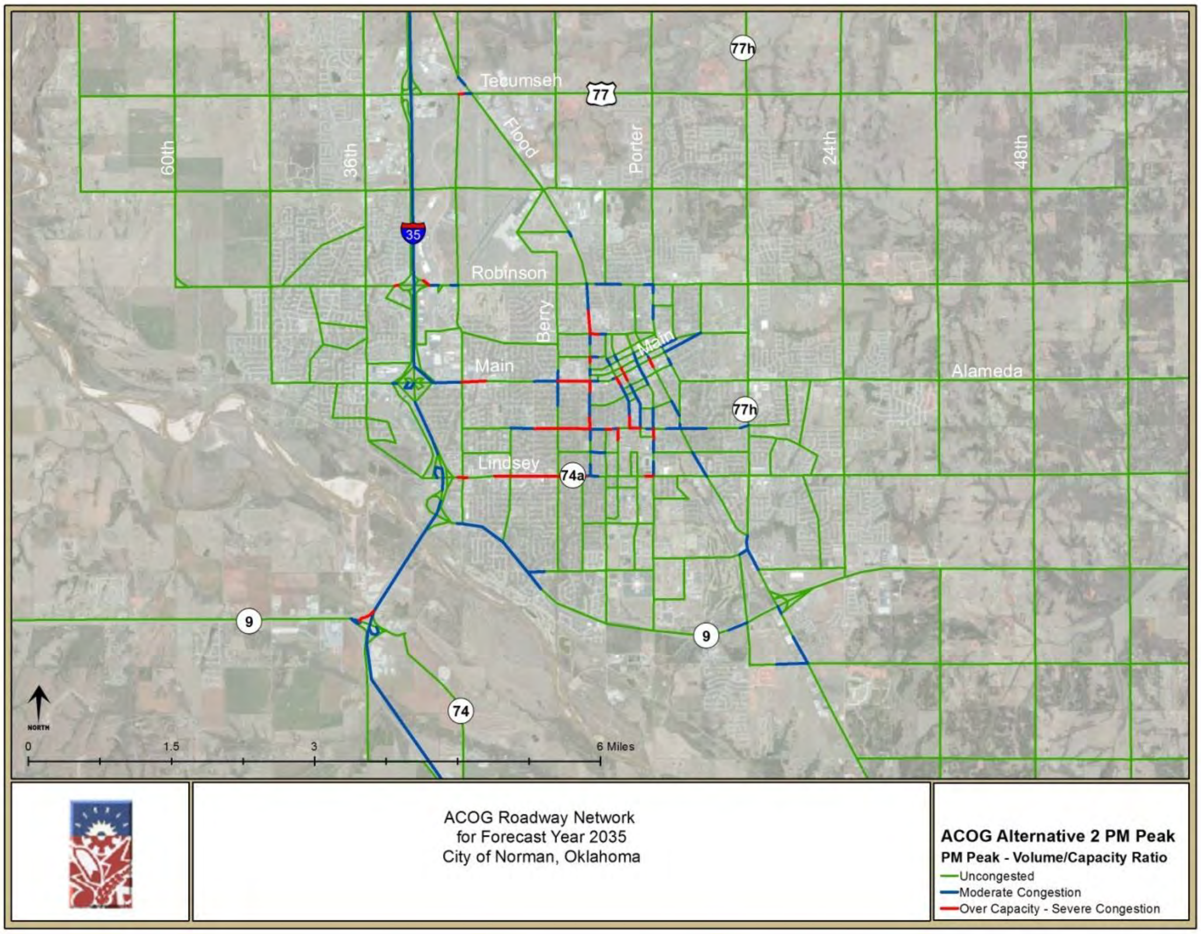
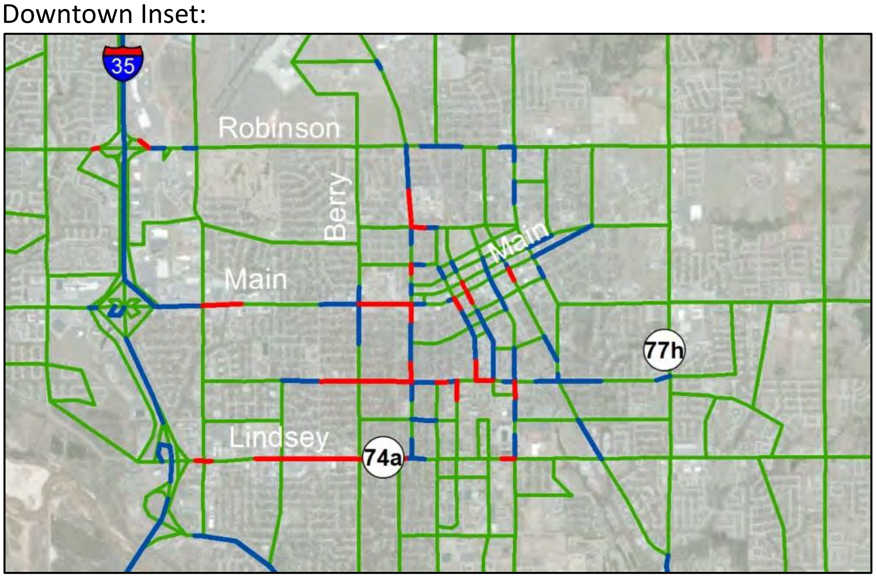


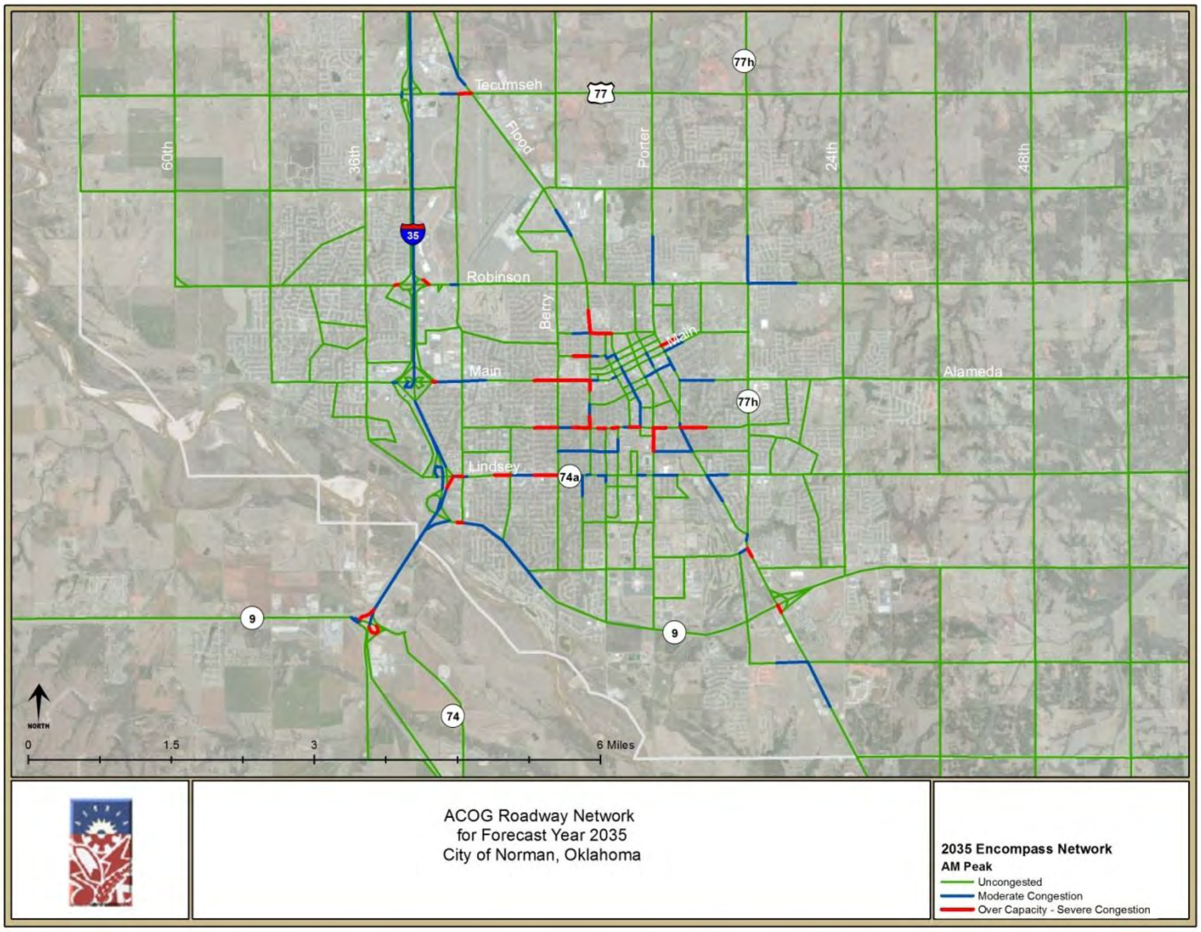
Figure 3: ACOG Alternative 2 – PM Peak Congestion Levels



Downtown Inset:



▶ Figure 4: ACOG Encompass 2035 – AM Peak Congestion Levels



Downtown Inset:

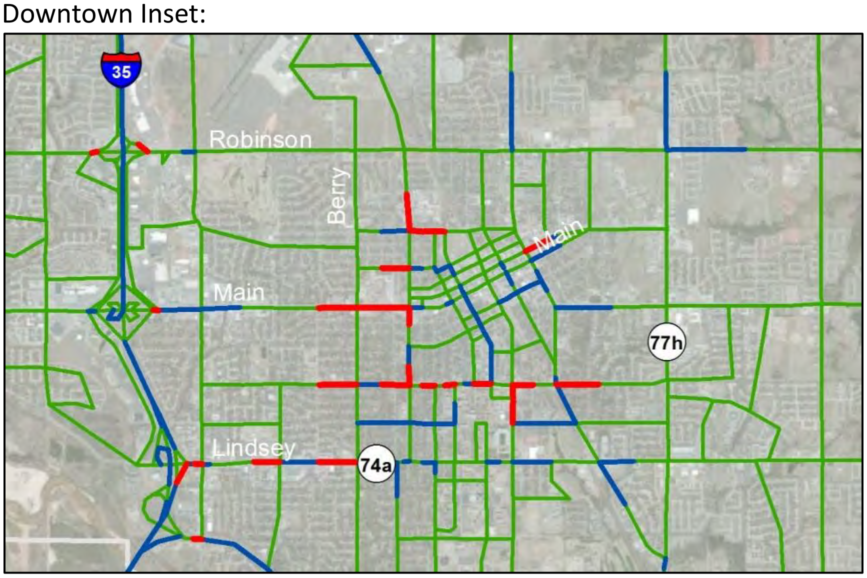
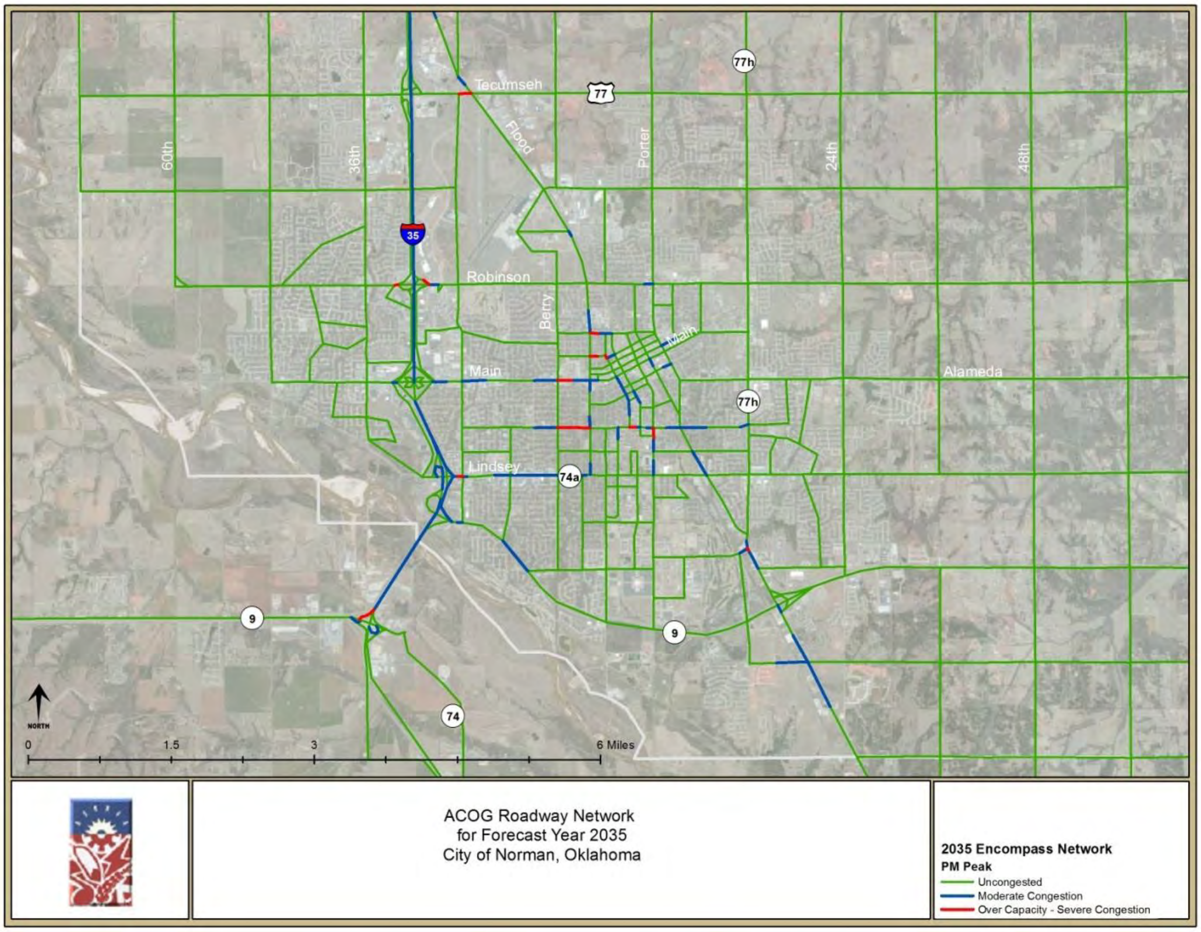


Figure 5: ACOG Encompass 2035 – PM Peak Congestion Levels



Downtown Inset:

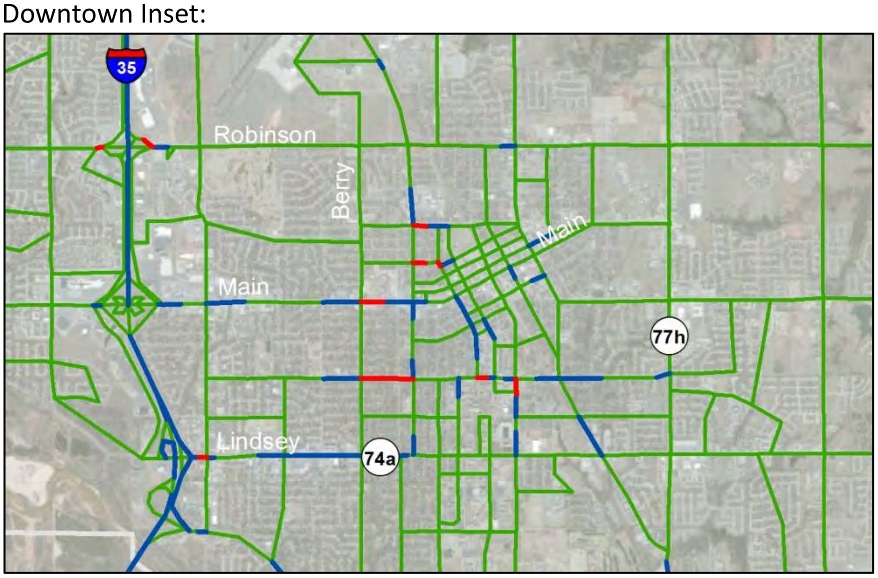
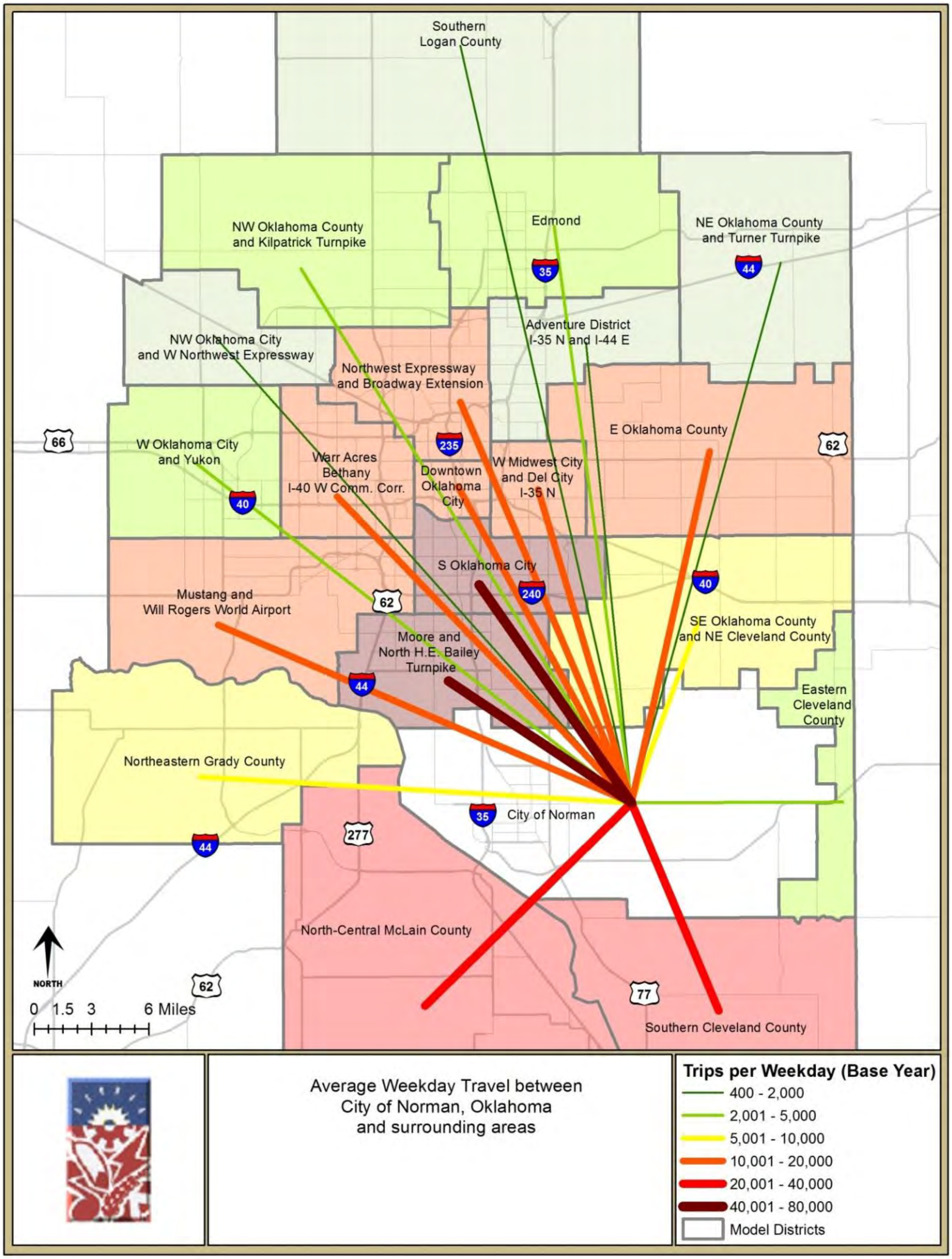
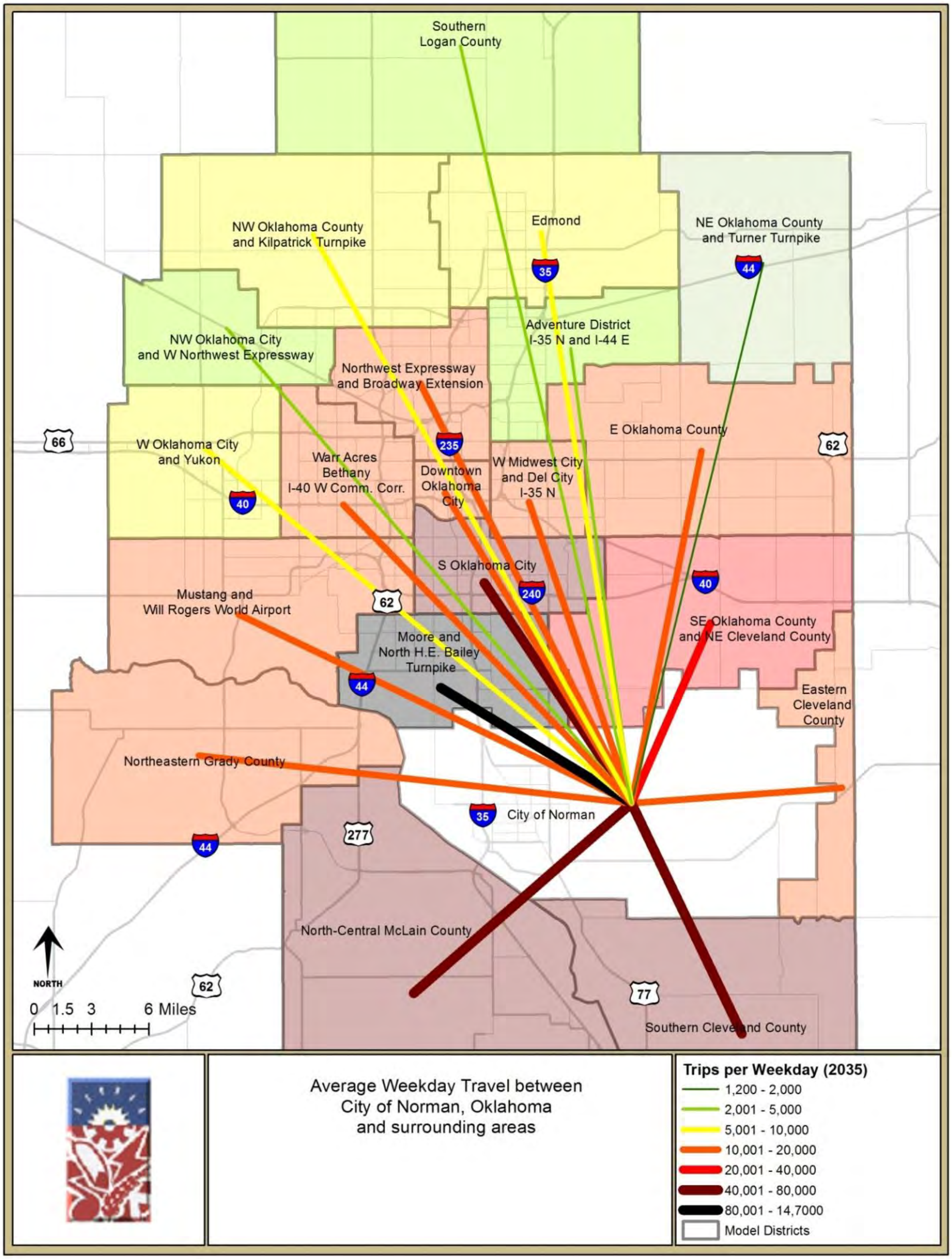


Figure 6: 2005 Regional Travel Patterns to and from the City of Norman



► Figure 7: 2035 Regional Travel Patterns to and from the City of Norman



Network Refinements

As discussed in the Validation Section, the ACOG-supplied 2035 model network was deemed to produce a reasonable travel forecast, and the actual network refinement to capture City of Norman-specific projects began.

During a travel demand model update, it is often necessary to update the model network to include changes that may have occurred after the model was originally developed. Modifications to transportation infrastructure are made necessary by the recent addition or removal of projects as outlined in the regional Transportation Improvement Program (TIP), addition of projects receiving bond funding, or completion of transportation infrastructure previously in progress. Additional updates might be necessitated when coding errors are found upon close examination of the network for a particular subarea.

The model used in this effort was originally developed by ACOG in 2010, as part of the development of the OCARTS area long-range transportation plan 'Encompass 2035'. The specific alternative chosen as the starting point for network updates was ACOG's Alternate 2 ('Updated E+C'), which included all regional projects that had either been built, were under construction, or had committed funding in September 2010.

The following subsections describe error correction and project specific model refinements, which were made in order to first provide the most realistic and up-to-date E+C network for the Norman subarea model, which was then used as the basis for the analysis of the future travel patterns within the City of Norman.

Network Errors

An 'error' modification occurs whenever it is necessary to correct mis-coded links. During the research of recently completed projects, and those which would be built in the near-term, several errors were discovered in the ACOG network. Table 3 displays a list of the required network modifications.

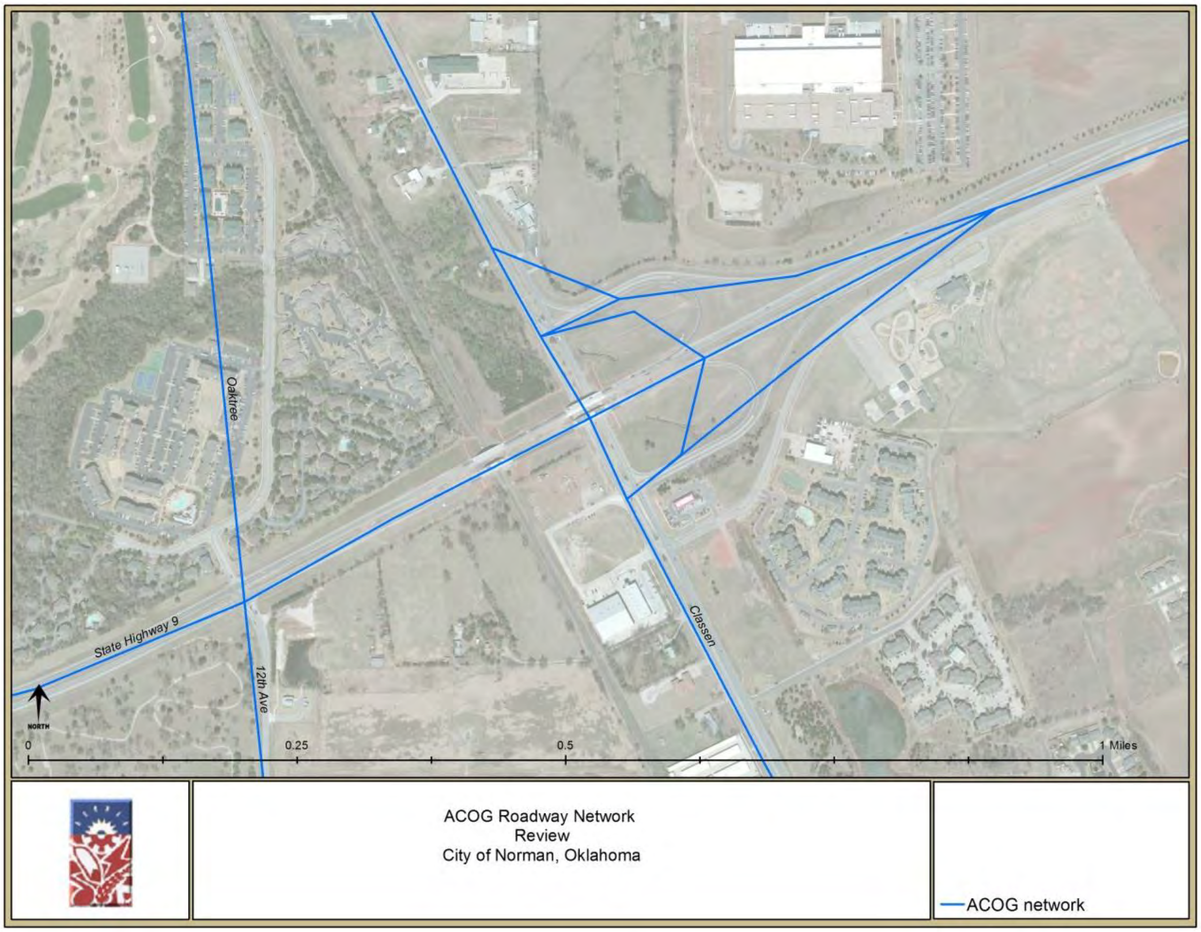
► Table 3: Corrected Network Errors

Street	From	To	Shown as	Corrected to	Changed in	Reason
12th Ave SE	E Alameda St.	E Boyd St	4	5	Enhanced	Existing configuration
36TH Ave SW	Shadowridge Dr	Ed Noble Pkwy	5	4	Enhanced	Existing configuration; no project pending
E Alameda St	Classen Blvd	Ridge Lake Blvd	4	5	Enhanced	Existing configuration
Chautauqua Ave	W Timberdell Rd	W Imhoff Rd	4	3	Enhanced	Existing configuration; no project pending
Chautauqua Ave	W Imhoff Rd	SH 9	2	4	Enhanced	Existing configuration
Classen Blvd	SH 9	Ash St (Noble)	4	5	Enhanced	Existing configuration
Imhoff Rd	Classen Blvd	1,400 ft east of Classen	3	4	Enhanced	Existing configuration

Street	From	To	Shown as	Corrected to	Changed in	Reason
		Blvd				
Lindsey St	Oakhurst Ave	24th Ave E	4	5	Build	Existing configuration
W Main St	24th Ave W	S University Blvd	4	5	Enhanced	Existing configuration
W Robinson St	Interstate Dr	24th Ave W	4	6	Enhanced	Existing configuration
W Robinson St	Crossroads Blvd	Interstate Dr	2	4	Enhanced	Existing configuration
	60th Ave NW	48th Ave NW	4	2	Enhanced	Existing configuration; no project pending
W Rock Creek Rd	½ mile west of 36th Ave W	36th Ave W	4	2/3	Enhanced	Existing configuration; no project pending
Stubbeman Ave	W Rock Creek Rd	E Robinson St	2	4	Enhanced	Existing configuration
W Tecumseh Rd	I-35	N Flood Ave	2	4	Enhanced	Existing configuration

Furthermore, an error was fixed early on to correct where State Highway (SH) 9 and Classen Boulevard (U.S. Highway [US] 77) had previously been coded with a full interchange instead of a grade separated interchange as shown in the aerial image below.

Figure 8: State Highway 9 and Classen Boulevard – Grade Separation Corrected Network



Not necessarily a coding error, but nonetheless important, was the update of three interstate interchanges. At the time of the original model development took place, interchange project design information needed to code the following projects was not yet available:

- I-35, Main Street Interchange – single-point urban interchange (SPUI)
- I-35, Lindsey Street Interchange – single-point urban interchange
- I-35, SH 9 Interchange – addition of a southbound I-35 off-ramp to SH 9

Figure 9 and Figure 10 show the new and previous interchange coding in comparison for the Main Street and the Lindsey and SH 9 interchanges, respectively.

Figure 9: Main Street Interchange Coding

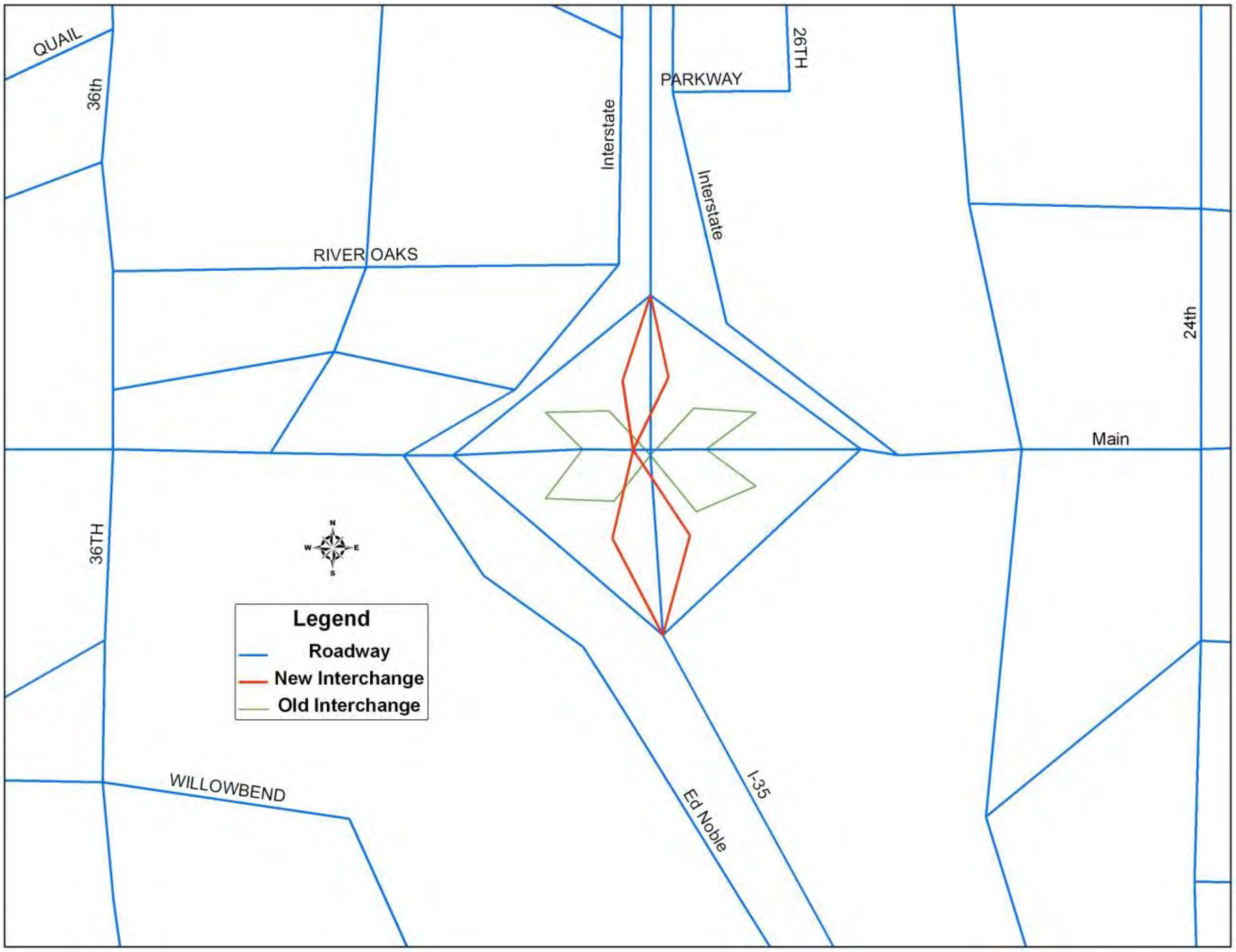
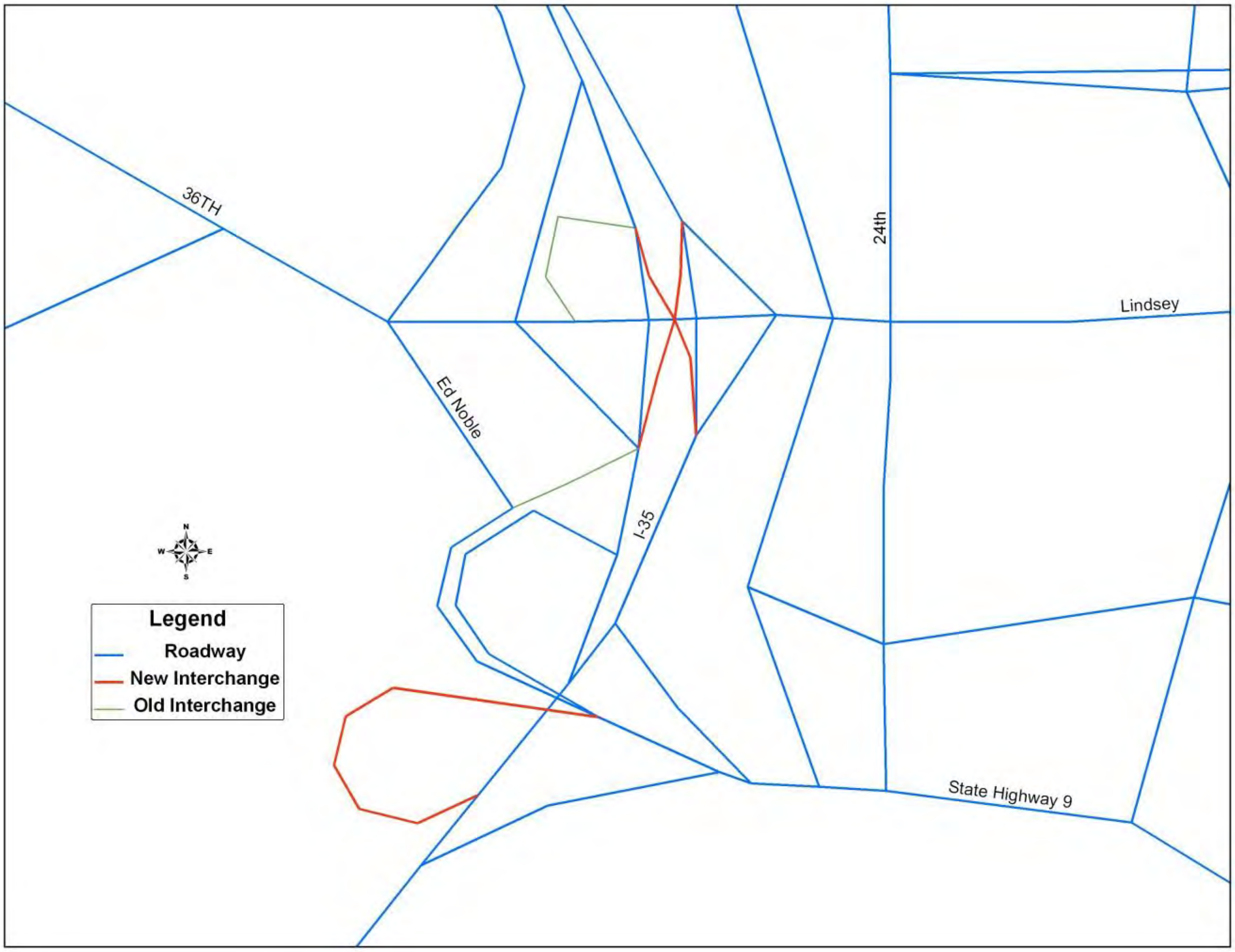


Figure 10: Lindsey Street and State Highway 9 Interchange Coding



Also corrected was the irregular placement of a centroid connector that erroneously crossed 36th Avenue W and connected to Ed Noble Parkway instead. As can be seen in the upper left corner of Figure 10 above, the centroid connector now ties into 36th Avenue W just west of the parkway.

Project-specific Network Updates

Existing-Plus-Committed

ACOG's Alternative 2 network served as the basis for the Norman subarea network, since it included all roadway improvement projects either built, under construction, or with committed funding by September 2010.

The following list of roadway projects was developed in collaboration with City of Norman staff, and includes all of the projects built or committed to be built between 2010 and 2013.

► Table 4: Norman Subarea – 2013 E+C Improvements

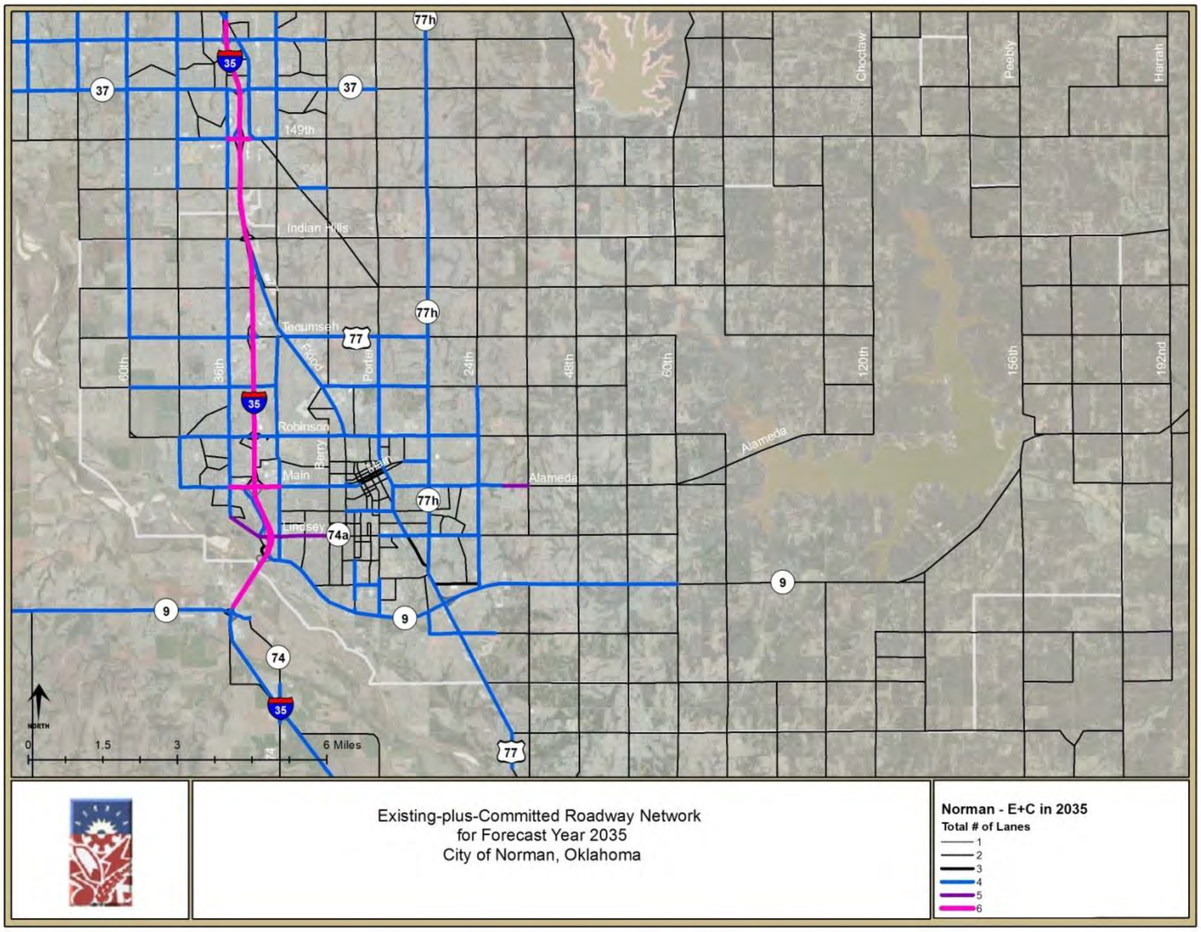
Street	From	To	Improvement
12th Ave E	SH 9	Cedar Lane Rd	Widening from 2 to 4 lanes
24th Ave E	Robinson St	Lindsey St	Widening from 2 to 4 lanes
36th Ave W	Indian Hills Rd	Tecumseh Rd	Widening from 2 to 4 lanes
60th Ave W	Indian Hills Rd	Tecumseh Rd	Widening from 2 to 4 lanes
Alameda St	Ridge Lake Blvd	36th Ave E	Widening from 2 to 5 lanes
I-35	1/2 mile north of Main St	1/2 mile south of Main St	Widening from 4 to 6 lanes
Lindsey St	Jenkins Ave	Classen Blvd	Widening from 2 to 4 lanes
Porter Ave	Tecumseh Rd	Rock Creek Rd	Widening from 3 to 4 lanes
Rock Creek Rd	36th Ave W	24th Ave W	Widening from 2 to 4 lanes
Rock Creek Rd	Porter Ave	12th Ave E	Widening from 2 to 4 lanes
SH 9	24th Ave E	72nd Ave E	Widening from 2 to 4 lanes

These projects were coded into the Norman subarea Existing-plus-Committed (E+C) network.

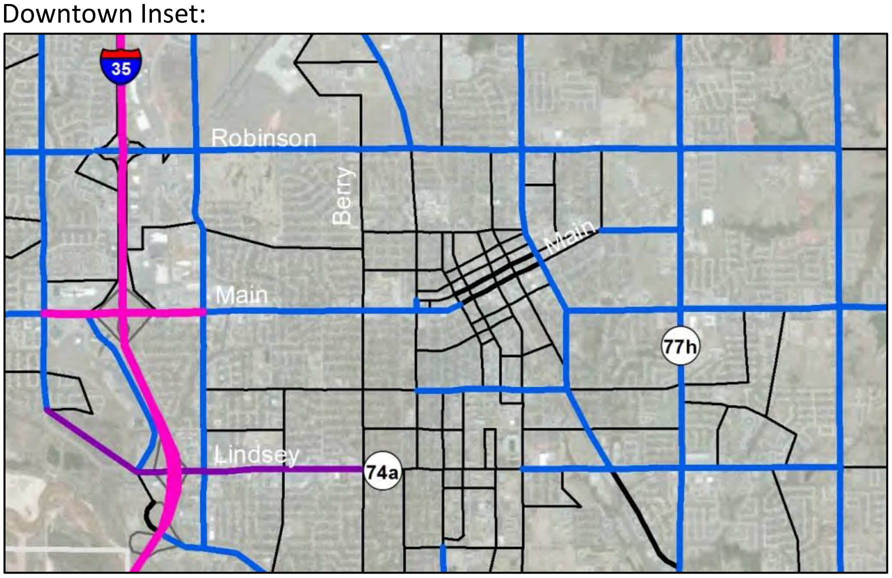
Model Results

Figure 11 through Figure 14 show the Norman subarea E+C network and associated TDM run results for the 2035 horizon year. Figure 13 and Figure 14 show high levels of peak period congestion occurring on Flood, University, Main, Boyd, and Lindsey.

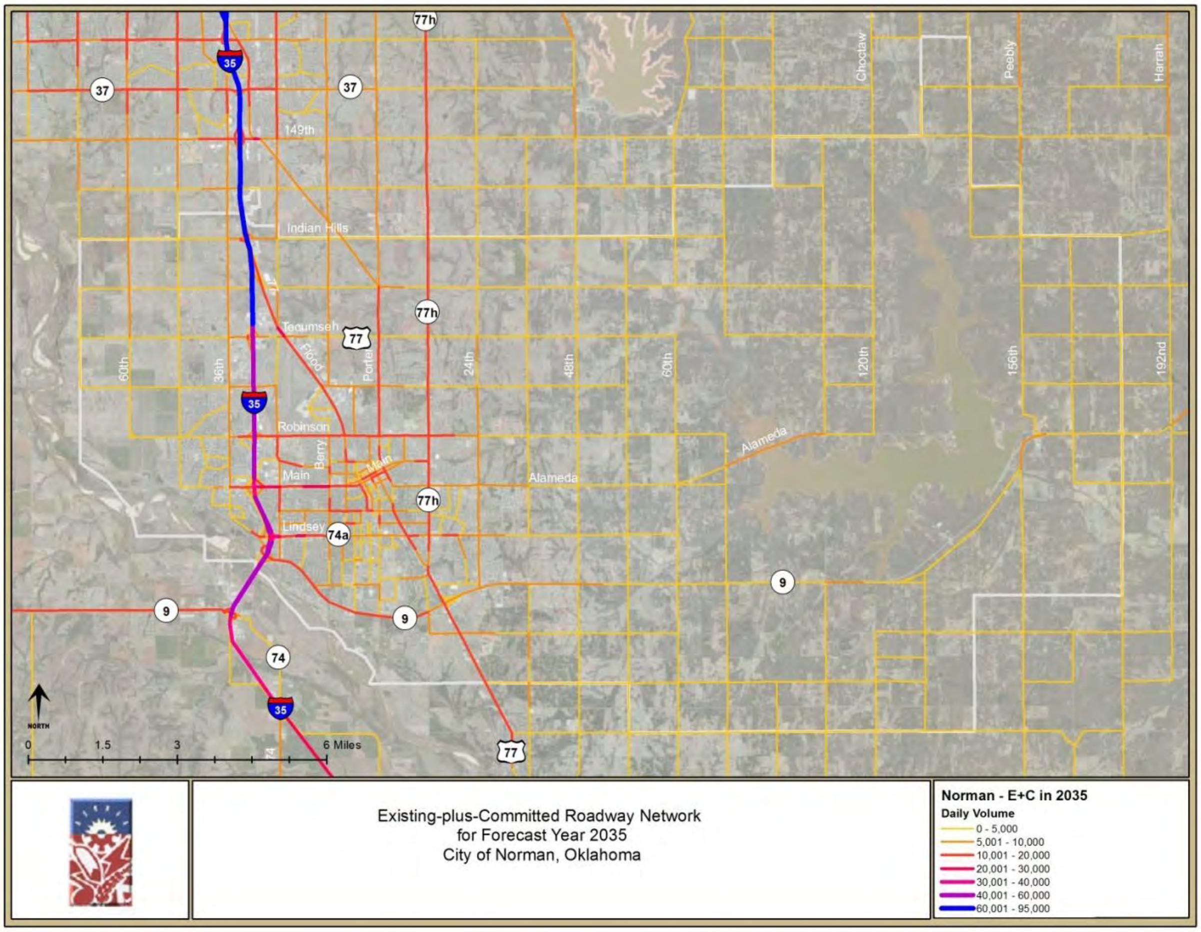
Figure 11: Norman E+C Network – Number of Lanes



Downtown Inset:



► Figure 12: Norman E+C Network – Daily Directional Volumes



Downtown Inset:

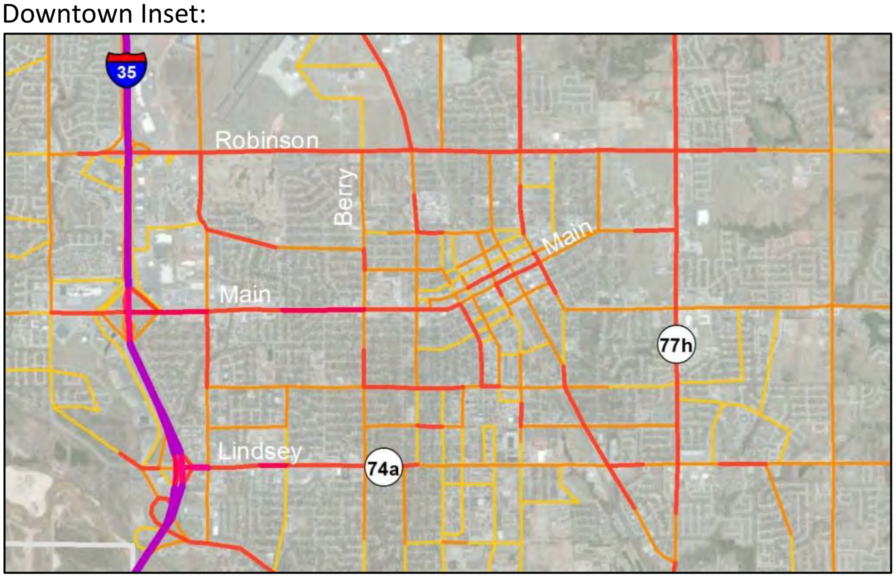
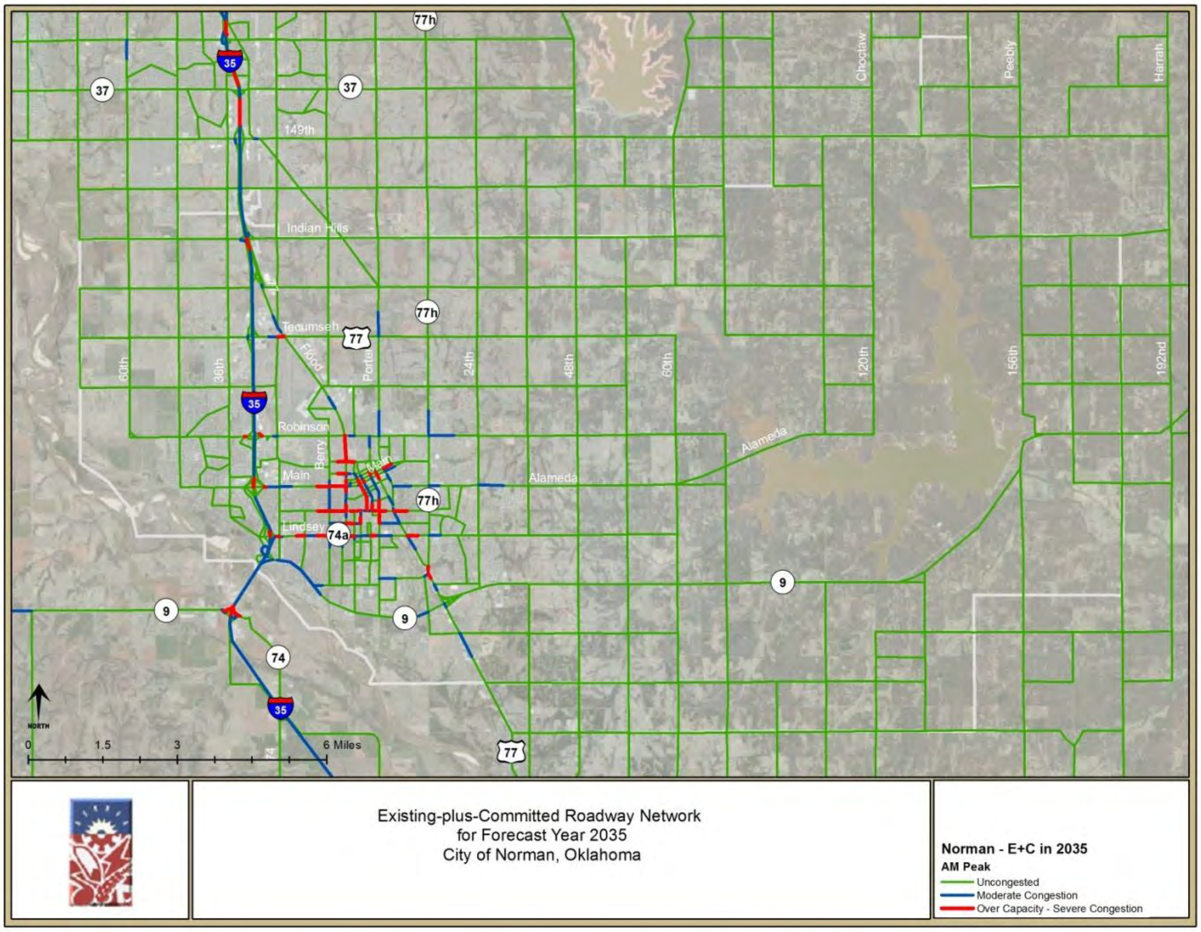
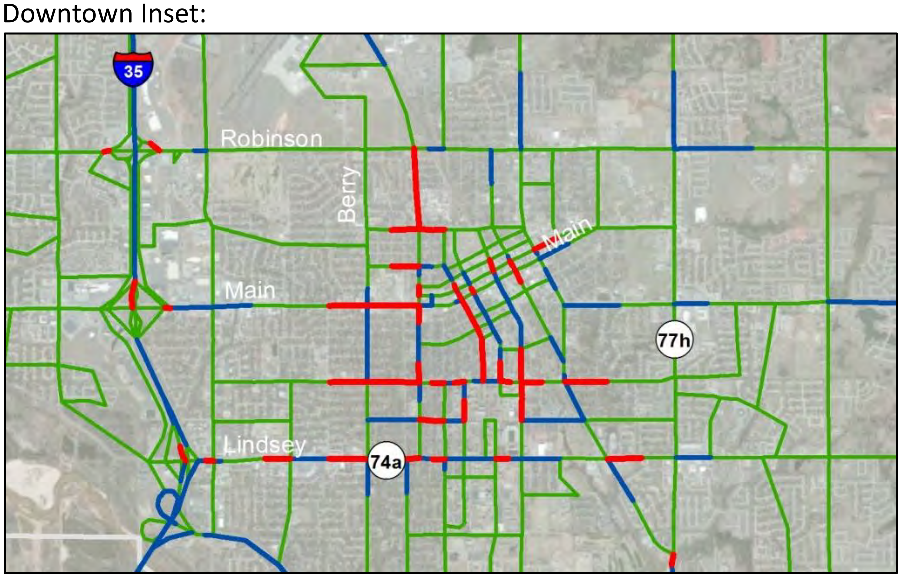


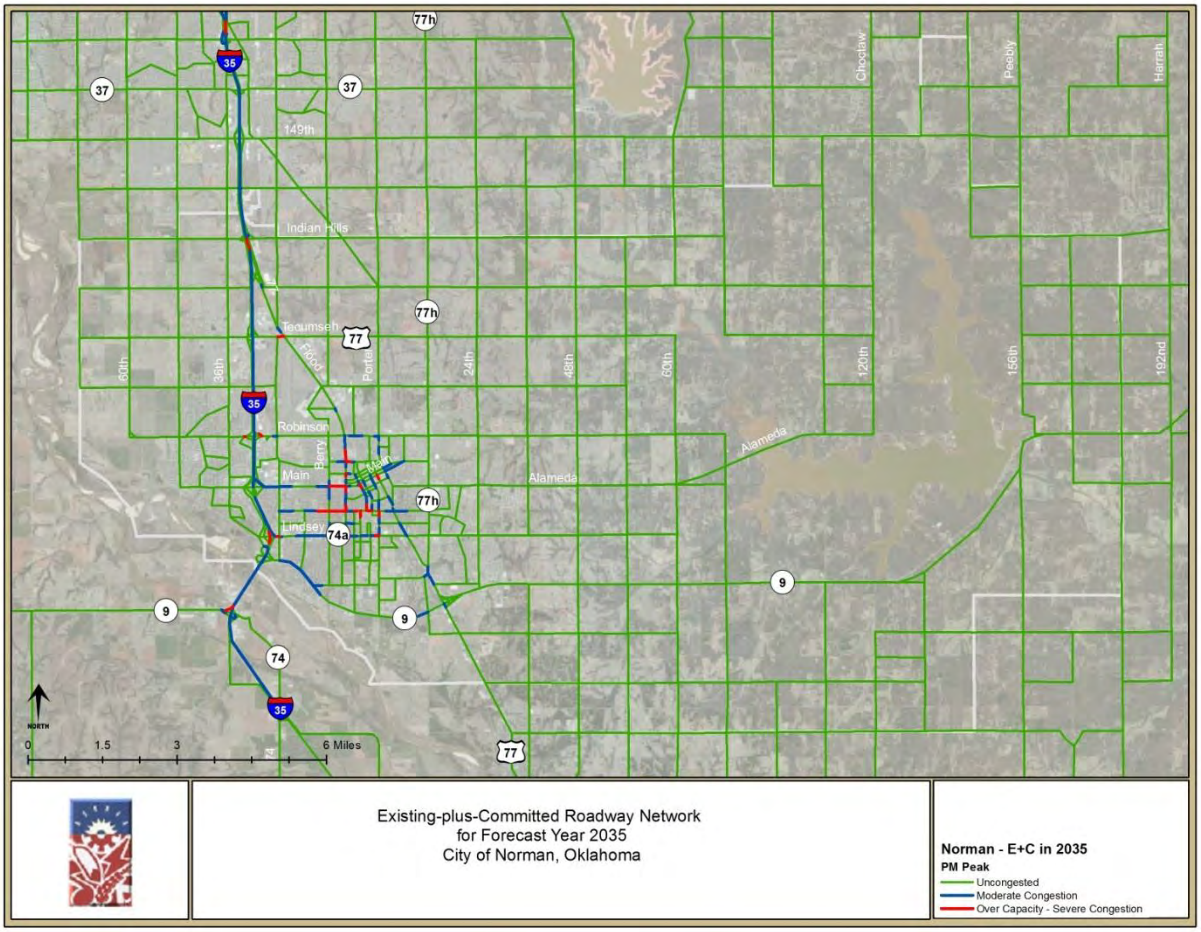
Figure 13: Norman E+C Network – AM Peak Congestion Levels



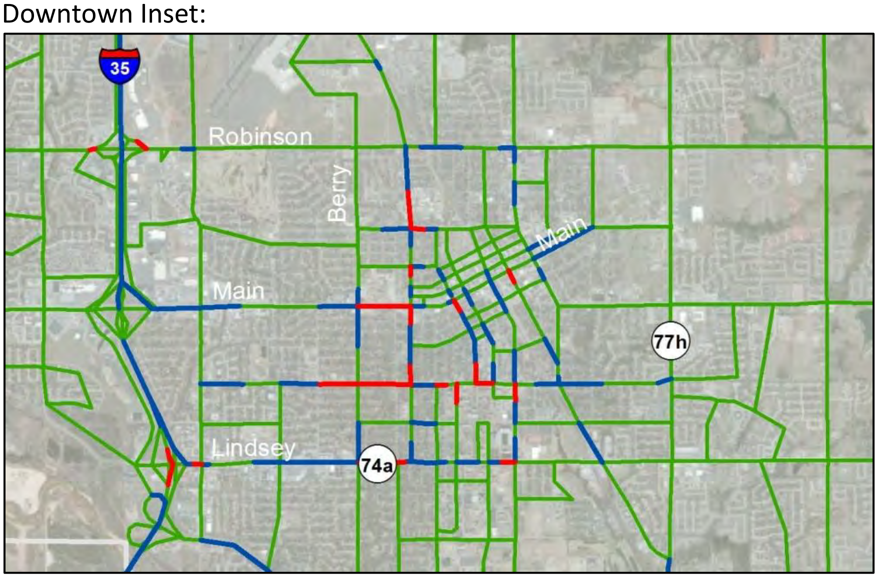
Downtown Inset:



► Figure 14: Norman E+C Network – PM Peak Congestion Levels



Downtown Inset:



Enhanced Existing-Plus-Committed

An in-depth review of the forecasted 2035 traffic volumes associated the Norman E+C network revealed that the regional travel demand model estimated significantly different roadway volumes associated with the anticipated University North Park development than had been documented as part of a site-specific traffic impact analysis, undertaken by one of the project team partners.

Upon further analysis, it was determined that affected TAZ 2154 of the underlying socioeconomic data that had been provided by ACOG at the start of the project only took a small amount of the anticipated growth into account, and actual growth had already reached levels commensurate with ACOG forecasted 2035 employment gains.

In order to forecast traffic volumes representative of the entire commercial and residential development, particularly in anticipation that the development would be fully built by 2035, the proposed square footage of retail, office, and other commercial developments was factored to arrive at associated employment growth, based on average employee per square foot ratios.[3] Table 5 shows the original ACOG socioeconomic data and the updated population and employment figures that were used for an updated TDM model run for the Enhanced E+C network for the City of Norman.

► Table 5: Update to University North Park related TAZ data

		2035 Population			2035 Employment		
	TAZ	Pop	DU	Occupied DU	Retail	Non-Retail	Total
Existing Data	2154	201	201	201	1,552	1,825	3,377
Revised Data	2154	2,812	1,296	1,206	2,204	3,192	5,396
Increase of Original 2035 Projections		**2,611**	**1,095**	**1,005**	**652**	**1,367**	**2,019**

Source: Freese and Nichols

A review of the underlying roadway network also indicated that the ACOG TDM would benefit from a different representation of traffic flows to better replicate travel patterns associated with the development's roadways. Consequently, one of the centroid connectors for the affected TAZ 2154 was realigned to connect directly to 24th Avenue W, as indicated in

---

[3] The employee per square foot ratios were taken from a survey that had been conducted by the North Central Texas Council of Governments.

Figure 15. The realigned network was rerun with the updated socioeconomic data described above.

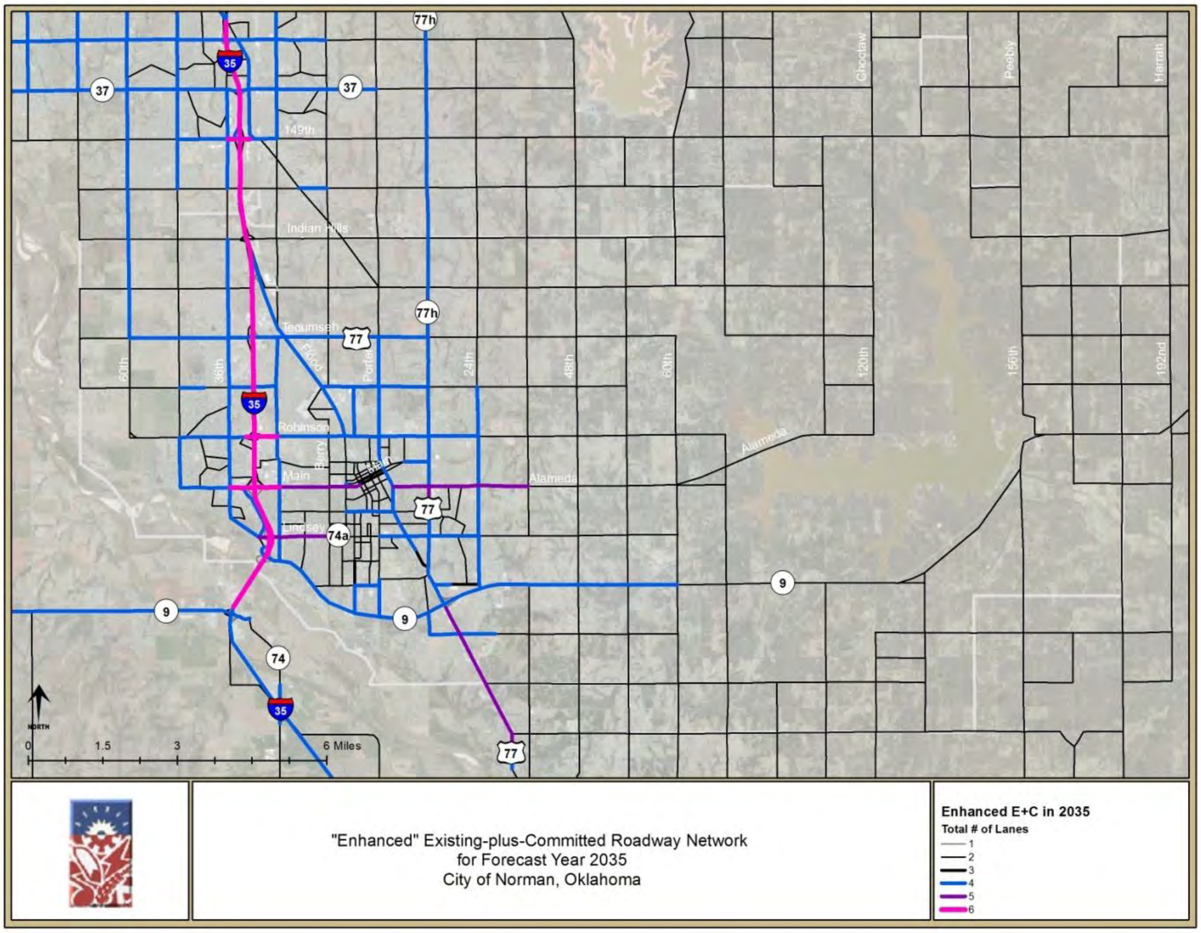
Model Results

Figure 16 through Figure 19 show the Norman subarea Enhanced E+C network and associated TDM run results for the 2035 horizon year. Similar to the results for the Norman E+C network, the highest levels of peak period congestion occur on Flood, University, Main, Boyd, and Lindsey.

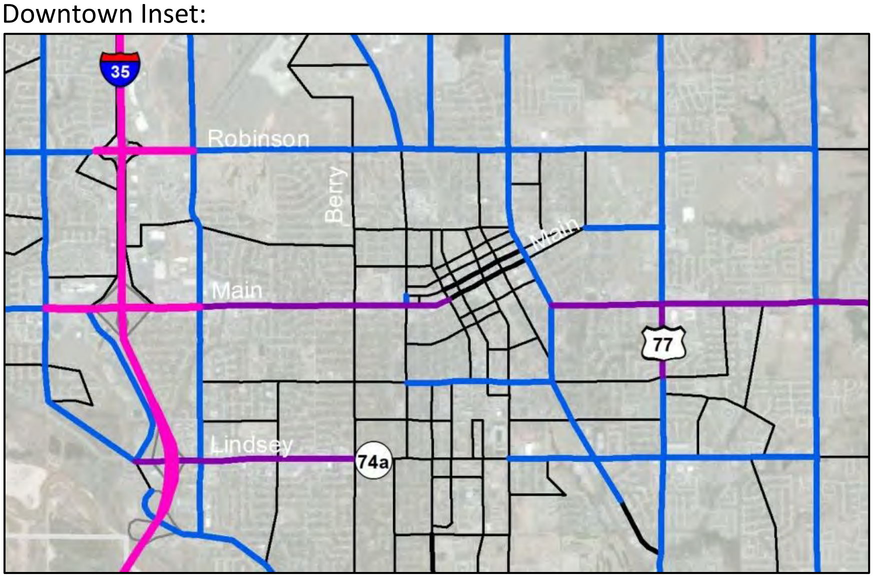
▶ Figure 15: University North Park Development – Preferred Centroid Connector Alignment

Source: City of Norman; annotation by Alliance Transportation Group

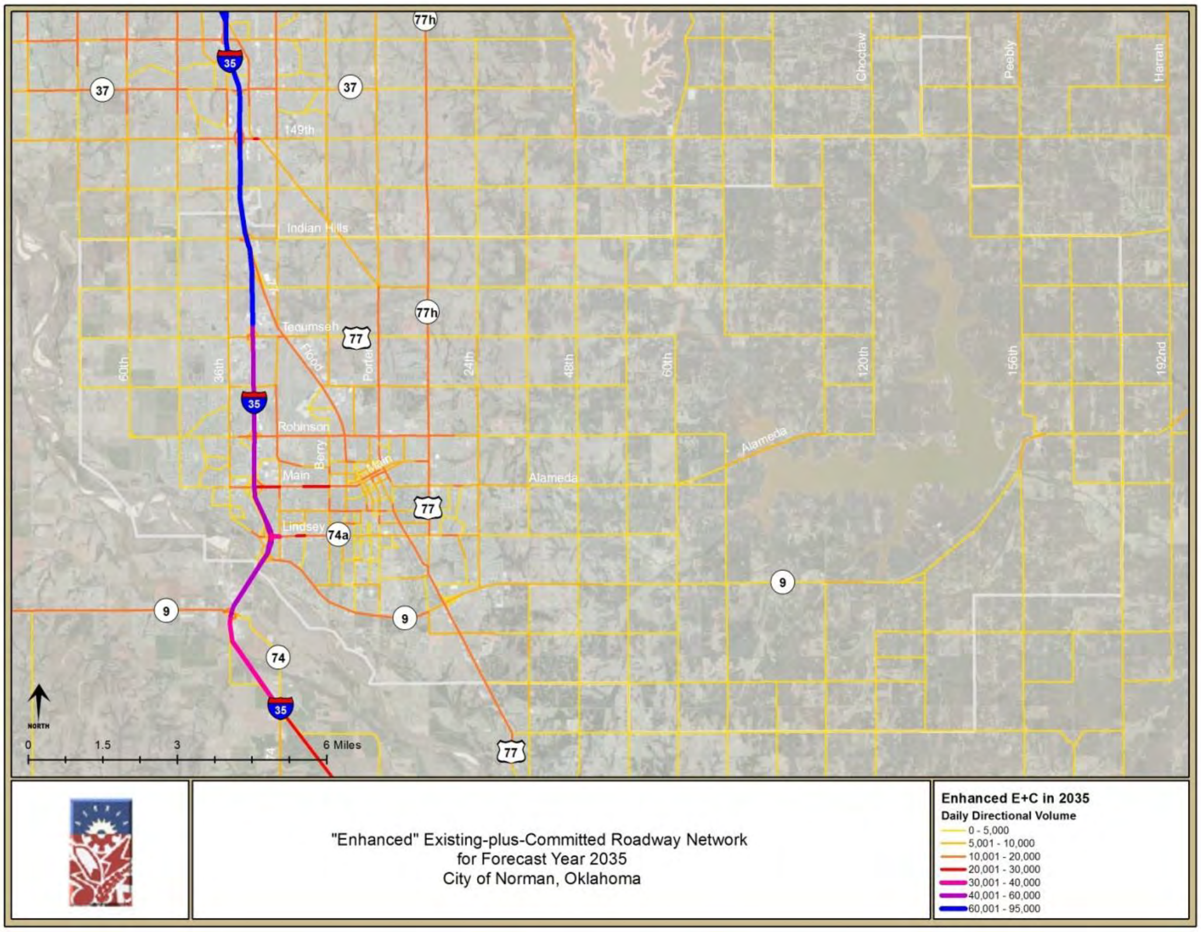
Figure 16: Norman Enhanced E+C – Number of Lanes



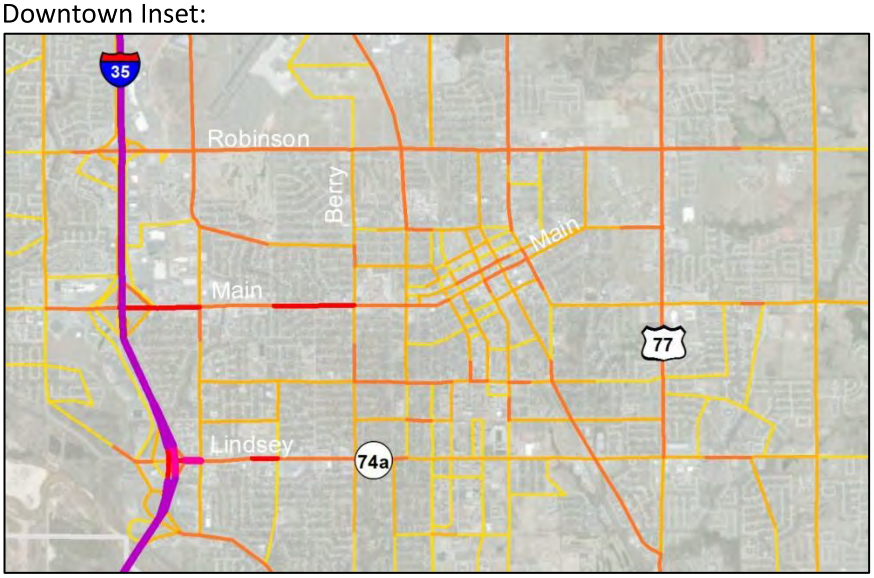
Downtown Inset:



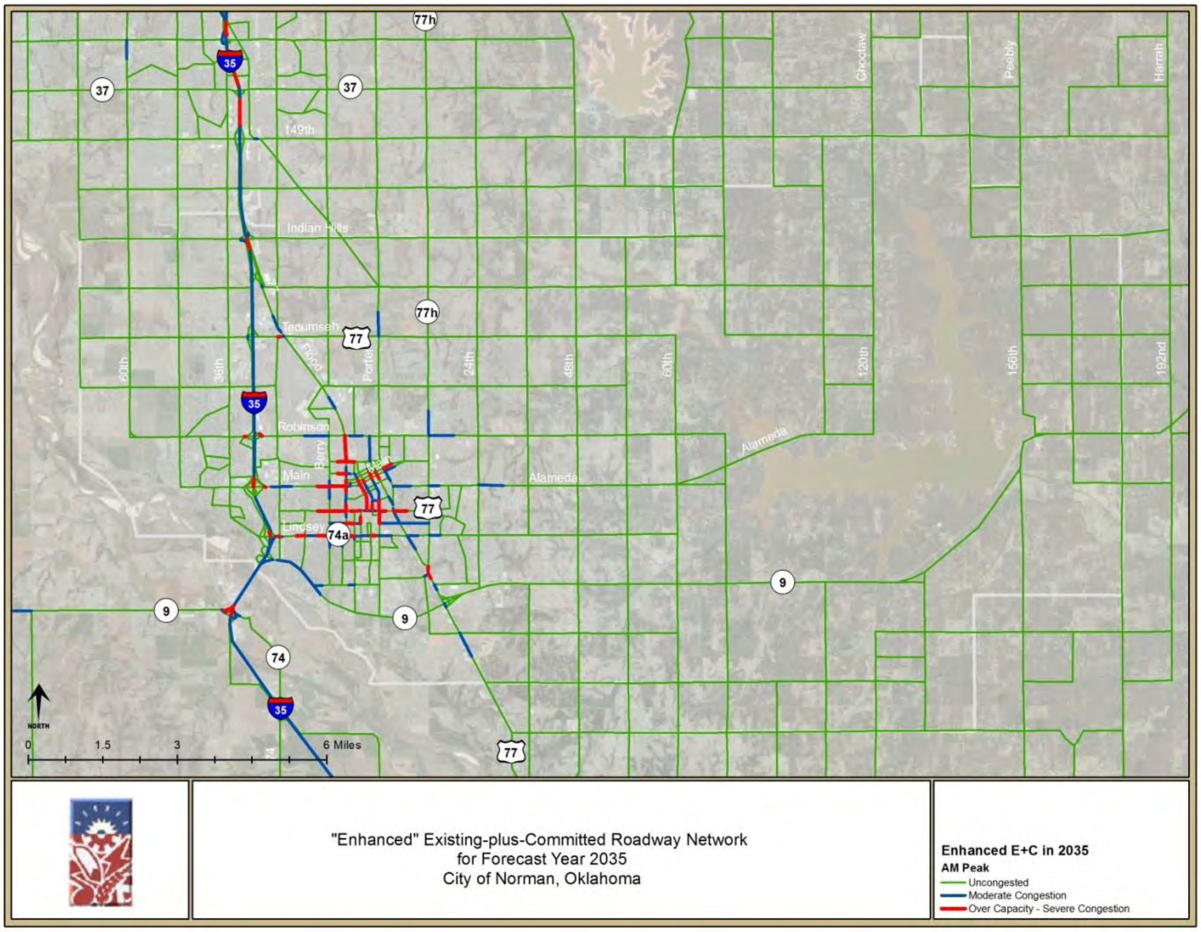
▶ Figure 17: Norman Enhanced E+C – Daily Directional Volumes



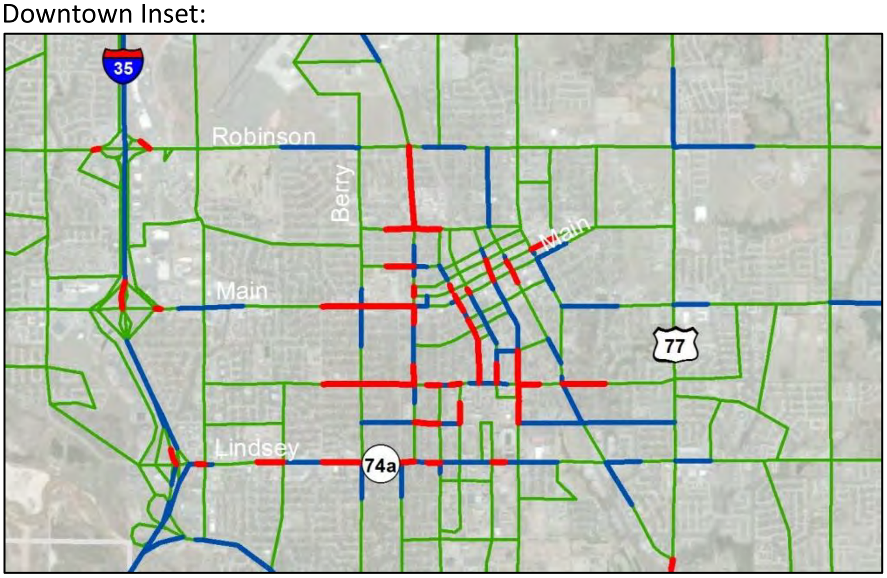
Downtown Inset:



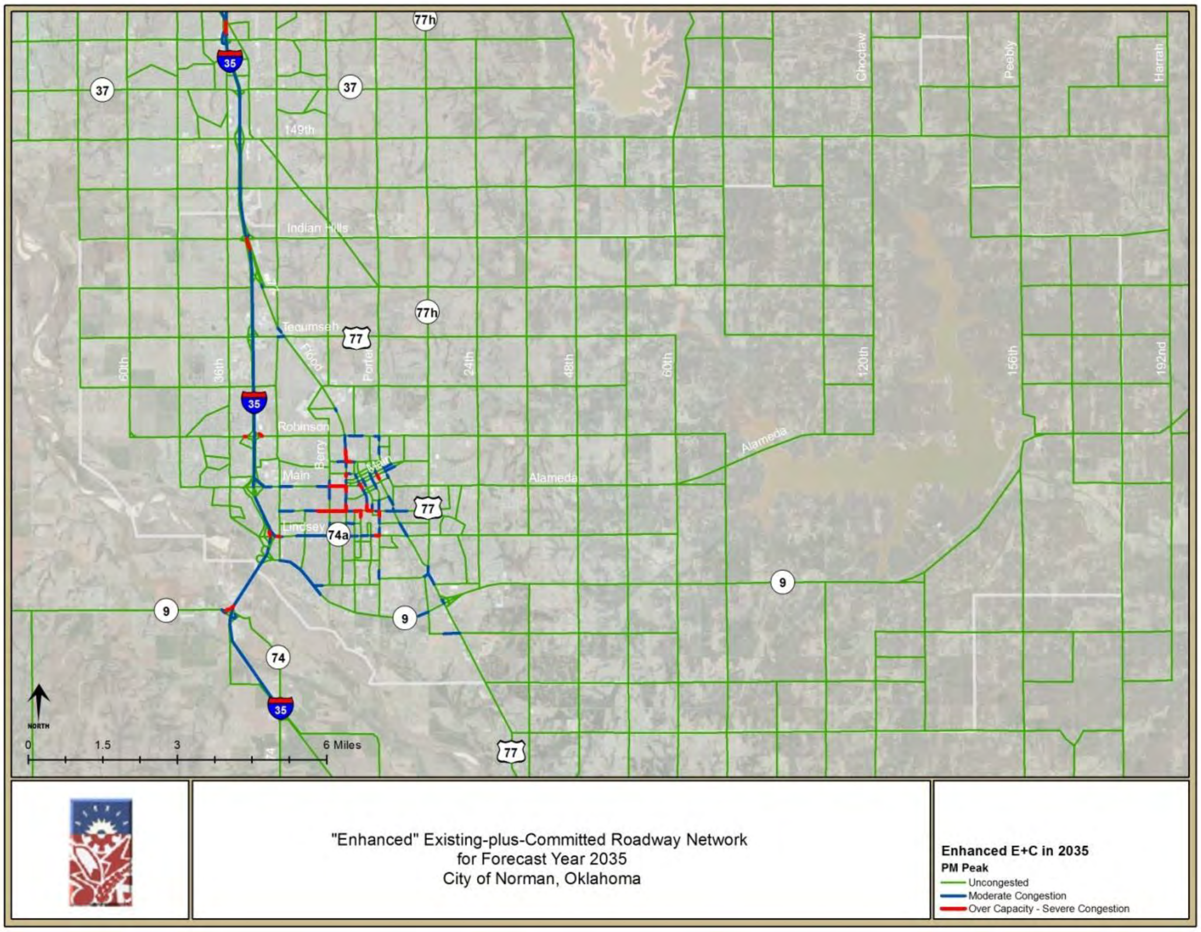
▶ Figure 18: Norman Enhanced E+C – AM Peak Congestion Levels



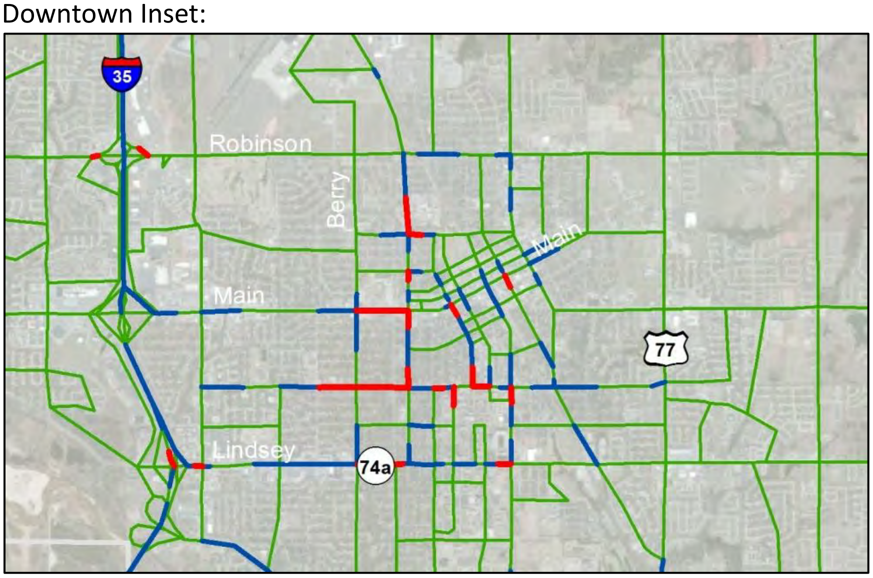
Downtown Inset:



▶ Figure 19: Norman Enhanced E+C – PM Peak Congestion Levels



Downtown Inset:



Deficiency Analysis

The TDM run results from the Enhanced E+C network were used to identify those links that might benefit from additional capacity improvements to allow them better accommodate the forecasted travel demand. Table 6 details the findings and provides information on forecasted, average daily 2035 traffic volumes, current roadway configuration, time-of-day period affected by the deficiency, direction of travel affected by the deficiency, and maximum volume to capacity ratio associated with the affected link by time-of-day and direction of travel. This detailed information was shared with project team members and subsequently considered in the determination of which projects should be included in the Norman Build Scenario.

Table 6: Norman Enhanced E+C – Detailed Deficiency Findings

Street | Segment | Functional Classification | 2035 Volume | Number of Lanes | Failure Period | Both Directions | Deficiency | Affected Movement | VC Ratio | Additional Concern

Street	Segment	Functional Classification	2035 Volume	Number of Lanes	Failure Period	Both Directions	Deficiency	Affected Movement	VC Ratio	Additional Concern
12th Avenue E/ Sooner	Classen to Constitution	Principal Arterial	35,000	4	AM		AM Peak Failure	NB	AM 1.08	
12th Avenue E/ Sooner	Constitution to Imhoff	Minor Arterial	34,000	4	AM		AM Peak Failure	NB	AM 1.07	PM 0.98
Acres	Berry to Flood	Minor Arterial	10,000	2	AM		AM Peak Failure	EB	AM 1.11	PM 0.71
Acres	Flood to University	Minor Arterial	19,000	2	AM/PM /MD	x	AM and PM Peak Failure	EB and WB	EB AM 1.05; WB AM 1.45; WB PM 1.25; WB MD 1.01	
Alameda	Porter to 12th Ave E	Minor Arterial	16,000	5			Nearing Capacity (AM Peak)	WB	AM 0.77	
Alameda	12th Ave E to 24th Ave E	Minor Arterial	18,000	5			Nearing Capacity (AM Peak)	WB	AM 0.74	
Alameda	24th Ave E to 36th Ave E	Minor Arterial	18,000	5			Nearing Capacity (AM Peak)	WB	AM 0.72	
Berry	Kansas to Main	Minor Arterial	13,000	2			Nearing Capacity	SB	AM 0.90; PM 0.82	
Berry	Main to Boyd	Minor Arterial	18,000	2			Nearing Capacity (AM Peak)	NB	AM 0.89	
Berry	Brooks to Lindsey	Minor Arterial	16,000	2			Nearing Capacity (PM Peak)	SB	PM 0.78	

Street	Segment	Functional Classification	2035 Volume	Number of Lanes	Failure Period	Both Directions	Deficiency	Affected Movement	VC Ratio	Additional Concern
Boyd	Asp to Jenkins	Collector	15,000	4			Nearing Capacity (AM Peak)	WB	AM 0.96	
Boyd	Jenkins to Classen	Collector	19,000	4	AM		AM Peak Failure	WB	AM 1.18	EB PM 0.84
Boyd	Classen to 12th Ave E	Collector	13,000	2	AM		AM Peak Failure	WB	AM 1.40	WB PM 0.88; WB MD 0.82
Brooks	Berry to Flood	Collector	16,000	2			Nearing Capacity (AM Peak)	EB	AM 0.88	
Brooks	Flood to Chautauqua	Collector	19,000	2	AM		AM Peak Failure	EB	AM 1.12	WB PM 0.92
Brooks	Chautauqua to Elm	Collector	15,000	2			Nearing Capacity (AM Peak)	EB	AM 0.90	
Brooks	Jenkins to Classen	Collector	14,000	2			Nearing Capacity (AM Peak)	WB	AM 0.90	
Chautauqua	Lindsey to Elmwood	Collector	8,000	2			Nearing Capacity (AM Peak)	NB	AM 0.88	
Classen	Miller to Boyd	Minor Arterial	25,000	4			Nearing Capacity	SB	AM 0.95; PM 0.82	
Classen	Boyd to Lindsey	Minor Arterial	26,000	4		x	Nearing Capacity	NB and SB	NB AM 0.98; SB PM 0.89	
Classen	Lindsey to 12th Ave E	Minor Arterial	20,000	3 to 4			Nearing Capacity (AM Peak)	NB	AM 0.86	

Street	Segment	Functional Classification	2035 Volume	Number of Lanes	Failure Period	Both Directions	Deficiency	Affected Movement	VC Ratio	Additional Concern
Classen	Cedar to City Limits	Principal Arterial	29,000	5			Nearing Capacity (AM Peak)	NB	AM 0.82	
Constitution	Jenkins to Classen	Collector	11,000	2			Nearing Capacity	EB	PM 0.96	AM 0.87; MD 0.82
Elm	Boyd to Brooks	Minor Arterial	17,000	2	PM		PM Peak Failure	NB	PM 1.36	AM 0.99
Flood	Robinson to W Acres	Collector	20,000	2	AM/MD/PM		AM and PM Peak Failure	SB	AM 2.06; PM 1.36; MD 1.27	NB AM 0.83; NB PM 0.84
Flood	W Acres to Main	Collector	13,000	2	AM/PM	x	AM and PM Peak Failure	NB and SB	NB PM 1.26; SB AM 1.10	NB MD and PM > 0.70; SB MD and PM >0.74
Flood	Main to Boyd	Collector	17,000	2	AM/MD/PM/NT	x	AM and PM Peak Failure	NB and SB	NB PM 1.58; NB AM 1.36; SB AM 1.94; SB PM 1.20	NB MD 1.21; NT 1.06; SB MD 1.20
Flood	Boyd to Brooks	Collector	8,000	2			Nearing Capacity (AM Peak)	NB	AM 0.90	
Flood	Brooks to Lindsey	Collector	6,000	2			Nearing Capacity (PM Peak)	SB	PM 0.90	
Gray	Porter to Findlay	Minor Arterial	11,000	2	AM		AM Peak Failure	WB	AM 1.22	PM 0.90
Imhoff	SH 9 to Berry	Collector	10,000	2			Nearing Capacity	WB	AM 0.76; PM 0.79	

Street	Segment	Functional Classification	2035 Volume	Number of Lanes	Failure Period	Both Directions	Deficiency	Affected Movement	VC Ratio	Additional Concern
Imhoff	Pickard to Chautauqua	Collector	9,000	2			Nearing Capacity	EB	AM 0.71	
James Garner	Daws to Tonhawa	Collector	12,000	2			Nearing Capacity	SB	AM 0.77	
James Garner	Tonhawa to Main	Collector	16,000	2	AM		AM Peak Failure	SB	AM 1.35	PM 0.73
James Garner	Main to Linn	Collector	17,000	2		x	Nearing Capacity	NB and SB	NB PM 0.87; SB AM 0.96	NB AM 0.78;
Jenkins	Linn to Duffy	Collector	9,000	2			Nearing Capacity	SB	AM 0.81	
Jenkins	Duffy to Boyd	Collector	11,000	2	AM		AM Peak Failure	SB	AM 1.33	MD 0.76; PM 0.75
Jenkins	Boyd to Brooks	Collector	19,000	2	AM/PM	x	AM and PM Peak Failure	NB and SB	NB PM 1.24; SB AM 1.46	NB MD 0.78
Jenkins	Brooks to Lindsey	Collector	9,000	2			Nearing Capacity (PM Peak)	SB	PM 0.70	
Kansas	Berry to Flood	Minor Arterial	12,000	2	AM		AM Peak Failure	EB	AM 1.03	
Kansas	Flood to University	Minor Arterial	12,000	2			Nearing Capacity	WB	AM 0.89; PM 0.87	MD 0.78
Lindsey	I-35 to 24th Ave W	Minor Arterial	61,000	5	AM/PM		AM and PM Peak Failure	EB	AM 1.82; PM 1.38	MD 1.42
Lindsey	24th Ave W to Berry	Minor Arterial	40,000	5	AM		AM Peak Failure	EB	AM 1.16	EB PM 0.93; WB AM 0.91; WB PM 0.96;

Street	Segment	Functional Classification	2035 Volume	Number of Lanes	Failure Period	Both Directions	Deficiency	Affected Movement	VC Ratio	Additional Concern
										WB MD 0.91
Lindsey	Berry to Pickard	Minor Arterial	26,000	2	AM/PM /MD	x	AM and PM Peak Failure	EB and WB	EB AM 1.02; WB AM 2.01; WB PM 1.96; WB MD 1.61	EB AM 0.87; EB MD 0.79; EB PM 0.97
Lindsey	Pickard to Flood	Minor Arterial	19,000	2	AM/PM /MD	x	AM and PM Peak Failure	EB and WB	EB AM 1.65; WB AM 1.12; WB PM 1.55; WB MD 1.17	EB MD 0.93; EB PM 0.95
Lindsey	Flood to Chautauqua	Minor Arterial	14,000	2	AM		AM Peak Failure	EB	AM 1.19	EB PM 0.79; EB MD 0.78; WB AM 0.96; WB PM 0.88; WB MD 0.79
Lindsey	Chautauqua to Elm	Minor Arterial	14,000	2		x	Nearing Capacity	EB and WB	EB AM 0.93; WB AM 0.76; WB PM 0.78	
Lindsey	Elm to Jenkins	Minor Arterial	15,000	2	AM/PM	x	AM and PM Peak Failure	EB and WB	EB PM 1.23; WB AM 1.29	
Lindsey	Jenkins to George	Minor Arterial	15,000	4			Nearing Capacity	WB	AM 0.74	

Street	Segment	Functional Classification	2035 Volume	Number of Lanes	Failure Period	Both Directions	Deficiency	Affected Movement	VC Ratio	Additional Concern
										WB MD 0.91
Lindsey	Berry to Pickard	Minor Arterial	26,000	2	AM/PM /MD	x	AM and PM Peak Failure	EB and WB	EB AM 1.02; WB AM 2.01; WB PM 1.96; WB MD 1.61	EB AM 0.87; EB MD 0.79; EB PM 0.97
Lindsey	Pickard to Flood	Minor Arterial	19,000	2	AM/PM /MD	x	AM and PM Peak Failure	EB and WB	EB AM 1.65; WB AM 1.12; WB PM 1.55; WB MD 1.17	EB MD 0.93; EB PM 0.95
Lindsey	Flood to Chautauqua	Minor Arterial	14,000	2	AM		AM Peak Failure	EB	AM 1.19	EB PM 0.79; EB MD 0.78; WB AM 0.96; WB PM 0.88; WB MD 0.79
Lindsey	Chautauqua to Elm	Minor Arterial	14,000	2		x	Nearing Capacity	EB and WB	EB AM 0.93; WB AM 0.76; WB PM 0.78	
Lindsey	Elm to Jenkins	Minor Arterial	15,000	2	AM/PM	x	AM and PM Peak Failure	EB and WB	EB PM 1.23; WB AM 1.29	
Lindsey	Jenkins to George	Minor Arterial	15,000	4			Nearing Capacity	WB	AM 0.74	

Street	Segment	Functional Classification	2035 Volume	Number of Lanes	Failure Period	Both Directions	Deficiency	Affected Movement	VC Ratio	Additional Concern
							(AM Peak)			
Lindsey	Classen to 12th Ave E	Minor Arterial	19,000	4			Nearing Capacity (AM Peak)	WB	AM 0.94	
Lindsey	12th Ave E to Biloxi	Minor Arterial	18,000	4			Nearing Capacity (AM Peak)	WB	AM 0.72	
Main	I-35 to Interstate Dr	Minor Arterial	52,000	6	AM		AM Peak Failure	EB	AM 1.20	PM 0.89; MD 0.86
Main	Interstate Dr to 24th Ave W	Minor Arterial	40,000	6			Nearing Capacity (AM Peak)	EB	AM 0.88	
Main	24th Ave W to Berry	Minor Arterial	39,000	4	AM		AM Peak Failure	EB	AM 1.18	EB PM 0.92; EB MD 0.87; WB AM 0.94; WB PM 0.97; WB MD 0.80
Main	Berry to Flood	Minor Arterial	39,000	4	AM/PM	x	AM and PM Peak Failure	EB and WB	EB AM 1.30; EB PM 1.05; WB AM 1.17; WB PM 1.21	EB MD 0.98; WB MD 0.98
Main	Flood to University	Minor Arterial	22,000	4		x	Nearing Capacity	EB and WB	EB AM 0.81; WB AM 0.77	
Main	Porter to Acres	Collector	11,000	2		x	Nearing Capacity	EB and WB	EB PM 0.70; WB AM 0.87	

Street	Segment	Functional Classification	2035 Volume	Number of Lanes	Failure Period	Both Directions	Deficiency	Affected Movement	VC Ratio	Additional Concern
Miller	Boyd to Classen	Minor Arterial	18,000	2		x	Nearing Capacity	NB and SB	NB AM 0.93; SB PM 0.77	
N Peters	Robinson to Acres	Minor Arterial	17,000	2			Nearing Capacity (AM Peak)	SB	AM 0.81	
N Peters	Tonhawa to Gray	Minor Arterial	10,000	2			Nearing Capacity	SB	AM 0.76; PM 0.72	
N Peters	Gray to Main	Minor Arterial	11,000	2	AM		AM Peak Failure	NB	AM 1.01	NB PM 0.71; SB AM 0.83
N Peters	Main to Eufala	Minor Arterial	15,000	2	AM/PM		AM and PM Peak Failure	NB	AM 1.17; PM 1.04	MD 0.80
Pickard	Lindsey to Timberdell	Minor Arterial	11,000	2			Nearing Capacity (AM Peak)	NB	AM 0.91	
Porter	Franklin to Tecumseh	Minor Arterial	21,000	2			Nearing Capacity (AM Peak)	SB	AM 0.70	
Porter	Robinson to Alameda	Minor Arterial	20,000	4		x	Nearing Capacity	NB and SB	NB AM 0.87; NB PM 0.76; SB AM 0.70	
Robinson	24th Ave W to Berry	Principal Arterial	25,000	4			Nearing Capacity (AM Peak)	EB	AM 0.70	
Robinson	Flood to Porter	Principal Arterial	34,000	4		x	Nearing Capacity	EB and WB	EB AM 0.74; EB PM 0.80; WB AM 0.71; WB	

Street	Segment	Functional Classification	2035 Volume	Number of Lanes	Failure Period	Both Directions	Deficiency	Affected Movement	VC Ratio	Additional Concern
									PM 0.74	
Robinson	12th Ave E to 24th Ave E	Minor Arterial	21,000	4			Nearing Capacity (AM Peak)	WB	AM 0.77	
SH 9	I-35 to Chautauqua	Principal Arterial	35,000	4		x	Nearing Capacity	EB and WB	EB AM 0.89; EB PM 0.86; WB AM 0.92; WB PM 0.82	WB MD 0.72
SH 9	Jenkins to 12th Ave E	Principal Arterial	30,000	4			Nearing Capacity (PM Peak)	EB	PM 0.76	
University	Kansas to Main	Collector	10,000	2	AM		AM Peak Failure	SB	AM 1.29	
University	Main to Boyd	Collector	19,000	2	AM/MD/PM	x	AM and PM Peak Failure	NB and SB	NB AM 1.43; NB PM 1.62; SB AM 2.01; SB PM 1.16	NB MD 1.20; SB MD 1.15
US 77	Franklin to Tecumseh	Principal Arterial	38,000	4		x	Nearing Capacity	NB and SB	NB AM 0.90; NB PM 0.89; SB AM 0.80	
US 77	Rock Creek to Robinson	Principal Arterial	29,000	4		x	Nearing Capacity	NB and SB	NB PM 0.70; SB AM 0.77	
Webster	Daws to Main	Collector	10,000	2	AM		AM Peak Failure	SB	AM 1.05	SB PM 0.72; NB PM 0.71
Webster	Main to Symmes	Collector	11,000	2		x	Nearing Capacity	NB and SB	NB AM	

Street	Segment	Functional Classification	2035 Volume	Number of Lanes	Failure Period	Both Directions	Deficiency	Affected Movement	VC Ratio	Additional Concern
									0.75; NB PM 0.76; SB AM 0.72	
Webster/Asp	Symmes to Boyd	Collector	18,000	2	AM		AM Peak Failure	SB	AM 1.84	PM 0.82

Abbreviations used:

AM - Morning; PM - Afternoon: MD - Midday; NT - Nighttime; NB - Northbound; EB - Eastbound; SB - Southbound; WB – Westbound; VC – Volume/Capacity

Initial Build Scenario

Following the Enhanced E+C deficiency review, as well as additional discussion among project team members and City of Norman staff, the following projects were coded as part of the initial Build Scenario for the Norman CTP, including seven (7) capacity, six (6) roadway diet, and two (2) intersection enhancement projects.

Table 7: Norman Initial Build Scenario

ROADWAY WIDENING & NEW ROADWAYS

Name	From	To	Existing	Proposed Improvement
Lindsey St.	Elm	Berry	2 lanes	3 lanes (with reversible center lane = 2 EB/1 WB in AM, 1 EB/2 WB in PM)
Chautauqua	Imhoff	Lindsey	2 lanes	Widen to 4 lanes
Jenkins St	Imhoff	Lindsey	2 lanes	Widen to 4 lanes
Flood St	Robinson	Acres	2 lanes/3 lanes	3 lanes (2 SB, 1 NB)
Berry Rd	Robinson	Lindsey	2 lanes	4 lanes with off-peak parking
Front/Jenkins	Acres	Boyd	2 lanes	3 lanes – with center turn lanes
James Garner Extension	Acres	US 77	New – new link between Nodes	2 lanes (grade separation at Robinson)

ROAD DIETS & ONE WAY COUPLETS

Name	From	To	Existing	Proposed Improvement
Main St.	University	Porter	3 lanes, 1-way	2 lanes, 1-way (3 @ Porter)
Gray St.	Porter	University	3 lanes, 1-way	2 lanes, 1-way (3 @ University - dbl LT, thru & RT)
University	Gray	Main	2 lanes SB, 1 lane NB	3 lanes SB (dbl RT, thru & LT)
Porter	Alameda	Acres	2 lanes each way	1 lane each way plus center turn lane, except for 2 lanes each way between Main & Gray
36th Avenue W	Noble	Franklin	4 lanes	3 lanes
Rock Creek	12th	US 77	4 lanes	3 lanes

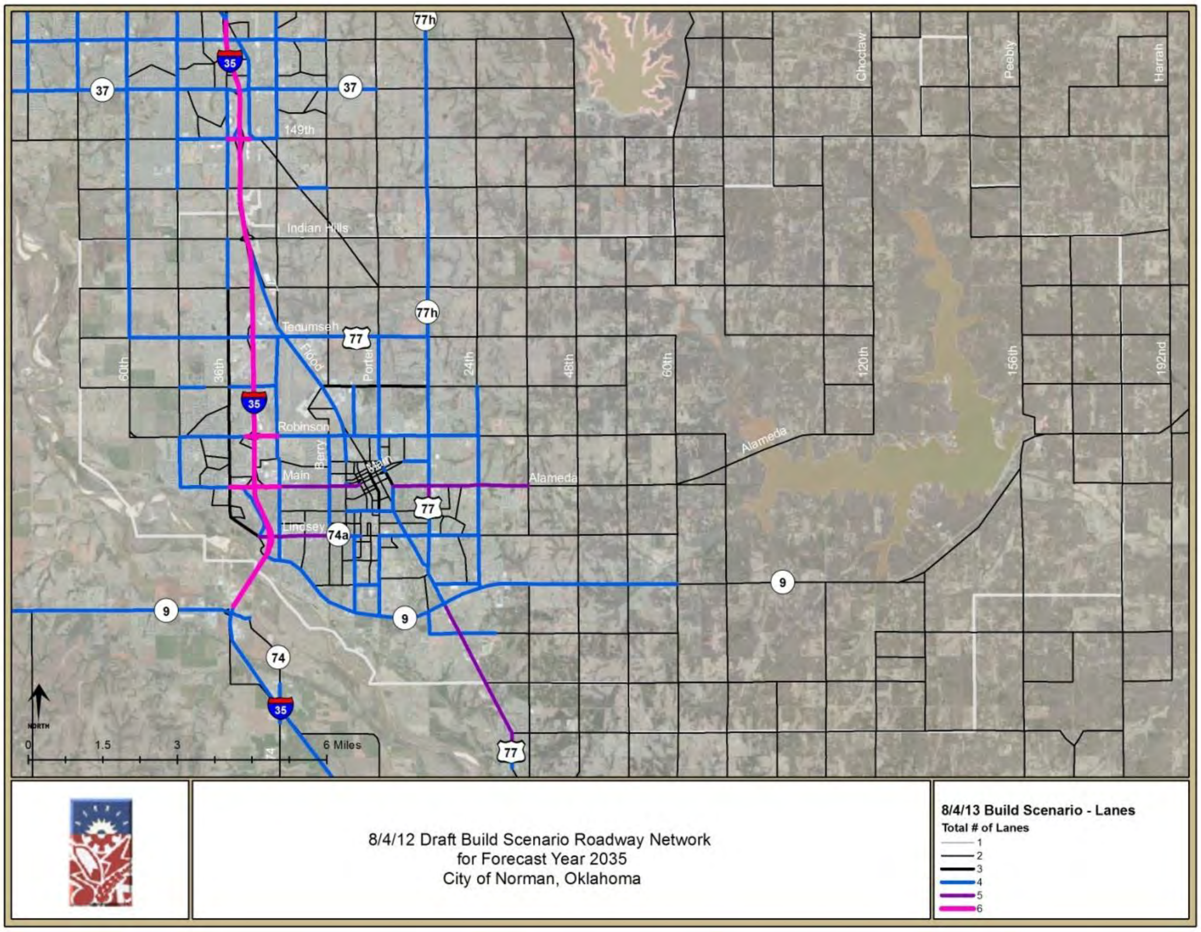
INTERSECTION ENHANCEMENTS

Name	NB	SB	Name	EB	WB
12th E	Dbl LT	Dbl LT	Robinson (recently built)	Dbl LT	Dbl LT
Flood (exist. cond.)	1 LT, 1 thru & RT	1 LT, 2 thru & RT	Main St (exist cond.)	1 LT, 2 thru & RT	1 LT, 2 thru & RT

Model Results

Figure 20 through Figure 23 document the results of the Initial Build Scenario 2035 model run. A reduction of peak period congestion occurred along Flood.

Figure 20: Norman Initial Build Scenario – Number of Lanes



Downtown Inset:

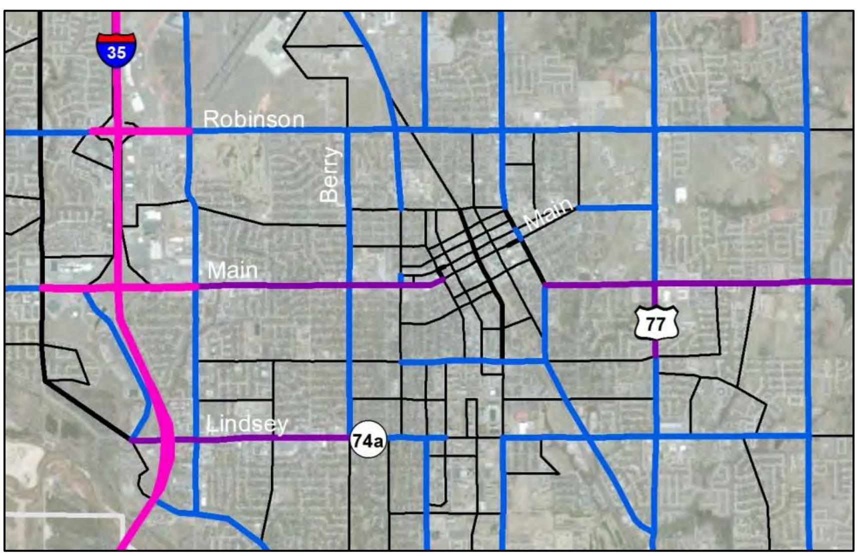
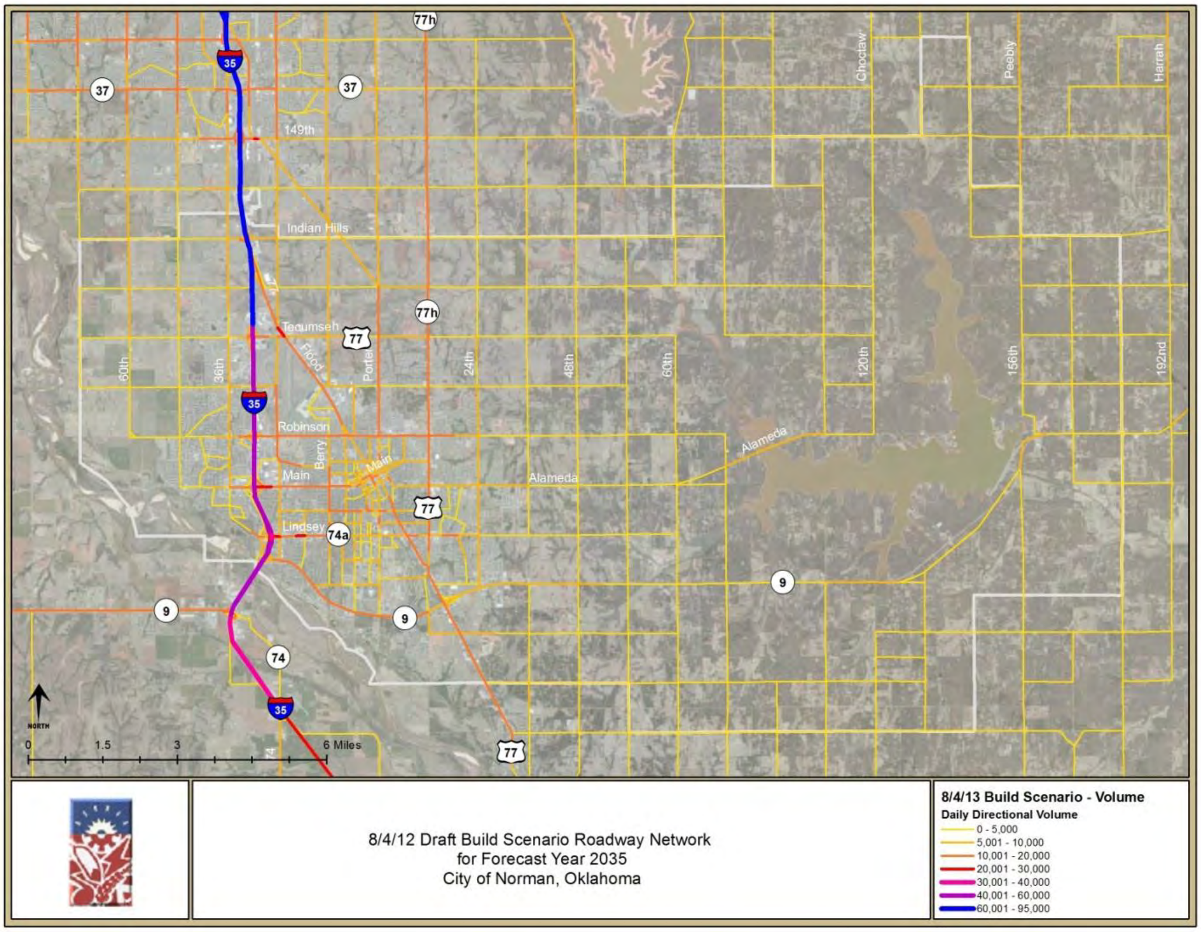


Figure 21: Norman Initial Build Scenario – Daily Directional Volumes



Downtown Inset:

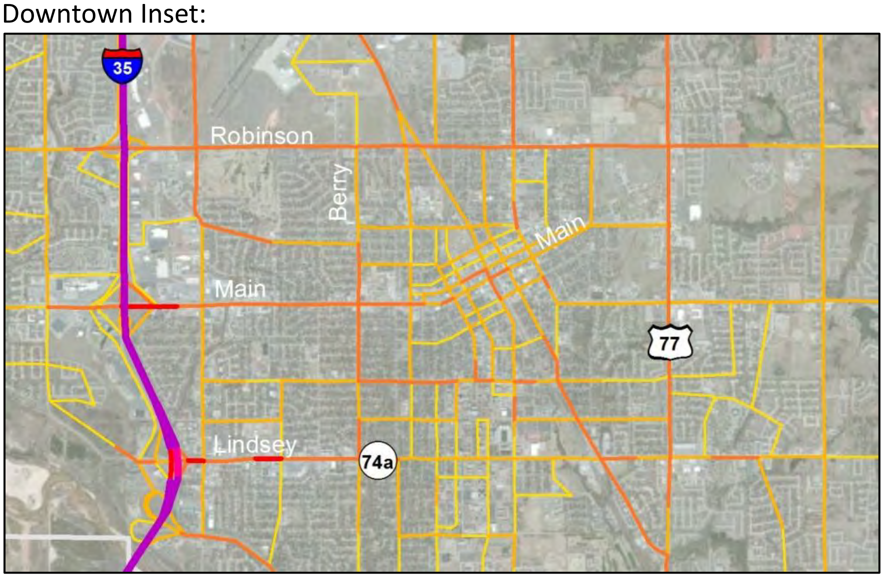
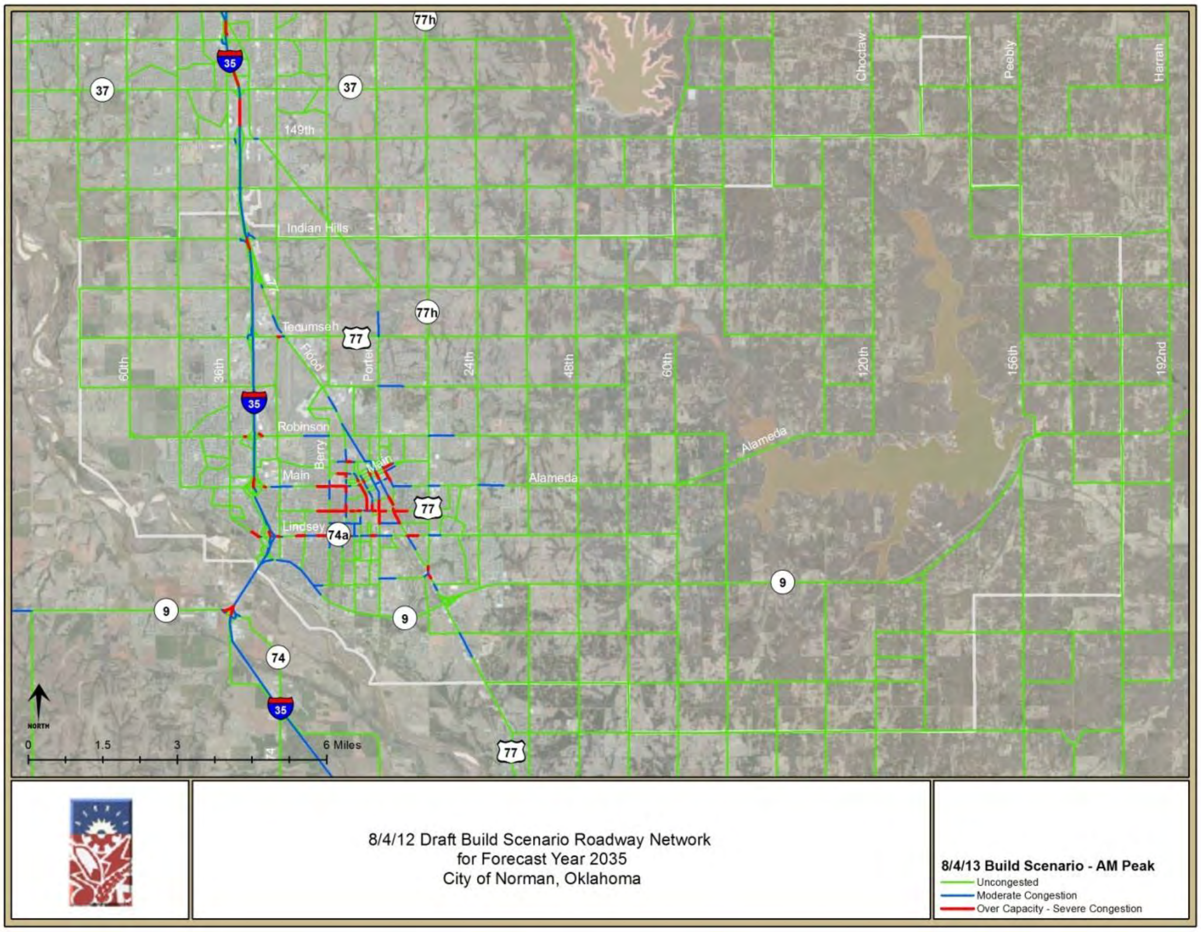


Figure 22: Norman Initial Build Scenario – AM Peak Congestion Levels



Downtown Inset:

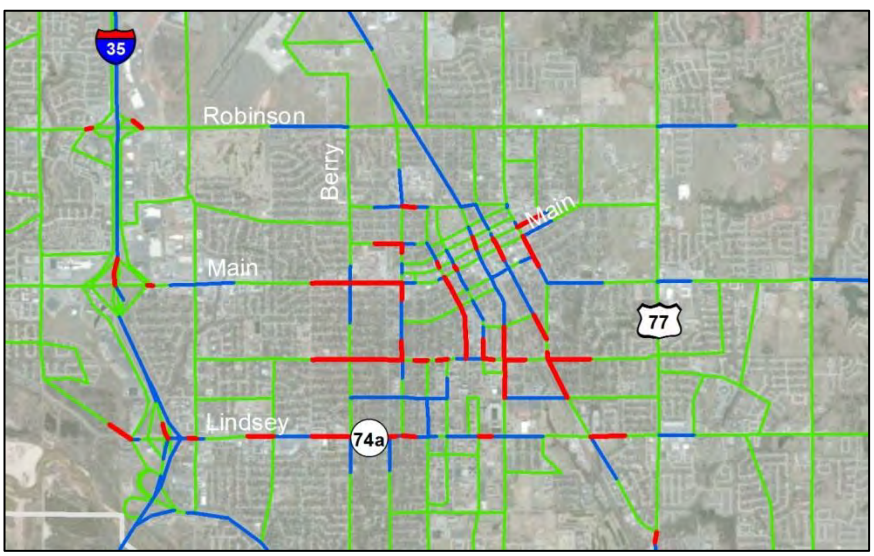
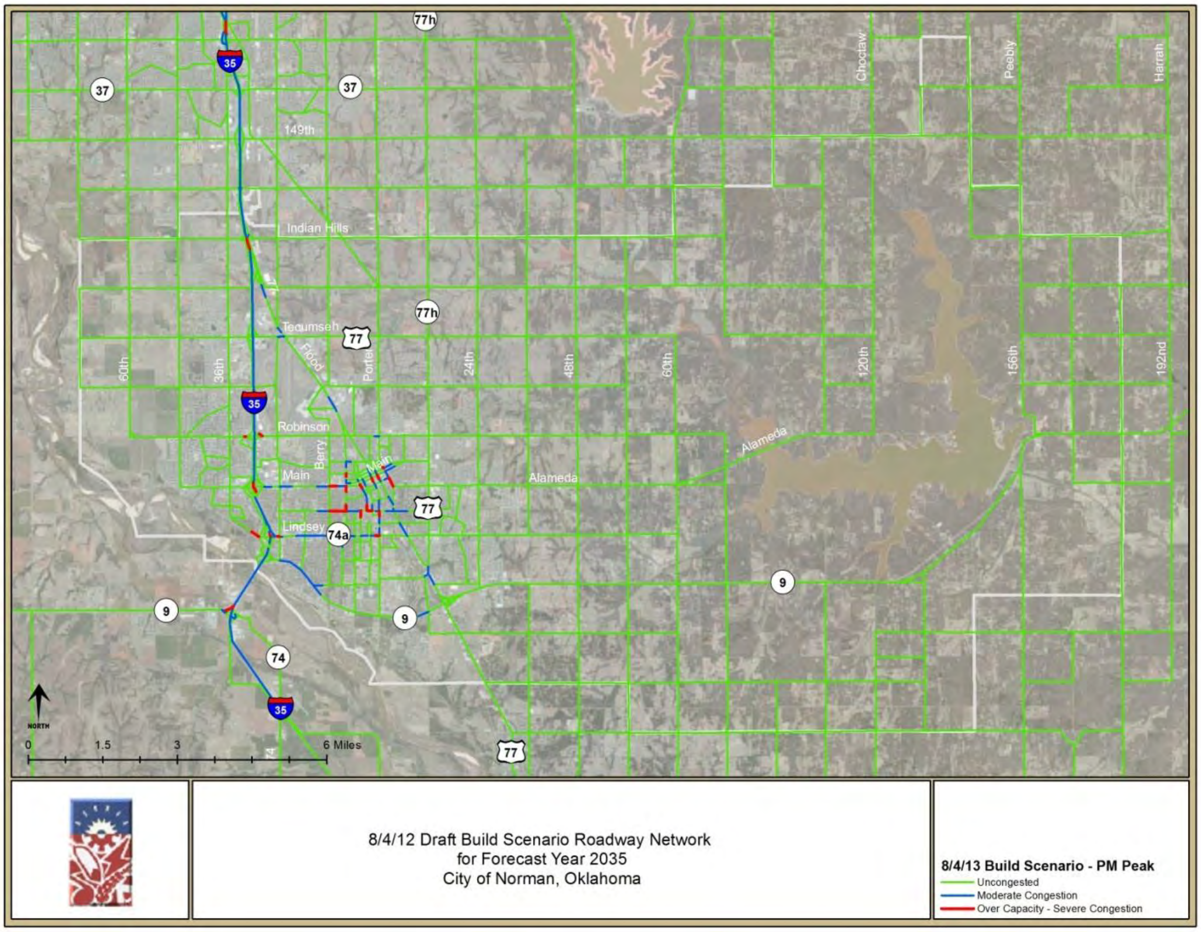
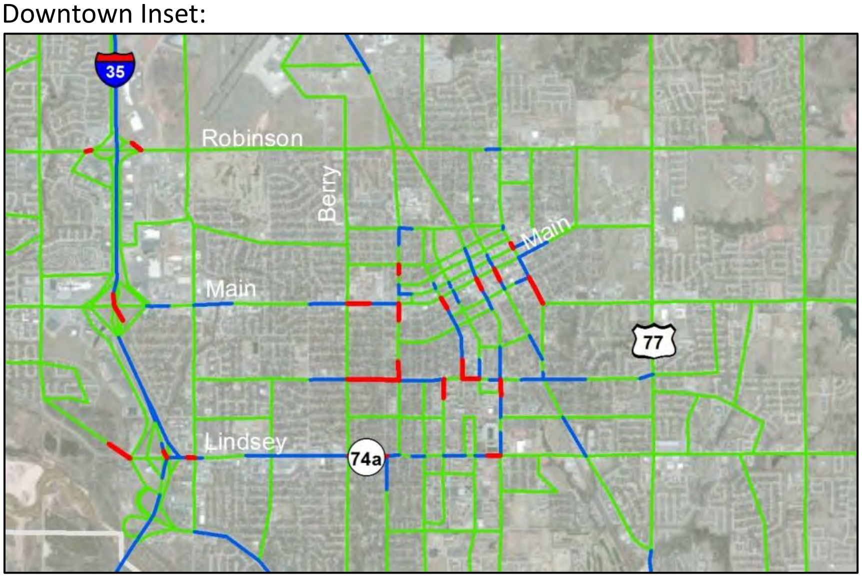


Figure 23: Norman Initial Build Scenario – PM Peak Congestion Levels



Downtown Inset:

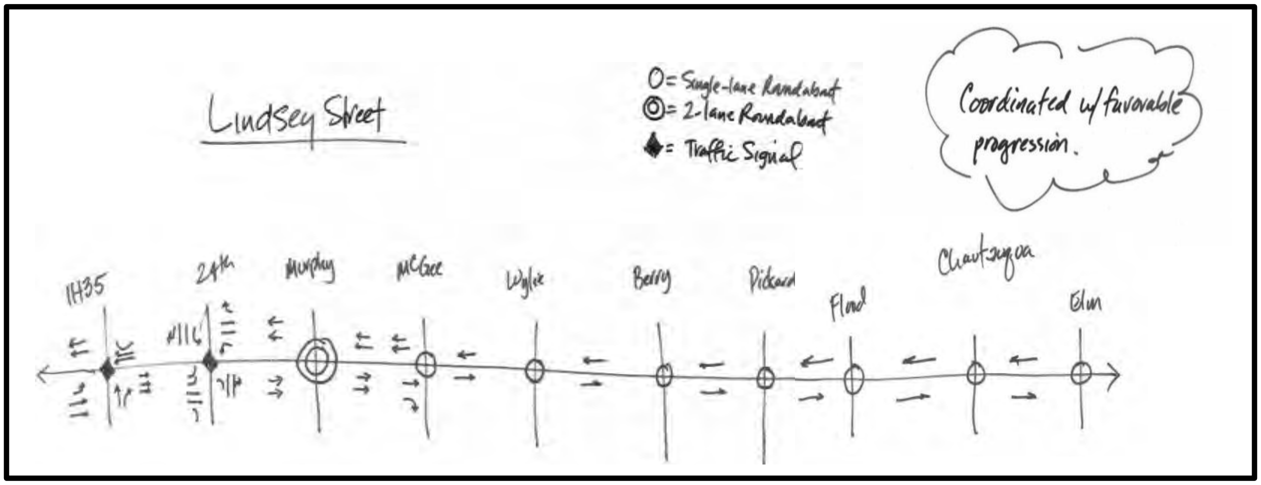


Special Scenario: Lindsey Street – 2-Lane with Roundabouts

The Lindsey Street corridor is an important corridor that provides east-west mobility, including access to the University of Oklahoma campus, which it bisects. It serves nearby commercial and residential areas, is marked by corridor-wide congestion and a higher than average number of traffic crashes.

In response to proposed capacity improvements along Lindsey Street east of I-35, City of Norman staff was approached by representatives of the University of Oklahoma to consider roundabouts as an alternative intersection design in combination with a 2-lane segment stretching from McGee Drive to Jenkins Avenue as is shown in Figure 24. The associated assumptions were that traffic signals would remain at the intersections of Lindsey Street with I-35 and 24th Avenue W, whereas a two-lane roundabout would be considered for the intersection with Murphy Street, and one-lane roundabouts would be implemented for all other intersections up to and including Elm Avenue. Lindsey Street would be reconstructed as a 4-lane divided facility between I-35 and McGee Drive and continue eastward to Elm Avenue as a 2-lane divided roadway. The proposed improvements were coded into the Enhanced E+C network.

Figure 24: Proposed Configuration for Lindsey Street



Source: Freese and Nichols

In comparison, the initial build scenario discussed in the previous section proposed no roundabout intersections, a build-out of Lindsey to a five-lane facility between 24th Avenue W and Berry Road, and four lanes between Berry Road and Elm Avenue.

Model Results

The proposed street improvements were coded and the resulting 2035 traffic forecast is shown in Figure 25 through Figure 28 below. The corridor is forecasted to experience peak period congestion along the proposed 2-lane segment, as volumes rise slightly due to the roundabouts allowing for a higher per hour throughput at the modeled intersections.

Limited traffic diversion occurred in response:

- Main: -2%
- Boyd: -4%%
- Chatauqua: -9%
- McGee: +9%
- Flood: +2%
- SH 9: +2%

Figure 25: Norman Lindsey 2-Lane Scenario – Number of Lanes

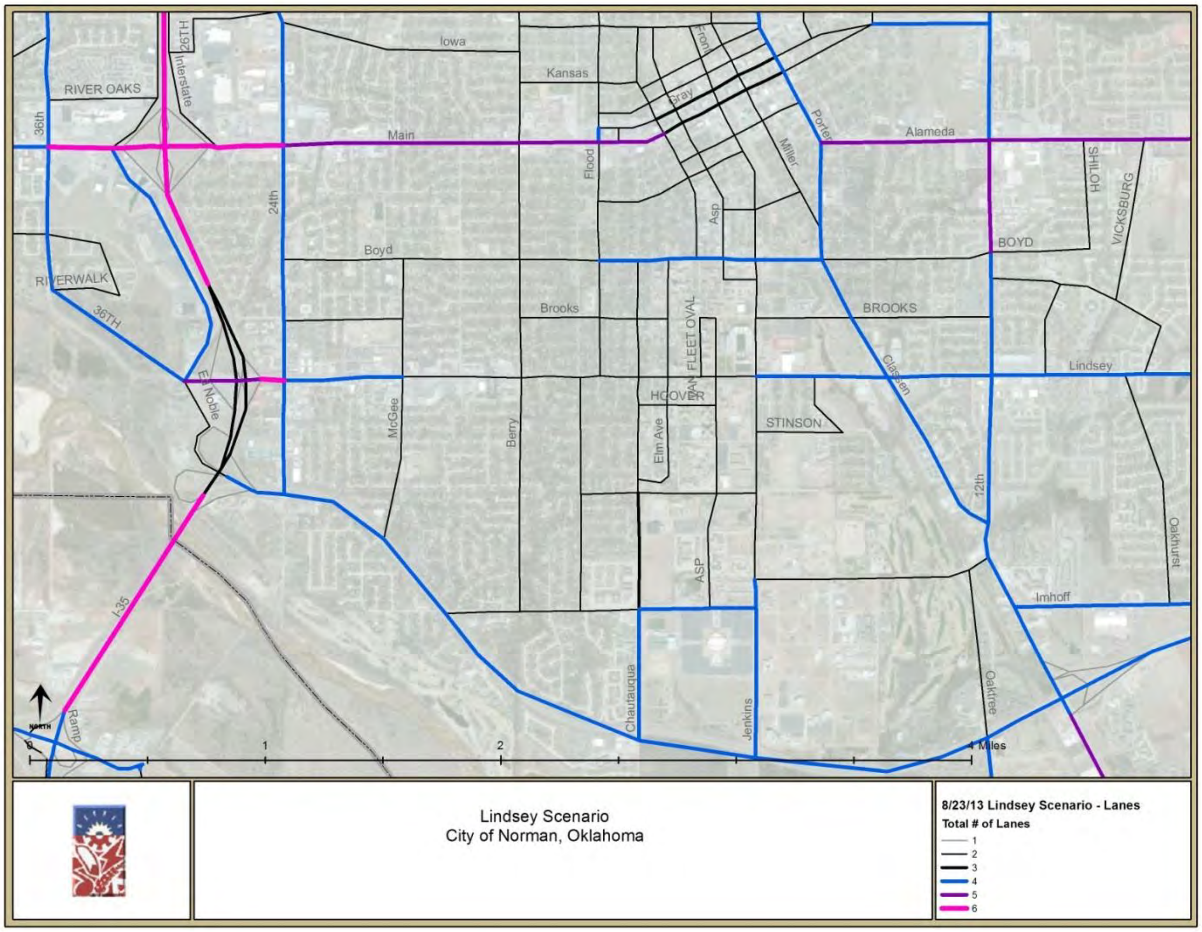


Figure 26: Norman Lindsey 2-Lane Scenario – Daily Directional Volumes

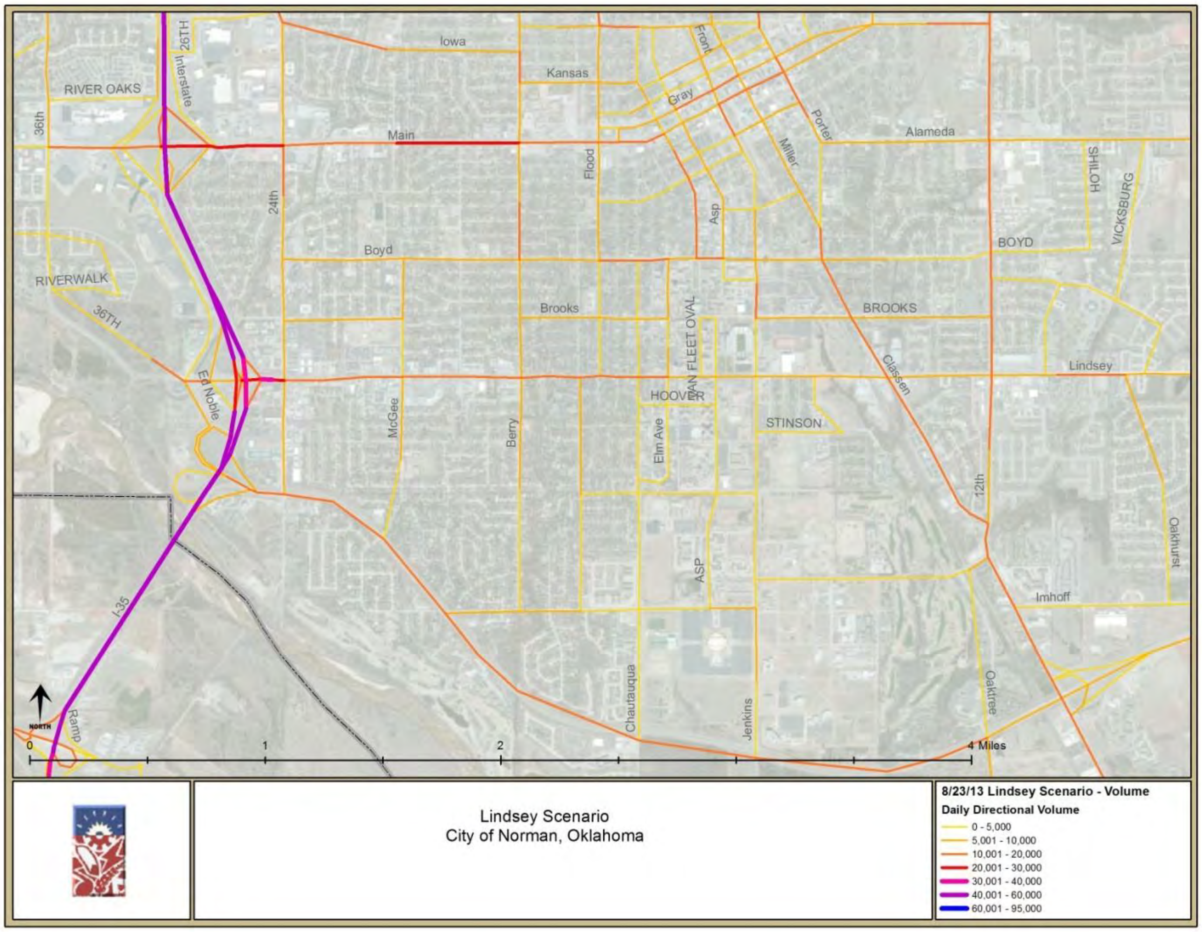


Figure 27: Norman Lindsey 2-Lane Scenario – AM Peak Congestion Levels

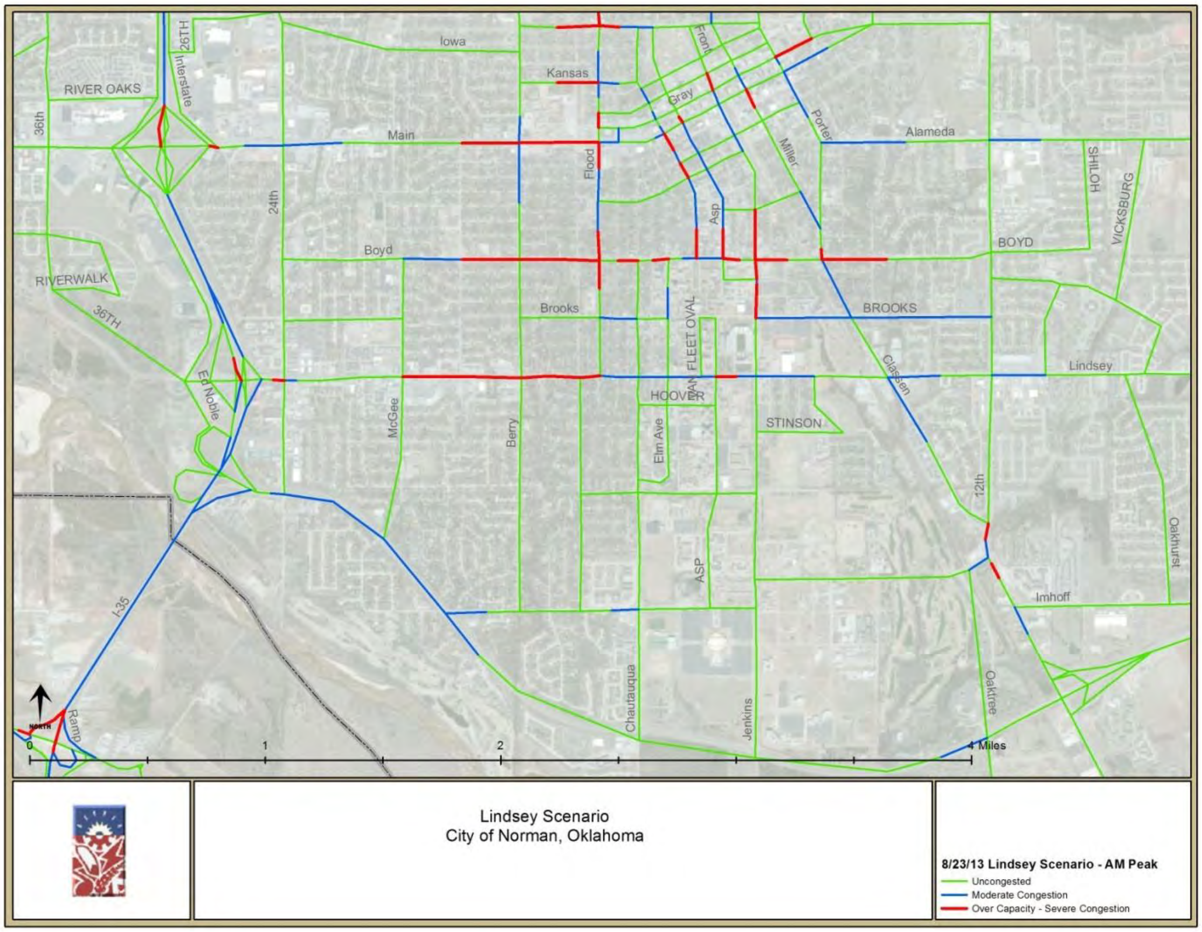
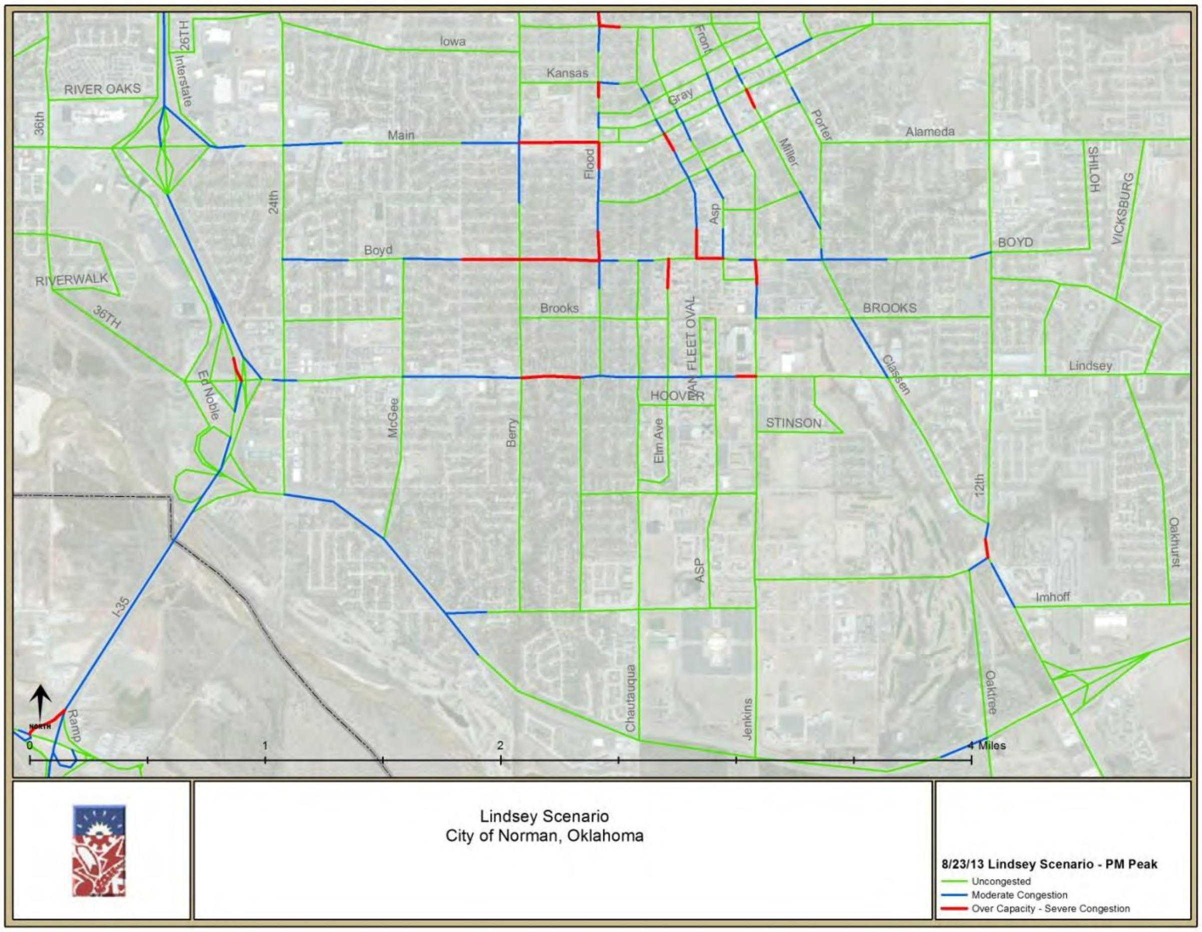


Figure 28: Norman Lindsey 2-Lane Scenario – PM Peak Congestion Levels



Recommendation

In light of Lindsey Street being a key linkage and dispersion of traffic to other corridors being minimal, the team made the following recommendations to City staff:

- Retention of Lindsey with 4-lanes between I-35 to Berry Road
- Roundabouts east of Berry Road
- Sidewalks and bike lanes
- Access management treatment

It was also suggested that micro-simulation of the corridor should be used to determine the ultimate operational configuration along Lindsey Street.

WORK CITED

Federal Highway Administration. (2010). *Travel Model Validation and Reasonableness Checking Manual, 2nd Edition.*

Federal Highway Administration. (1997). *Travel Model Validation and Reasonableness Checking Manual.*

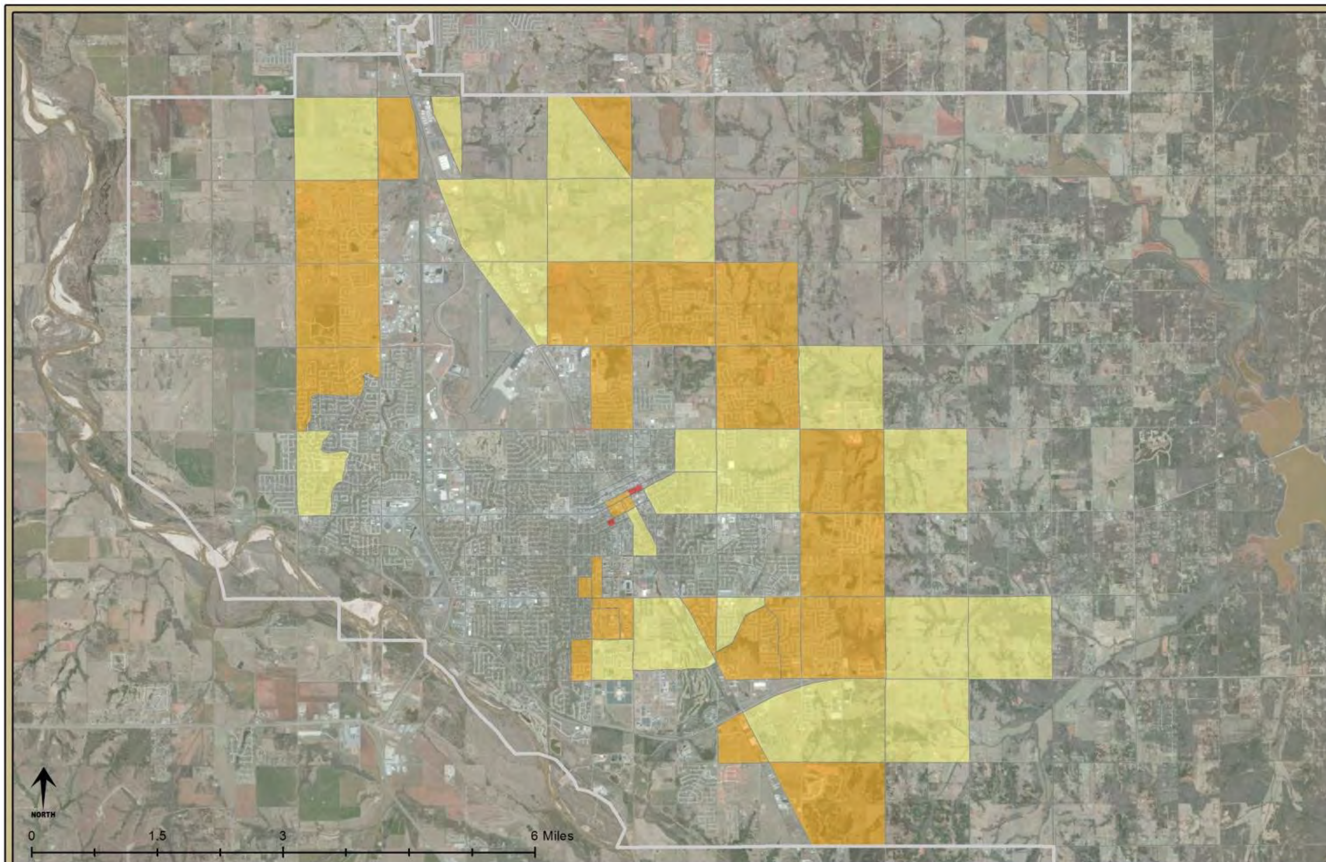
Initially submitted to city of Norman as
Technical Memorandum
February 1, 2013

1.0 TAZ Review related to forecasted Population & Employment Growth

For the purpose of "adequate coverage for anticipated growth", I reviewed all TAZs that showed a 25+% of growth in either population or employment, **if at least** a 500+ new pop change/sq mile or 100+ emp change/sq mile is forecasted for 2035.

1.1 *Population Growth Review*

Of 50 TAZs with a 500+ change in persons per square mile (see image below), approximately 39 showed an actual growth of more than 25%; of these 39, five TAZs with an area of less than 0.025 sq miles (16 acres) were removed from further consideration, as a refinement of the model network at this scale would not have improved the representation of traffic flows; the remaining 34 TAZs were reviewed in detail, but additional network modifications based on population growth were not thought to be necessary, as the TAZs in question were adequately represented in the model network.



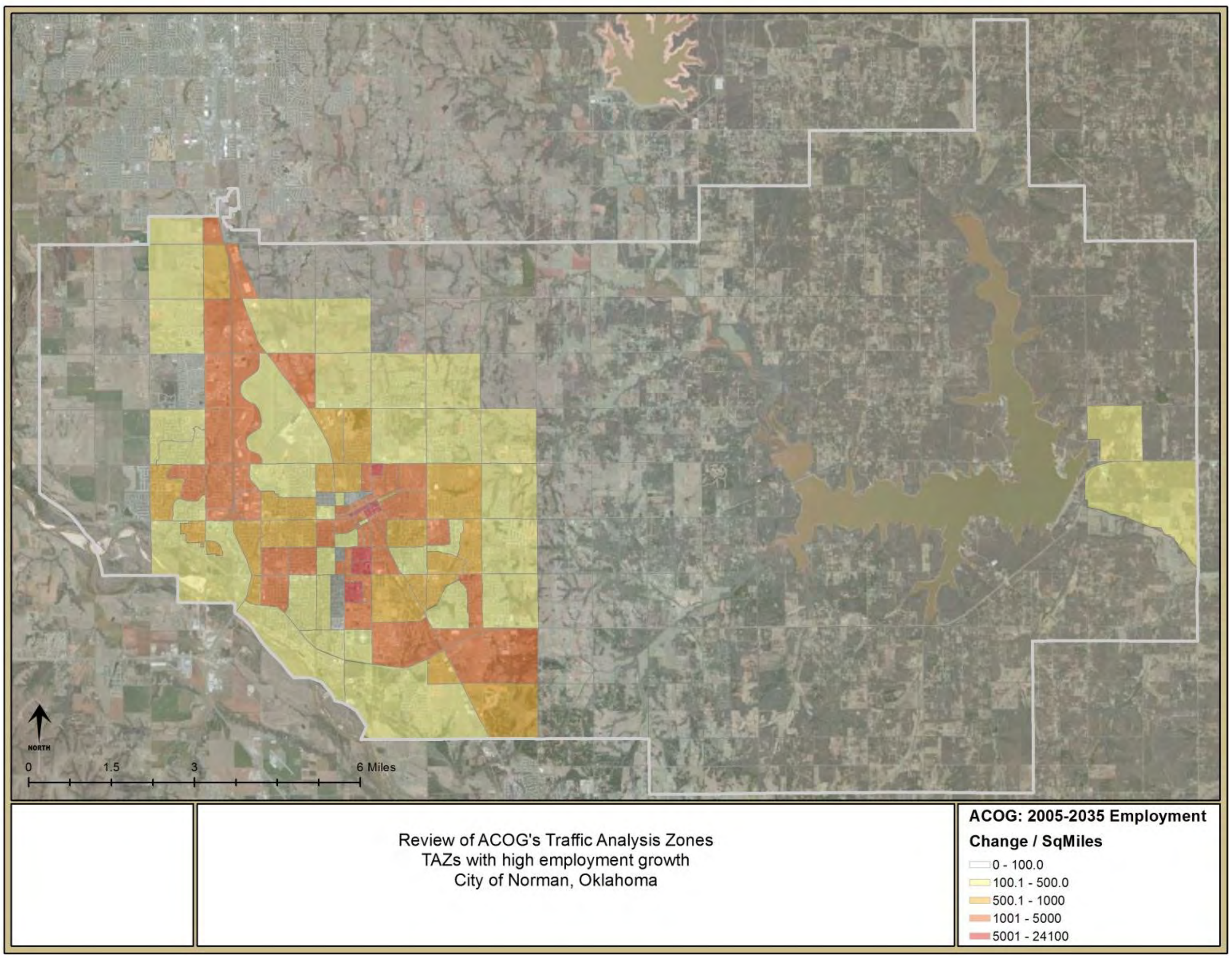
Review of ACOG's Traffic Analysis Zones
TAZs with high population growth
City of Norman, Oklahoma

ACOG: 2005-2035 Population Change / SqMiles
- 0 - 500.0
- 500.1 - 1000
- 1001 - 10000
- 10010 - 26870

1.2 *Employment Growth*

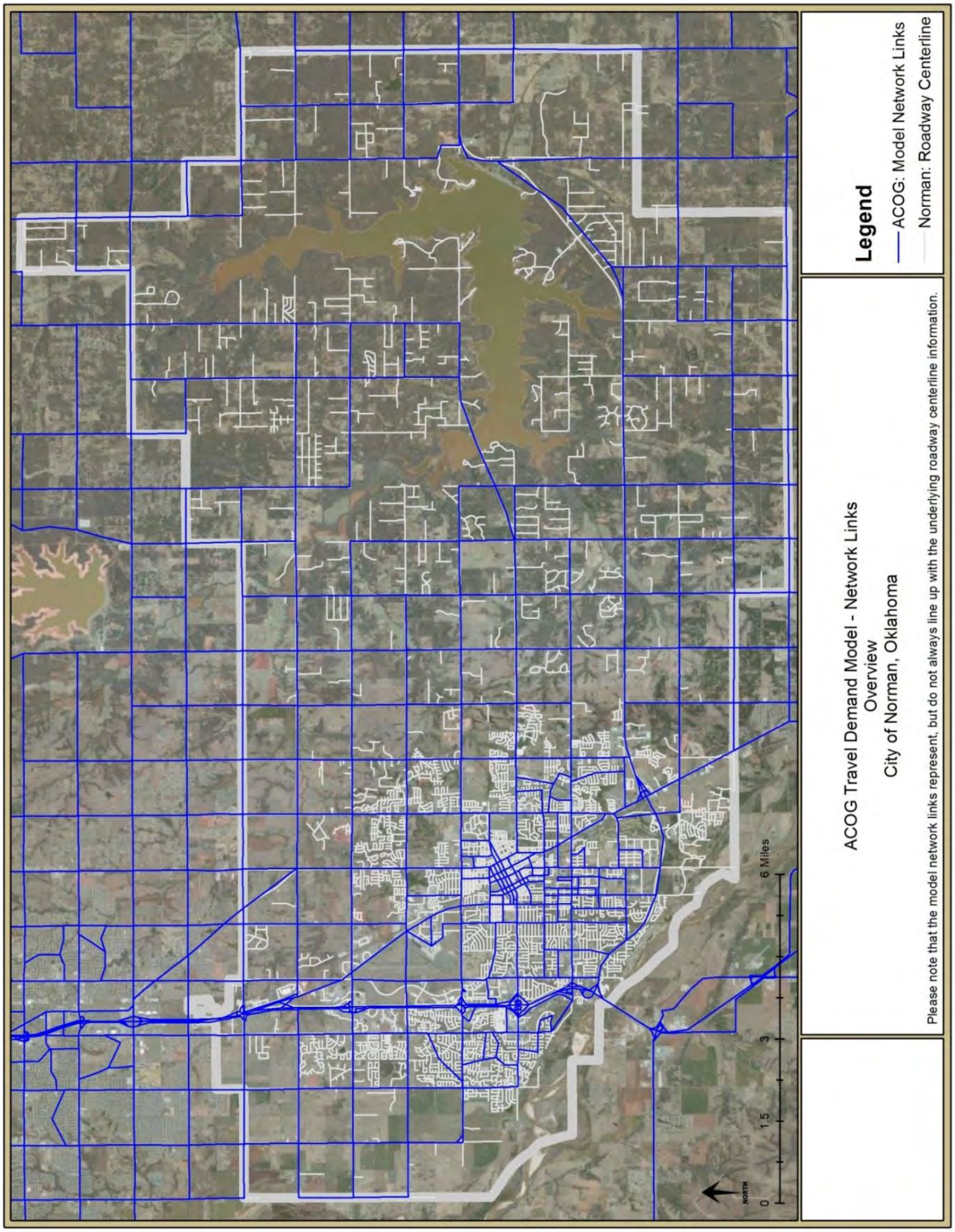
111 Norman TAZs are forecasted to have a growth of more than 100 employees per sq mile (see map below). 8 of the selected TAZs showed less than 25% growth over 2005 employment and were removed from the detailed analysis; 12 TAZs with an area of less than 0.025 sq miles (16 acres) were also eliminated from further consideration, as a refinement of the model network at this scale would not have improved the representation of traffic flows.

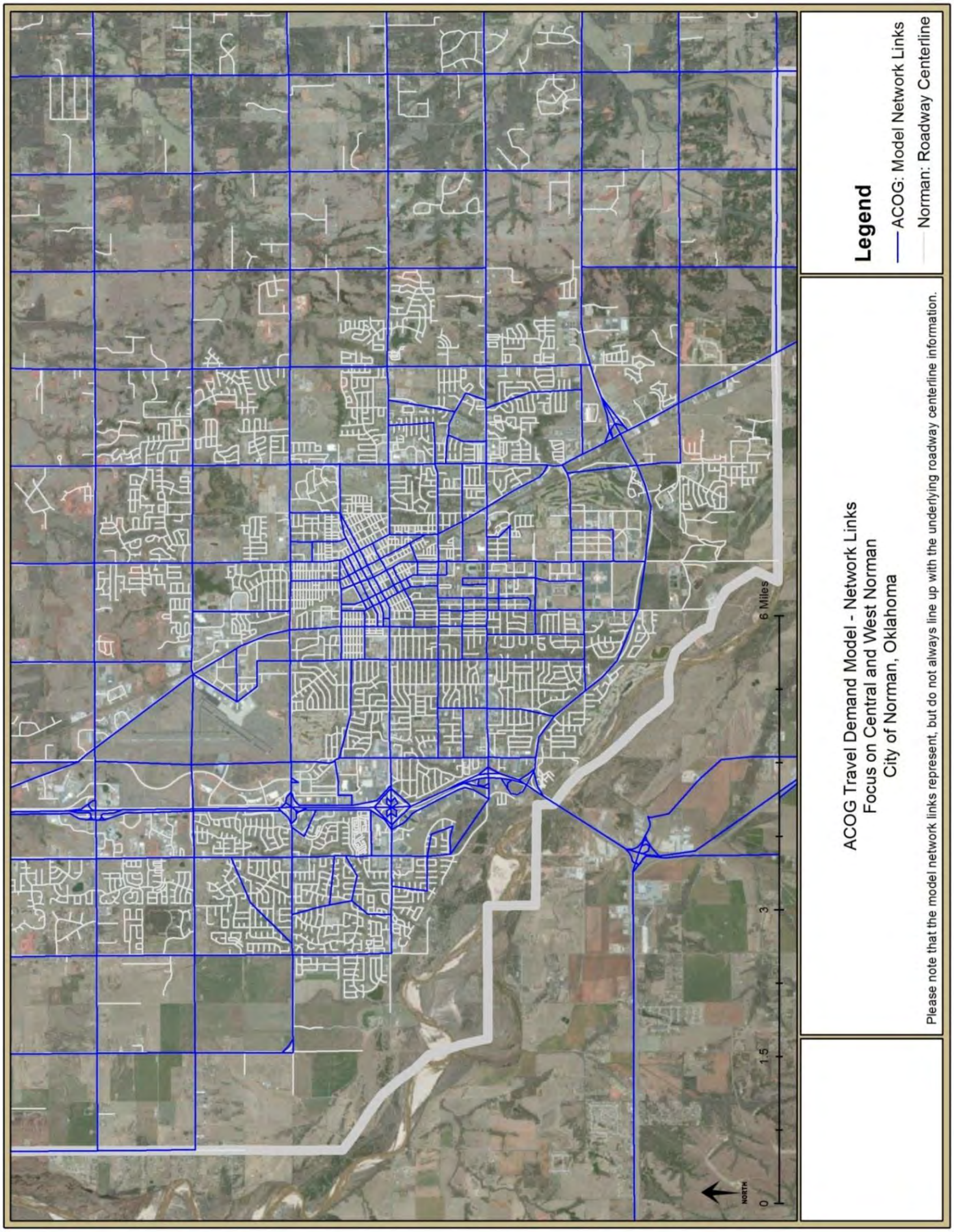
Of the 91 TAZs that underwent a more detailed assessment, 37 had already undergone a detailed review for population growth; the review of the remaining TAZs did not reveal any concerns about the high-growth TAZs not being captured adequately within the model network.



2.0 Network Review

The layout of links and centroid connectors within the ACOG travel demand model was reviewed in detail, to ensure a depiction of traffic flows within the City of Norman and reasonable access to each one of the traffic analysis zones within the jurisdiction. The figures on the next pages delineate the travel demand model network links and associated traffic analysis zones. The subsequent table details the findings of the analysis.


ACOG Travel Demand Model - Network Links
Overview
City of Norman, Oklahoma
Please note that the model network links represent, but do not always line up with the underlying roadway centerline information.
Legend
ACOG: Model Network Links
Norman: Roadway Centerline
0
1.5
3
6 Miles
NORTH


Legend
ACOG: Model Network Links
Norman: Roadway Centerline
ACOG Travel Demand Model - Network Links
Focus on Central and West Norman
City of Norman, Oklahoma
Please note that the model network links represent, but do not always line up with the underlying roadway centerline information.
0
1.5
3
6 Miles
NORTH