CITY COUNCIL CONFERENCE

MUNICIPAL BUILDING CONFERENCE ROOM
201 WEST GRAY, NORMAN, OK

JULY 12, 2016

5:30 P.M.

1. **DISCUSSION REGARDING CHANGE ORDER NO. ONE TO CONTRACT K-1516-122 BY AND BETWEEN THE NORMAN UTILITIES AUTHORITY AND URBAN CONTRACTORS, L.L.C., INCREASING THE CONTRACT AMOUNT BY $128,190 FOR A REVISED CONTRACT PRICE OF $1,912,870 AND EXTENDING THE CONTRACT TIME BY 30 CALENDAR DAYS FOR THE SEWER MAINTENANCE PROJECT FYE 2014, PHASE 1.**

2. **DISCUSSION REGARDING THE CONVERSION OF MAIN AND GRAY STREETS FROM ONE-WAY TO TWO WAY.**

ITEM 1
CHANGE ORDER WITH URBAN CONTRACTORS

City of Norman, OK

Municipal Building
Council Chambers
201 West Gray
Norman, OK 73069

Master

File Number: K-1516-122 CO1

File ID:	K-1516-122 CO1	**Type:**	Contract	**Status:**	Consent Item
Version:	1	**Reference:**	Item 23	**In Control:**	City Council
Department:	Utilities Department	**Cost:**	$128,190.00	**File Created:**	06/20/2016
File Name:	Change Order No. 1 - SMP14Ph1			**Final Action:**	

Title: CHANGE ORDER NO. ONE TO CONTRACT K-1516-122 BY AND BETWEEN THE NORMAN UTILITIES AUTHORITY AND URBAN CONTRACTORS, L.L.C., INCREASING THE CONTRACT AMOUNT BY $128,190 FOR A REVISED CONTRACT PRICE OF $1,912,870 AND EXTENDING THE CONTRACT TIME BY 30 CALENDAR DAYS FOR THE SEWER MAINTENANCE PROJECT FYE 2014, PHASE 1 AND BUDGET APPROPRIATION FROM THE SEWER MAINTENANCE FUND BALANCE.

Notes: ACTION NEEDED: Acting as the Norman Utilities Authority, motion to approve or reject Change Order No. One to Contract K-1516-122 with Urban Contractors, L.L.C., increasing the contract amount by $128,190 for a revised contract amount of $1,912,870 and extending the contract by 30 calendar days; authorize the execution thereof, and appropriate $14,866 from the Sewer Maintenance Fund Balance (321-0000-432.00-00) to Project WW0202, Sewer Maintenance Project FYE 2014, Construction (321-9338-432.61-01).

ACTION TAKEN: _____

Agenda Date: 07/12/2016

Agenda Number: 23

Attachments: Location map, Change Order K-1516-122, Purchase Order

Project Manager: Charlie Thomas, Capital Projects Engineer

Entered by: charlie.thomas@normanok.gov

Effective Date:

History of Legislative File

Version:	Acting Body:	Date:	Action:	Sent To:	Due Date:	Return Date:	Result:

Text of Legislative File K-1516-122 CO1

Body

BACKGROUND: In 2001, the citizens of Norman approved a five dollar per month sewer maintenance fee to provide for the systematic rehabilitation or replacement of aged and deteriorated sewer lines throughout our wastewater collection system. On April 22, 2016, the Norman Utilities Authority (NUA) approved Contract K-1516-122 with Urban Contractors, LLC (Urban) in the amount of $1,784,680 to replace sewer lines and manholes for the Sewer Maintenance Project FYE 2014, Phase 1 (SMP14Ph1). Construction began April 25, 2016, and is on schedule and within budget.

DESCRIPTION: During project construction, the Sewer Line Maintenance Division requested assistance to replace additional sewer lines and manholes in very poor condition. Proposed Change Order No. 1 (CO1)

consists of the requested extra work, about 1,600 feet of supplementary pipe-bursting along Boyd Street (see attached map). NUA staff requested, and Urban agreed to replace those lines and manholes at the contract unit prices. The current contract bid prices create excellent value for supplementary work during the project. The estimated cost of sewer line replacement under this change order is about $80 per foot. Typical sewer replacement costs in the past have approached $100 per foot.

Proposed CO1 will increase the contract amount about by $128,190 from $1,784,680 to $1,912,870 (7% increase). Urban requested, and staff recommends approval of a thirty (30) calendar day time extension for completion of the extra work.

The Fiscal Year Ending 2017 (FYE17) budget includes an unencumbered balance of $113,324 in SMP14 construction (account 321-9338-432.61-01; project WW0202), a shortfall of $14,866 to fund CO1. Staff recommends a supplemental appropriation of $14,866 from the Sewer Maintenance Fund balance (account 321-0000-432.00-00).

RECOMMENDATION: Staff recommends approval of that Change Order No. 1 with Urban Contractors, L.L.C., increasing the contract amount by $128,190 to $1,912,870 and extending the contract by 30 calendar days. Staff further recommends appropriation of $14,866 from the Sewer Maintenance Fund balance (account 321-0000-432.00-00) to Project WW0202, Sewer Maintenance Project FYE 2014, Construction (account 321-9338-432.61-01).

NORMAN UTILITIES AUTHORITY
CLEVELAND COUNTY
NORMAN, OKLAHOMA

DATE: June 21, 2016

CHANGE ORDER NO.: 1

CONTRACT NO.: Contract K-1516-122

PROJECT: Sewer Maintenance Project FYE 2014, Phase 1

CONTRACTOR: Urban Contractors, LLC
7113 No. Bryant
Oklahoma City, OK 73121

	Contract Time	Contract Amount
ORIGINAL:	270 calendar days	$1,784,680.00
PREVIOUS CHANGE ORDERS:	0 calendar days	$0.00
THIS CHANGE ORDER:	30 calendar days	$128,190.00
REVISED AMOUNT:	300 calendar days	$1,912,870.00

ORIGINAL START DATE: April 25, 2016

ORIGINAL COMPLETION DATE: January 20, 2017

PREVIOUS COMPLETION DATE: January 20, 2017

NEW COMPLETION DATE: February 19, 2017

Bid Item No.	**Pipe-burst existing sewer along W. Boyd Street** Description	Unit	Quantity	Unit Price	Total Price
2	Add OSHA Trench Safety	LF	1,610	$1.00	$1,610.00
3	Add Traffic Control	LS	1	$5,000.00	$5,000.00
9	Add Pipe-burst 8" to 10" HDPE	LF	1,610	$55.00	$88,550.00
11	Add Rehab Sewer Manhole	EA	12	$600.00	$7,200.00
16	Add Re-connect Services	EA	14	$230.00	$3,220.00
22	Add Site Restoration	LS	1	$21,000.00	$21,000.00
21	Post Construction Clean & TV	LF	1,610	$1.00	$1,610.00
	Total Increase				$128,190.00

SUBMITTED BY CONTRACTOR: James Parrish, P.E., Urban Contractors, LLC — Date: 7/5/16

RECOMMENDED BY STAFF ENGINEER: Charlie Thomas, P.E., Norman Utilities Authority — Date: 7/6/16

APPROVED AS TO FORM AND LEGALITY: City Attorney — Date: 7/6/16

ACCEPTED BY NORMAN UTILITIES AUTHORITY: Lynne Miller, Chair — Date:

ITEM 2
CONVERSION OF MAIN & GRAY STREETS FROM ONE-WAY TO TWO-WAY

Conversion of Main & Gray Streets from One-way to Two-way

Norman City Council Conference

Presented by:

Angelo Lombardo, P.E., City of Norman Transportation Engineer

Kevin St. Jacques, P.E., Freese and Nichols, Inc.

Norman, Oklahoma
July 12, 2016
5:30 p.m.

Overview

- Purpose
- Goals, Objectives
- Analysis
- Recommendations
- Pros & Cons
- Implementation

Purpose

History of Main & Gray Streets

- Originally configured as two-way streets
  - 1 lane each way plus angled parking
- Converted to one-way in 1974
  - Traffic Operations Program to Increase Capacity and Safety (TOPICS)
  - University Blvd to Porter Ave the most accident prone segment in Norman.
  - On-street parking was identified as one cause of the collisions
- Requests to convert back to 2-way began in 1990s
  - 2002 study recommended that Main and Gray Streets remain one-way
- 2014 Comprehensive Transportation Plan showed changing traffic patterns
  - Main & Gray Streets could be reduced by one travel lane thru Downtown
  - 6-foot buffers could be added between parking and two travel lanes
  - Recommendation for further analysis of converting Main & Gray to two-way
- Two-Way Implementation Study began in July 2015

FREESE AND NICHOLS

Purpose

Why Are One-Way Pairs Created?

- Streets grew, engineers provided solution
- Positive attributes of one-way couplets
  - Distributes traffic off the congested street
  - Reduces movement conflicts & crashes
  - Allows for better signal progression
  - Can reduce delay and emissions
  - Expands traffic exposure for development
  - Can allow room to retain/add parking on street
  - Can allow room to retain/add pedestrian space along street

Purpose

Benefits of one way pairs

Purpose

Why Convert Back to Two-way Streets?

- Negative attributes of One-way couplets vs. Two-way
  - Can induce higher traffic speeds
  - More complex traffic circulation
  - Splits development energy, neighborhoods
- Potential economic enhancements
- End terminus configuration issues
- Development intensity/attraction imbalance on pair
- Traffic volumes or traffic patterns change
- Development patterns change
- Consistent with Center City visioning process

Purpose

Downtown Norman

Focus Group

Name	Occupation/Business
Ashly Adair-Garner*	Real Estate - Adair & Associates, Fall Fest Organizer
Brent Swift	Developer - Brent Swift Design-Build
Ed Copelin	Retailer - Copelin's Office Suppy & Kidoodles Toys
Matt Robinson*	Banker - 1st Fidelity Bank
Brady Sexton	Restauranteur - Scratch Kitchen & Cocktails
Sam Talley	Attorney
Steve Calonkey	Retailer - Mr. Roberts Furniture
Nick Miglioriono	Norman Public Schools
Shawn O'Leary	CON - Director of Public Works
Susan Connors	CON - Director of Planning and Communtiy Developmen
Scott Sturtz	CON - City Engineer
David Riesland	CON - Traffic Engineer
Sara Kaplan	CON - Retail Marketing Coordinator
Angelo Lombardo	CON - Transporation Engineer

*Board Members of Norman Downtowners Association

Framework

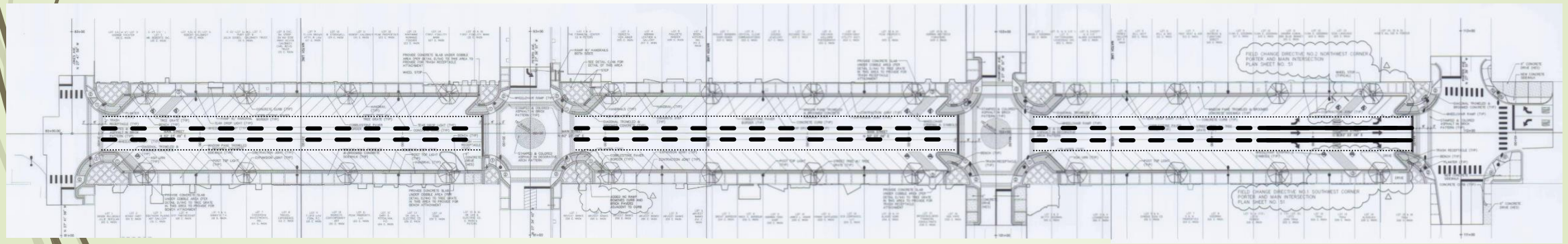
Goals, Objectives & Performance Measures

- **Goal: Provide for adequate Traffic Operations:** (40 pts)
  - Objective: Process future traffic with acceptable intersection LOS (20 pts)
  - Objective: Provide for acceptable traffic speed and progression (10 pts)
  - Objective: Accommodate train crossing interruptions (10 pts)
- **Goal: Provide for Pedestrian and Bicycle Mobility and Safety** (30 pts)
  - Objective: Minimize crossing distance for pedestrians (10 pts)
  - Objective: Provide acceptable spacing of controlled ped. crossings (10 pts)
  - Objective: Retain high quality sidewalk environment (10 pts)
- **Goal: Retain On-street Parking Supply** (30 pts)
  - Objective: Retain existing angled parking on Main and Gray Streets (15 pts)
  - Objective: Simplify and support access to downtown parking supply (15 pts)

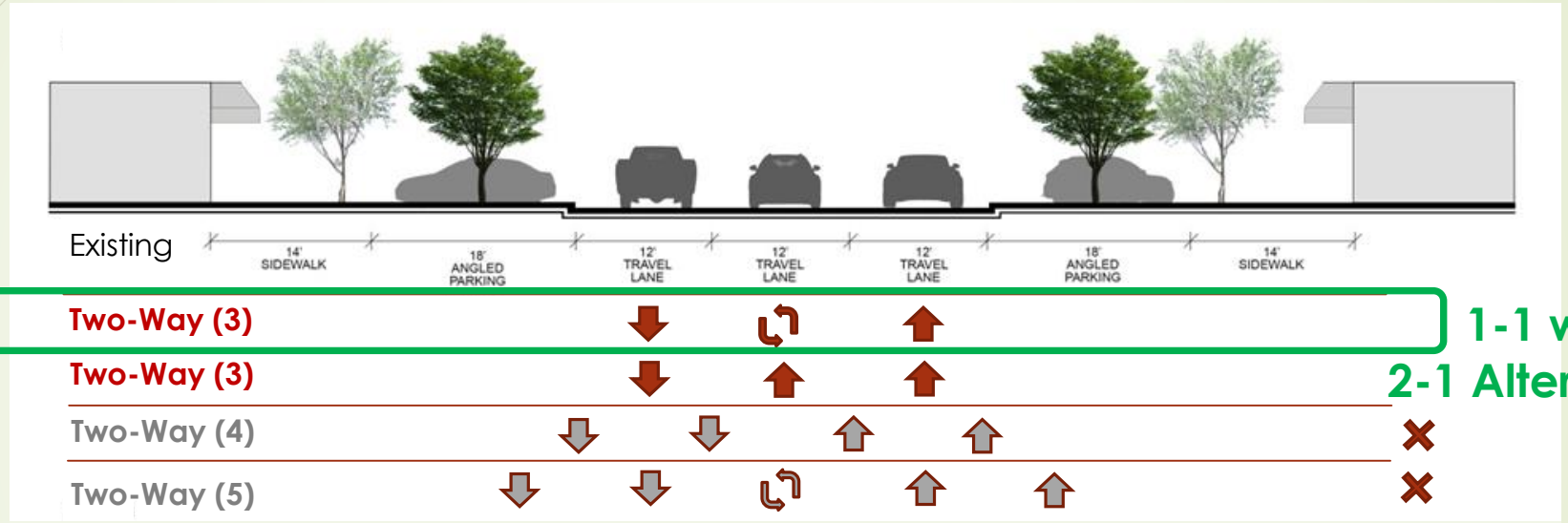
Framework

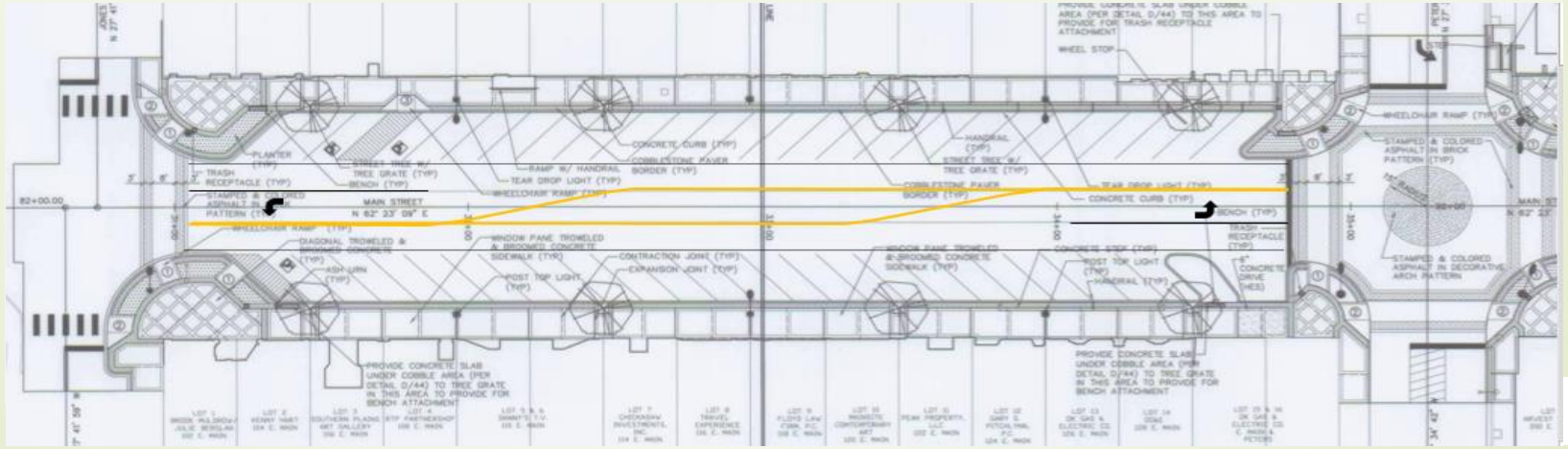
Existing One-Way Character

- One direction traffic flow in 3 lanes
- Angled parking both sides
- Bulb-outs for 36' Pedestrian crossing



Alternative Concepts

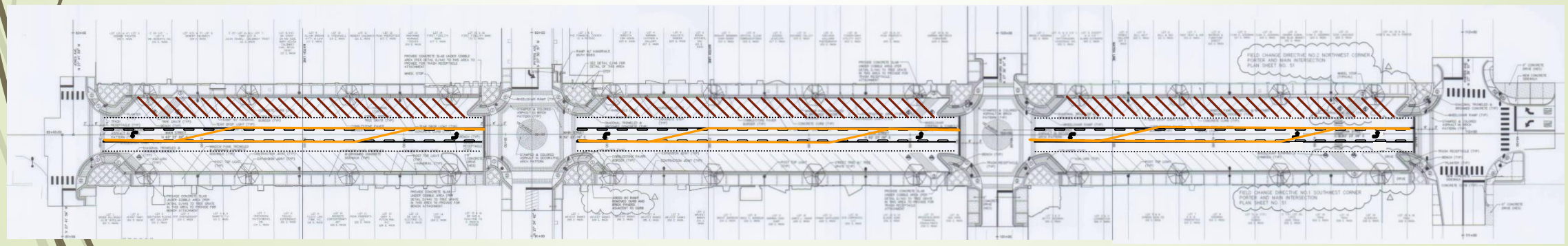




Framework

Desired Two-Way Character

- Two directional flow
- One lane each direction
- Left turn bays @ intersections
- Angled parking both sides
- Retain 36’ wide Crossings



Operations Analysis

Traffic Re-distribution onto Network

- James Garner Extension
  - Traffic from Flood
  - Traffic from Porter
  - Traffic onto Acres
  - Change on Main
  - Change on Gray

Existing vs Proposed

both with 20% Growth

Intersection	Existing One-Way Scenario 1.2 Growth Factor		Two-Way Conversion Scenario 1.2 Growth Factor With modifications	
	Control Delay (Sec/veh)	LOS	Control Delay (Sec/veh)	LOS
Gray Street at Flood Avenue	10.9	B	6.4	A
Gray Street at University Boulevard	10.2	B	12.2	B
Gray Street at Webster Avenue	10.5	B	6.8	A
Gray Street at Santa Fe Avenue	5.3	A	10.6	B
Gray Street at James Garner Boulevard	20.8	C	15.1	B
Gray Street at Jones Avenue	0.0	A	5.8	A
Gray Street at Peters Avenue	14.7	B	11.0	B
Gray Street at Crawford Avenue	1.4	A	5.4	A
Gray Street at Porter Avenue	17.8	B	20.3	C
Main Street at Flood Avenue	37.3	D	24.9	C
Main Street at Downtown Shopping Center	3.7	A	3.4	A
Main Street at University Boulevard	15.8	B	35.4	D
Main Street at Webster Avenue	23.2	C	50.8	D
Main Street at Santa Fe Avenue	4.2	A	20.8	B
Main Street at James Garner Boulevard	15.7	C	35.9	D
Main Street at Jones Avenue	1.0	A	10.6	B
Main Street at Peters Avenue	8.8	A	18.3	B
Main Street at Crawford Avenue	6.6	A	12.1	B
Main Street at Porter Avenue	17.3	B	37.7	D

Proposed Treatment

Two-Way Configuration Modifications

University

Webster

James Garner/RR/Jones

Porter

Proposed Treatment

Pros and Cons of Implementation

Factor	Positive Attributes	Negative Attributes
Traffic Operations	Creates a calmer traffic environment, better suited to Downtown destination. The new directional flow on both streets provides more direct access to destinations.	Higher average delay, lower LOS, parking interrupts flow of the one through lane
Train Crossings	Queuing traffic still has two lanes in each direction spread across two streets, queues generally dissipate after one traffic signal cycle	Traffic queues are about 1.5 to 2 times as long as existing, back of queue extends to over 3 blocks on Main Street during PM peak
Pedestrian Crossings	The bulb-outs are retained, keeping crossing distances minimal with good pedestrian visibility and accommodations	Pedestrians must watch for added conflicts from left and right turning vehicles from added traffic direction
Parking	Retains angled parking on both sides, center turn lane allows use of angled parking from both directions by smaller vehicles	Added cost to re-orient parking stalls and modify bulb-outs, large vehicles would need to turn from through lane to enter opposite side parking
Special Events	Downtown functional as a destination with same amount of angled parking and new parking garage, traffic flow more logical for visitors	High traffic generation events will not be as well accommodated for throughput.
Development	The two-way flow of traffic on both streets and the traffic calming allow for better visibility of businesses, less focus on passing through Downtown	Current pass-thru traffic may divert to other routes, reducing exposure. Delivery trucks will be forced to use sidestreets and alleys.

Proposed Treatment

Cost Estimate

Improvement	Estimated Costs
Traffic Signal Modifications (opposite flow signal assembly at 7 intersections – foundations, poles, signal heads)	$350,000
Traffic Signal Modifications at University Blvd int'ns at Main and Gray Sts.	$125,000
New traffic signals (4 intersections: James Garner Bld. @ Main and Gray Sts.; Lahoma and Jones Aves. @ Main St.)	$1,000,000
Intersection modification for WB Main St. @ Porter Ave.	$120,000
Intersection modification for NB University Blvd @ Main Street	$200,000
Intersection modifications for Webster @ Main Street	$120,000
Pavement Markings and opposing direction signage	$200,000
Railroad Crossing Improvements at Main, Gray (Quad Gates) and Supplemental Safety Devices for Railroad Quiet Zone	$2,000,000
James Garner Avenue 3-lane improvements from Acres Street to south of Main Street	$1,000,000
Total Potential Cost	$5,115,000
Design Fees for Implementation	$750,000
Total Implementation Costs	$5,865,000

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NEXT STEPS

Conclusion

- Converting Main and Gray Streets to two-way using the three existing travel lanes on each street will reasonably accommodate traffic operations with room for 20% growth.
- The preferred configuration on both Main and Gray Streets would provide one travel lane in each direction with the center lane used to create left turn pockets at intersections.

FREESE AND NICHOLS

NEXT STEPS

Key Issues for Implementation

- Consider "road diet" on one-way Main & Gray Street as an interim measure (per 2014 Norman CTP)
- Coordination with the City's Railroad Quiet Zone project
- Conduct Public Information/Discussion Meetings
- Identification of Funding Sources and Opportunities
- Confirm James Garner Avenue projected traffic volumes with ACOG

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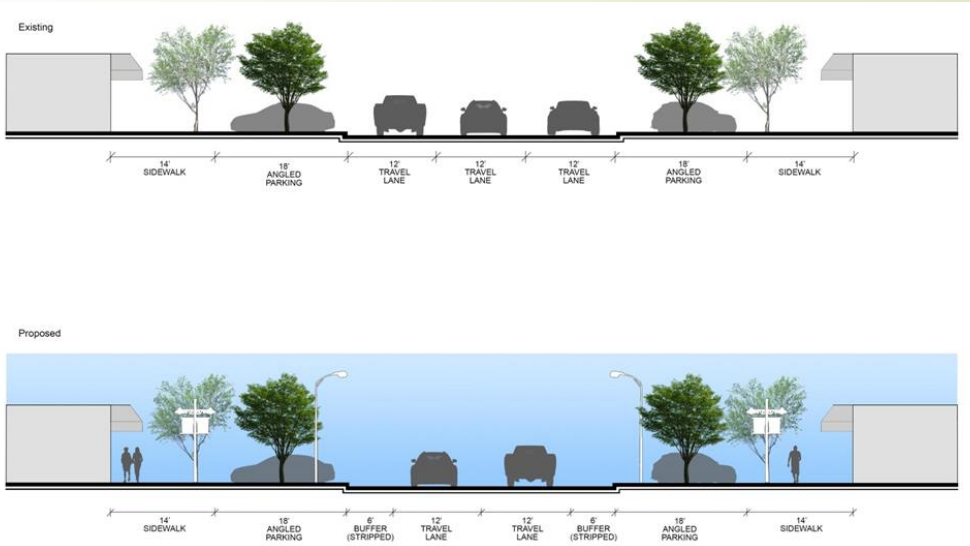
NEXT STEPS

Option: Main & Gray Street One-Way Road Diet

as proposed in the 2014 Comprehensive Transportation Plan

Match Line

Match Line



NEXT STEPS

Next Steps

1. Implement Railroad Quiet Zone
2. Construct James Garner Extension, Acres St. to Flood Ave.
3. Secure $5.8 Million funding for Main & Gray conversion
4. Prepare City Ordinance directing that Main and Gray Streets be two-way traffic operation
5. Detailed design of recommended improvements
6. Convert Main and Gray Streets to two-way operation

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Discussion

Operations Analysis

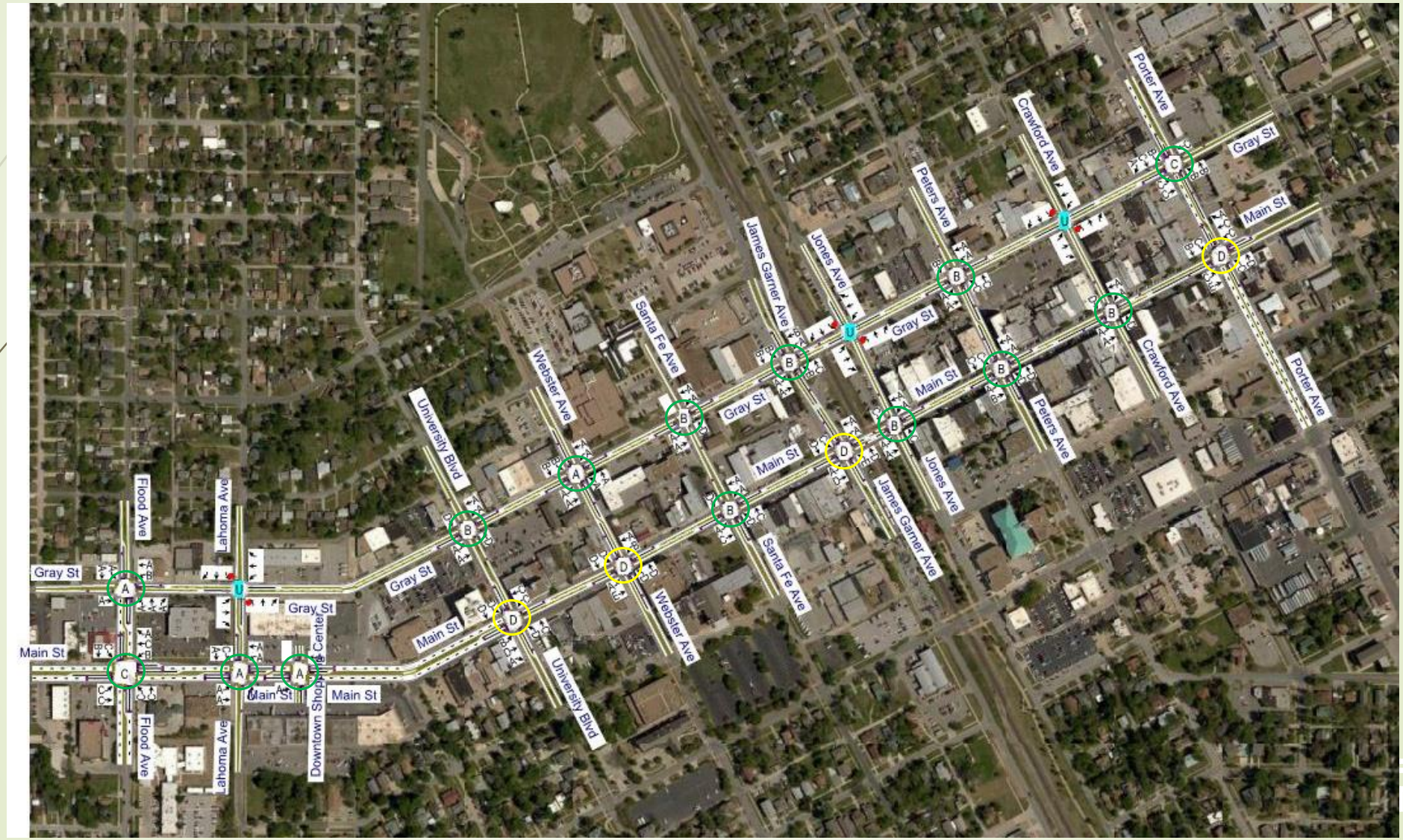
Recommended Configuration Traffic Performance

Intersection	Control	MOE	EB Movement			WB Movement			NB Movement			SB Movement			Overall
			Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	
Gray Street at Flood Avenue	Signal	LOS	7.7			11.0	5.1		4.3	5.0	0.4	7.8	6.4		6.4
		Delay	A			B	A		A	A	A	A	A		A
Gray Street at University Boulevard	Signal	LOS	3.2	1.4		1.4	2.8		39.9			53.5			12.2
		Delay	A	A		A	A		D			D			B
Gray Street at Webster Avenue	Signal	LOS	3.8	3.2		3.0	4.4		8.5	10.0		14.5	14.1		6.8
		Delay	A	A		A	A		A	A		B	B		A
Gray Street at Santa Fe Avenue	Signal	LOS	2.6	2.5		1.9	7.6		43.1						10.6
		Delay	A	A		A	A		D						B
Gray Street at James Garner Avenue	Signal	LOS	9.0	9.5		5.7	13.9		15.4	20.4		10.5	16.3		15.1
		Delay	A	A		A	B		B	C		B	B		B
Gray Street at Jones Avenue	TWSC*	LOS	8.5			7.8			28.9			27.2		11.9	5.8
		Delay	A			A			D			D		B	A
Gray Street at Peters Avenue	Signal	LOS	4.2	4.6		4.6	6.5		22.5	23.6		17.7			11.0
		Delay	A	A		A	A		C	C		B			B
Gray Street at Crawford Avenue	TWSC*	LOS	7.9			7.9			19.1			17.6			5.4
		Delay	A			A			C			C			A
Gray Street at Porter Avenue	Signal	LOS	28.2	20.4		28.2			14.4	11.3		17.3	31.8	2.8	20.3
		Delay	C	C		C			B	B		B	C	A	C
Main Street at Flood Avenue	Signal	LOS	27.5	24.6		15.0	28.7	0.3	29.6	23.0		20.8	17.5		24.9
		Delay	C	C		B	C	A	C	C		C	B		C
Main Street at University Boulevard	Signal	LOS	11.9	41.1	3.5	26.1	24.8		50.4	29.6		47.8	49.2		35.4
		Delay	B	D	A	C	C		D	C		D	D		D
Main Street at Webster Avenue	Signal	LOS	4.3	76.0		10.3	3.8		50.7	45.5		46.0	43.3		50.8
		Delay	A	E		B	A		D	D		D	D		D
Main Street at Santa Fe Avenue	Signal	LOS	1.4	26.6		5.6	4.6		43.1			41.2			20.8
		Delay	A	C		A	A		D			D			C
Main Street at James Garner Avenue	Signal	LOS	9.1	43.4		8.9	8.1		75.1	41.1		27.8	41.3		35.9
		Delay	A	D		A	A		E	D		C	D		D
Main Street at Jones Avenue	Signal	LOS	1.0	9.4		3.0	4.1		34.0			34.7			10.6
		Delay	A	A		A	A		C			C			B
Main Street at Peters Avenue	Signal	LOS	1.3	19.9		2.9	3.1		39.4	44.7		31.6	28.7		18.3
		Delay	A	B		A	A		D	D		C	C		B
Main Street at Crawford Avenue	Signal	LOS	0.8	6.7		5.4	6.6		49.1			45.8			12.1
		Delay	A	A		A	A		D			D			B
Main Street at Porter Avenue	Signal	LOS	20.6	56.5		32.0	29.4	0.5	26.3	52.4		34.1	17.9		37.7
		Delay	C	E		C	C	A	C	D		C	B		D

* Two-way stop controlled intersection. Delay based on HCM 2010 methodology

Operations Analysis

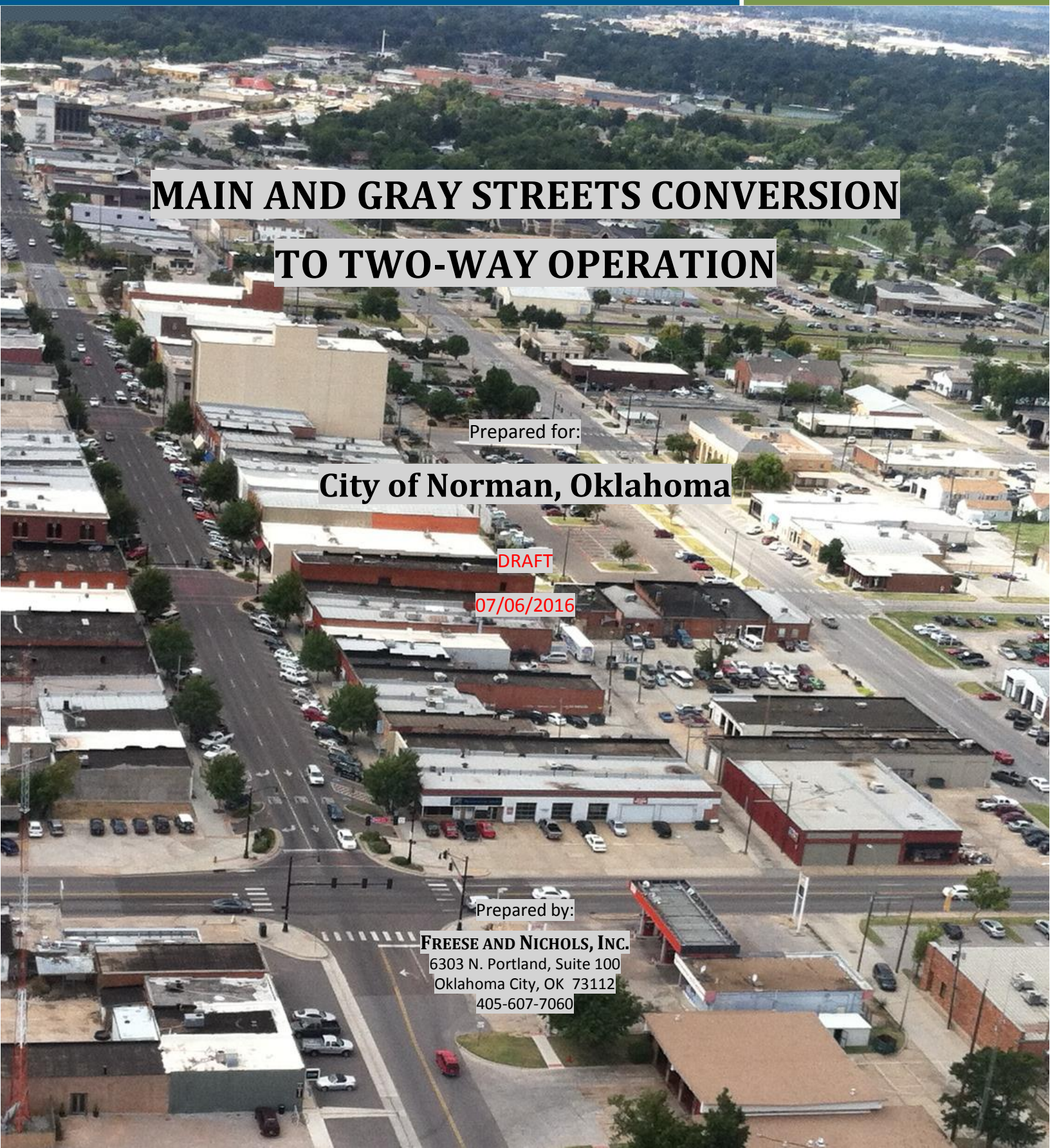
Traffic Operations of Two-Way Main & Gray



FREESE NICHOLS

FREESE AND NICHOLS

Innovative approaches
Practical results
Outstanding service



MAIN AND GRAY STREETS CONVERSION TO TWO-WAY OPERATION

Prepared for:

City of Norman, Oklahoma

DRAFT

07/06/2016

Prepared by:

FREESE AND NICHOLS, INC.
6303 N. Portland, Suite 100
Oklahoma City, OK 73112
405-607-7060

Innovative approaches
Practical results
Outstanding service

MAIN AND GRAY STREETS CONVERSION TO TWO-WAY OPERATION

Prepared for:

City of Norman, Oklahoma

DRAFT

THIS DOCUMENT IS RELEASED FOR THE PURPOSE OF INTERIM REVIEW UNDER THE AUTHORITY OF KEVIN ST. JACQUES, P.E., OKLAHOMA NO. 28215 ON 07-06-2016. IT IS NOT TO BE USED FOR CONSTRUCTION, BIDDING OR PERMIT PURPOSES.

FREESE AND NICHOLS, INC.
OKLAHOMA REGISTERED
ENGINEERING FIRM CA 511

Prepared by:

FREESE AND NICHOLS, INC.
6303 N. Portland, Suite 100
Oklahoma City, OK 73112
405-607-7060

NRN12443A

TABLE OF CONTENTS

Figures

Tables

APPENDICES

EXECUTIVE SUMMARY

The City of Norman retained Freese and Nichols, Inc. (FNI) to determine an approach for converting the Main and Gray Streets from a pair of one-way streets to two-way streets. The streets under study extend from University Boulevard to Porter Avenue through downtown Norman. The purpose of this study is to develop two-way alternatives that would maintain acceptable flow of traffic along Main and Gray Streets while creating a less intense traffic environment befitting the Downtown as a destination.

Conversion of Main Street and Gray Street to two-way operation is feasible using the existing three lanes of pavement currently provided. Keeping the conversion within the footprint of the existing three travel lanes will save costs and construction impacts to Downtown businesses. The provision of one lane in each direction with a dedicated left turn lane at intersections, preserving existing angled parking, will be an effective treatment that will suit the character of the Downtown street network and adjacent development. The configuration will adequately accommodate current daily traffic as well as future traffic conditions that would include the extension of James Garner Boulevard northward to Flood Avenue and allowance for 20 percent growth in traffic above what is currently experienced. There are both positive and negative aspects to this conversion, as summarized in the following table.

Factor	Positive Attributes	Negative Attributes
Traffic Operations	Creates a calmer traffic environment, better suited to Downtown destination. The new directional flow on both streets provides more direct access to destinations.	Higher average delay, lower LOS, parking interrupts flow of the one through lane
Train Crossings	Queuing traffic still has two lanes in each direction spread across two streets, queues generally dissipate after one to two traffic signal cycles	Traffic queues are about 1.5 to 2 times as long as existing, back of queue extends to over 3 blocks on Main Street during PM peak
Pedestrian Crossings	The bulb-outs are retained, keeping crossing distances minimal with good pedestrian visibility and accommodations	Pedestrians must watch for added conflicts from left and right turning vehicles from added traffic direction
Parking	Retains angled parking on both sides of the street where provided.	Some cost to re-orient parking stalls and modify bulb-outs, no use of parking on opposite side from flow of traffic
Special Events	Downtown functional as a destination with same amount of angled parking and new parking garage, traffic flow more logical for visitors	High traffic generation events will not be as well accommodated for throughput.
Development	The two-way flow of traffic on both streets and the traffic calming allow for better visibility of businesses, less focus on passing through Downtown	Current pass-thru traffic may divert to other routes, reducing exposure to businesses. Deliveries by truck will need to use side streets and alleys.

Acknowledgements

The study team would like to acknowledge the participation of the following members of the community that volunteered their time to meet with the study team as a focus group to discuss attributes of Downtown activities and traffic conditions, provide input into the formation of project goals and objectives, provide feedback on presentations of analyses, and provide comments on recommendations of the study. The following City of Norman (CON) staff members participated in technical support of the collaborative meetings with the focus group.

Focus Group Members

Name	Occupation/Business
Ashly Adair-Garner*	Real Estate - Adair & Associates, Fall Fest Organizer
Brent Swift	Developer - Brent Swift Design-Build
Ed Copelin	Retailer - Copelin's Office Suppy & Kidoodles Toys
Matt Robinson*	Banker - 1st Fidelity Bank
Brady Sexton	Restauranteur - Scratch Kitchen & Cocktails
Sam Talley	Attorney
Steve Calonkey	Retailer - Mr. Roberts Furniture
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Susan Connors	CON - Director of Planning and Community Development
Scott Sturtz	CON - City Engineer
David Riesland	CON - Traffic Engineer
Sara Kaplan	CON - Retail Marketing Coordinator
Angelo Lombardo	CON - Transporation Engineer

*Board Members of Norman Downtowners Association

1.0 INTRODUCTION

1.1 BACKGROUND

The City of Norman retained Freese and Nichols, Inc. (FNI) to determine an approach for converting the Main and Gray Streets, between University Boulevard and Porter Avenue, from a pair of one-way streets to two-way streets through downtown Norman as shown in Figure 1. The purpose of this study is to develop two-way alternatives that would maintain acceptable flow of traffic along Main and Gray Streets while creating a less intense traffic environment befitting the Downtown as a destination.

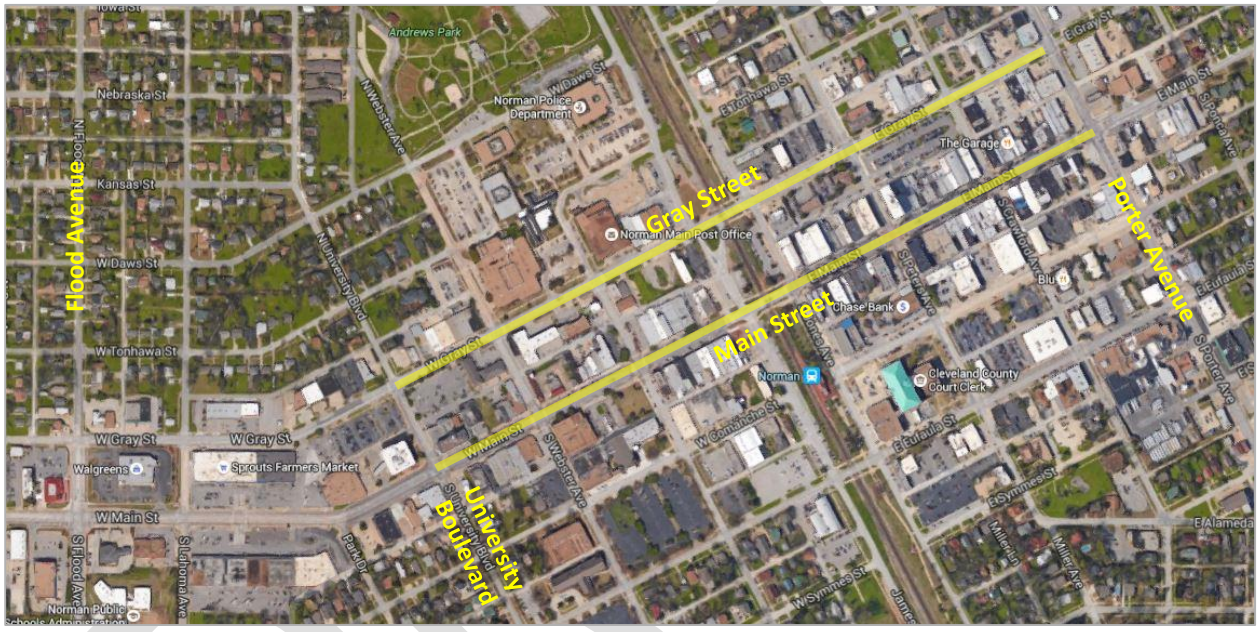

Figure 1. Study Area Location Map

Main and Gray Streets currently traverse through downtown as a pair of one-way streets between University Boulevard and Porter Avenue, with Main Street as the eastbound street and Gray Street as the westbound street. The land uses along the streets are a mixture of local retail, restaurant, service, and office. Main Street provides three one-way travel lanes with angle parking on both sides between University Boulevard and Porter Avenue. Gray Street also provides three one-way lanes with an assortment of angle parking, parallel parking and no parking on either side of the street between Porter Avenue and University Boulevard. Sidewalk bulb-outs have been provided at the corners to terminate the parking zones and allow minimal crossing distance for pedestrians. Posted speed along both streets is 25 mph, with a majority of current traffic measured to be traveling at between 25 and 30 mph. West of University Boulevard, both Main and Gray Streets are two-way operation. Continuing west of the study

area, Main Street serves as a five-lane major thoroughfare providing access to I-35, whereas Gray Street terminates one block west of Flood Avenue at N. Pickard Avenue adjacent to Norman High School. To the east of the study area beyond Porter Avenue, both Main and Gray Streets are two-lane two-way streets passing through a residential area for about four blocks, including two schools along Gray Street, before merging into a roundabout and continuing as one four-lane two-way street to a terminus at 12th Avenue NE.

1.2 HISTORY OF THE CORRIDOR

Main Street in downtown Norman was originally constructed as a two-way street with two traffic lanes (one per direction) and on-street parking (60-degree angle). It was reconfigured in the 1950's to include four 9-ft wide traffic lanes (two per direction). In 1968, City of Norman retained a consultant to develop a Traffic Operations Improvement Program. One of the recommendations was to convert traffic flow on Main Street and Gray Street from two-way to one-way.

The Federal-Aid Highway Act of 1968 focused attention on increasing operational efficiency of existing street and highway systems in urban areas by initiating TOPICS (Traffic Operations Program to Increase Capacity and Safety) administered by the Federal Highway Administration. A TOPICS Program for Norman was completed in March of 1971 and was accepted by Council resolution on May 4, 1971. Norman TOPICS identified Main Street, between University Boulevard and Porter Avenue as the most accident prone segment of roadway in the City of Norman. On-street parking was identified as the major cause of the collisions.

On April 17-18, 1974, the 39 members of the Norman Chamber of Commerce voted unanimously to approve the conversion of Main Street and Gray Street from two-way to one-way flow. On May 21, 1974, City Council voted unanimously to approve the conversion. On August 15, 1974, Main Street and Gray Street became one-way. 26 years after the conversion, in year 1990, City Council received a petition signed by 171 citizens requesting that traffic patterns on Main Street and Gray Street be returned to two-way.

On April 5, 1990, after becoming aware of the initiative to convert Main Street and Gray Street to two-way flow, the Norman Downtowners Association submitted a letter voicing objection over the conversion. On November 13, 2001, City Council retained a consultant to provide engineering services for the preparation of a Downtown Traffic Study to specifically look at the one-way – two-way situation. The study concluded that in order to maintain adequate traffic operations on Main Street and Gray Street under the

two-way scenario, five traffic lanes would be required on both facilities and the current angle parking converted to parallel parking. In conclusion, Council chose to keep Main Street and Gray Street as a one-way couplet.

The Comprehensive Transportation Plan (CTP), adopted by City Council in May 2014, included maintaining Main and Gray Streets as one-way streets but recommended that Main and Gray streets be reduced to two travel lanes each. Two lanes were identified as providing ample capacity for the 20-year growth expectations. The pavement would be re-striped to provide two travel lanes plus a six-foot buffer lane between the travel lane and the angled parking along each side of the street which would enhance the safety of backing out of angle parking and could also be utilized by bicyclists as a bike lane. The CTP also recognized the interest of Downtown businesses to further consider the potential conversion of Main and Gray Street to two-way operation.

Meetings and discussions that contributed to development of the City Center Form Based Code prompted the Norman Downtowners Association to approach City Council to reconsider Main and Gray Streets for conversion to two-way streets. Preliminary assessments were performed by city staff and a special traffic operations study was authorized by City Council to find an acceptable configuration for the conversion to two-way operations.

1.3 OPERATIONAL DATA COLLECTION

1.3.1 Existing Geometry

The typical existing cross-section of the one-way segments of Main and Gray Streets include three 12-foot wide travel lanes. On Main Street, 18-foot deep angled parking is provided on both sides, and 14- to 18-foot wide sidewalks extending from the parking to storefronts predominantly at the property line. This cross-section is depicted in Figure 2. Sidewalk bulb-outs are provided at the corners to enhance the visibility and shorten the crossing width for the pedestrian crosswalks. On Gray Street, some blocks have angled parking, some have parallel parking and some have no curbside parking, with a significant amount of off-street parking accessible from or abutting Gray Street.

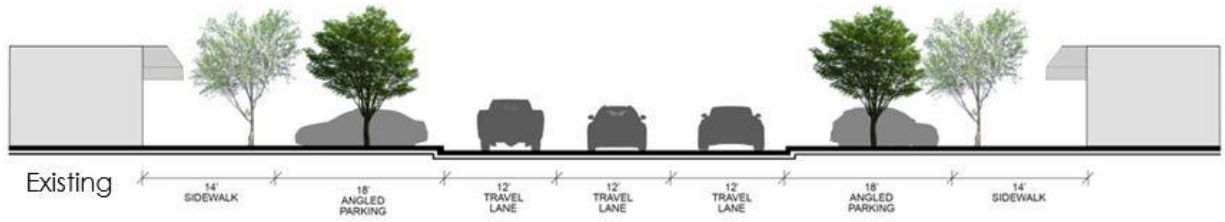

Figure 2. Existing Typical Cross-section of Main Street and some of Gray Street

1.3.2 Traffic Counts

Traffic counts were collected along Main and Gray Streets within the study limits by the City of Norman. 24-hour counts were collected for three consecutive days, Tuesday through Thursday, at the following locations:

- Main Street
  - One location between Webster Avenue and Santa Fe Avenue
  - One location between Peters Avenue and Crawford Avenue
- Gray Street
  - One location between Peters Avenue and Crawford Avenue
  - One location between Webster Avenue and Santa Fe Avenue

Additionally, directional Turning Movement Counts (TMCs) were collected on Tuesday, Wednesday or Thursday, during the AM peak period (7:00 am to 9:00 am), the midday peak period (11:00 am to 1:00 pm) and the PM peak period (4:00 pm to 6:00 pm) at the following locations:

- Main Street @ Flood Avenue
- Main Street @ Lahoma Avenue
- Main Street @ University Boulevard
- Main Street @ Webster Avenue
- Main Street @ Santa Fe Avenue
- Main Street @ James Garner Blvd.
- Main Street @ Jones Avenue
- Main Street @ Peters Avenue
- Main Street @ Crawford Avenue
- Main Street @ Porter Avenue
- Gray Street @ Flood Avenue
- Gray Street @ Lahoma Avenue
- Gray Street @ University Boulevard
- Gray Street @ Webster Avenue
- Gray Street @ Santa Fe Avenue
- Gray Street @ James Garner Blvd.
- Gray Street @ Jones Avenue
- Gray Street @ Peters Avenue
- Gray Street @ Crawford Avenue
- Gray Street @ Porter Avenue

These traffic volumes form the basis for the development of traffic volumes under the two-way conversion and future growth scenarios and for analysis of the existing and future conditions. The traffic counts are included in Appendix A.

1.3.3 Parking Operations

On-street angled parking currently exists on either side of Main Street between University Boulevard and Porter Avenue. Along Gray Street, parking provisions differ block to block. There is little to nor angled parking along the south side of Gray Street which is served mostly by private off-street parking and the large public surface parking lot between Crawford and Peters Avenues. Along the north side of Gray Street, except between Santa Fe and Webster Streets (in front of City Hall/Library), angled parking is provided along some of each of the blocks supplemented with pockets of private off-street parking. Parking maneuvers were counted by the city staff during the PM peak hour on Main and Gray Streets. Along Main Street, the highest parking activity was observed towards the eastern end of the study corridor between Jones Avenue and Porter Avenue due to retail and restaurant establishments. Along Gray Street, the highest parking maneuvers were observed along the north side of the street between Santa Fe Avenue and James Garner Boulevard serving the post office. The entering and exiting parking maneuver counts by street block and side of the street are presented in Table 1.

Table 1. Parking Maneuver Counts along Main and Gray Streets

		University to Webster		Webster to Santa Fe		Santa Fe to James Garner		James Garner to Jones		Jones to Peters		Peters to Crawford		Crawford to Porter	
		Ent.	Ext.	Ent.	Ext.	Ent.	Ext.	Ent.	Ext.	Ent.	Ext.	Ent.	Ext.	Ent.	Ext.
Gray Street	North Side	4	6			32	42			0	1	19	24	5	7
	South Side					0	0			0	0			1	2
Main Street	North Side	4	5	7	6	16	16			14	12	16	17	20	22
	South Side	5	3	2	4	10	14			13	20	8	13	18	16

An inventory of existing on-street parking spaces along Main and Gray Streets is provided in Table 2.

Table 2. Available On-Street Parking Spaces along Main and Gray Streets

		University to Webster	Webster to Santa Fe	Santa Fe to James Garner	James Garner to Jones	Jones to Peters	Peters to Crawford	Crawford to Porter
Gray Street	North Side	10		19		9	20	8
	South Side			9		4		8
Main Street	North Side	20	20	18		26	26	23
	South Side	15	18	24		24	25	23

On-street parking operations can have a negative impact on traffic flow. In particular, the backing-out maneuver from head-in angled parking interrupts the flow of traffic in the adjacent lane, resulting in a corresponding reduction in the flow capacity of the travel lane. It was noted in the History of the Corridor section that head-in parking was identified as a major cause for collision back when the streets were two-way with no buffer space for backing-out maneuvers. Consideration may want to be given for instituting back-in angled parking, which provides better parking exit visibility of oncoming traffic.

Three new parking garages are proposed to be constructed in Downtown in the near future: one near the courthouse, one using the existing surface parking lot between Main and Gray Streets, and one just west of the railroad tracks across from the Post Office. The first facility to be built is proposed to be located near the county courthouse, one block south of Main Street on Comanche Street between Peters and Jones Avenues, and is anticipated to ultimately provide 800 parking spaces. Provision of a concentrated location for longer term parking in this area of Downtown may reduce some of the traffic circulation on Main and Gray Streets seeking parking. Access and Circulation accommodations will need to be considered for this concentration of traffic activity.

1.3.4 Pedestrian Activity

Similar to the parking activity, the highest number of pedestrian crossings across Main Street was observed towards the eastern end of the study corridor between Jones Avenue and Porter Avenue due to retail and restaurant establishments. The number of observed pedestrian crossings across Main and Gray Streets was collected by the City staff during the PM peak hour, and the hourly crossing values are presented in Table 3.

Table 3. Pedestrian Crossing Activity Observed in the PM Peak Hour

		University	Webster	Santa Fe	James Garner	Jones	Peters	Crawford	Porter
Gray Street	Northbound	1	5	2	6	0	17	3	3
	Southbound	2	7	2	5	0	1	1	1
Main Street	Northbound	4	4	11	0	10	11	20	8
	Southbound	3	4	10	0	7	9	14	8

As with on-street parking operations, pedestrian crossing activity can have a negative impact on traffic flow. In particular, at signalized intersections, pedestrians cross the streets in conjunction with the green indication for that directional movement, and can interfere with the flow of right turning and left turning traffic. This interference can result in a corresponding reduction in the flow capacity of the travel lane that

allows those turning movements. The regular daily street operations experience very little delay due to pedestrian movements, but this effect has been accounted for in the modeling of street performance.

1.4 EXISTING LAND USES

The land uses along Main and Gray Streets within the Central Business District (CBD), between Park Drive and Porter Avenue are predominantly commercial in nature, consisting of retail, restaurant, office, services, and parking uses. There are also a number of vacant lots and vacant building spaces along both Main and Gray Streets. Table 4 summarizes an estimate of the current development mix along the corridor in the CBD area. The distribution of land uses in terms of square footage of land along Main and Gray Streets in the CBD area with the Main and Gray Street study area is shown in Figure 3.

Table 4. Current Development along Main and Gray Streets in CBD

Land Use Category	Distribution of CBD Parcels by Land Use				Grand Total
	Main Street		Gray Street		
	West of RR	East of RR	West of RR	East of RR	
Green Space	0	0	2	0	**2**
Office	22	25	6	6	**59**
Parking	6	8	2	0	**16**
Residential	1	0	0	0	**1**
Restaurant	2	6	3	7	**18**
Retail	4	9	1	7	**21**
Service	11	10	8	7	**36**
Vacant	9	6	1	2	**18**
Warehouse	0	0	1	3	**4**
Grand Total	**55**	**64**	**24**	**32**	**175**

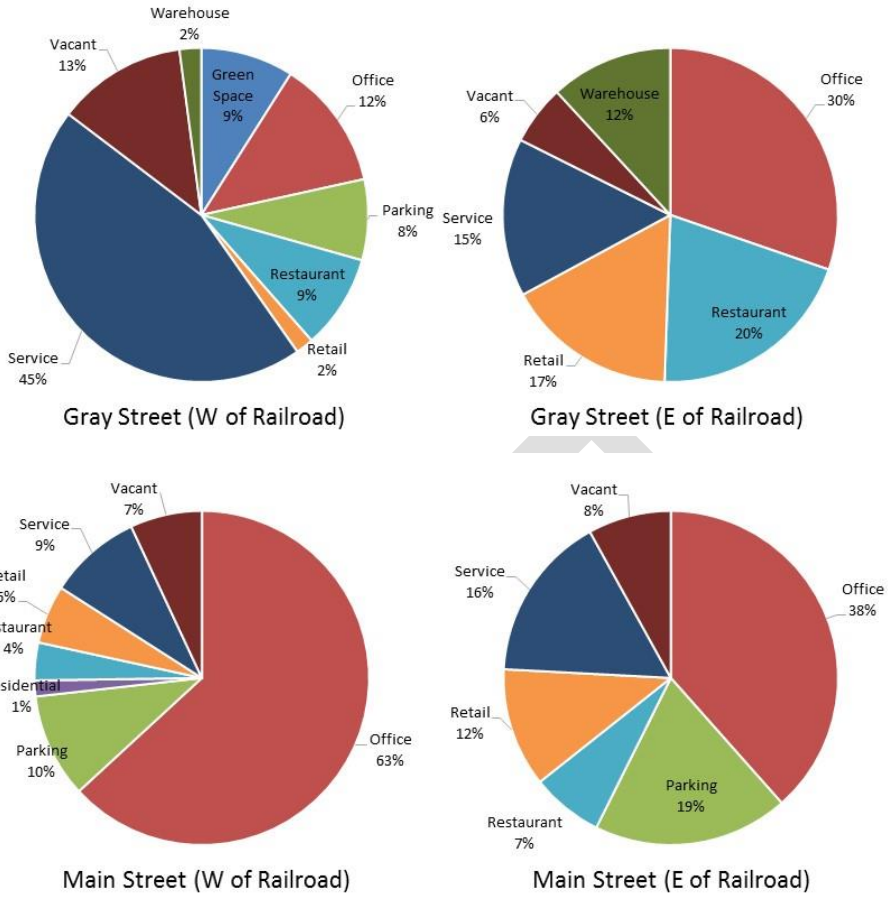

Figure 3. Distribution of Land Use (Sq. Ft. of Land) along Main and Gray Streets in CBD

1.5 HISTORICAL CRASH DATA

Historical crash data for the study corridor from January 2009 to June 2015 were obtained from the City of Norman. Figure 4 shows the location of crashes on Main and Gray Streets for the last three years (2012 to 2015). A high occurrence of crashes was found near the west end of the study corridors between Flood Avenue and University Boulevard. The crashes were concentrated on Main Street near the Downtown Shopping Center that experiences high driveway traffic activity. Additional summaries from the historical crash data for years 2009 through 2014 in the study corridors is presented in Figure 5.

Figure 4. Location of Crashes on Main and Gray Streets (2012-2015)

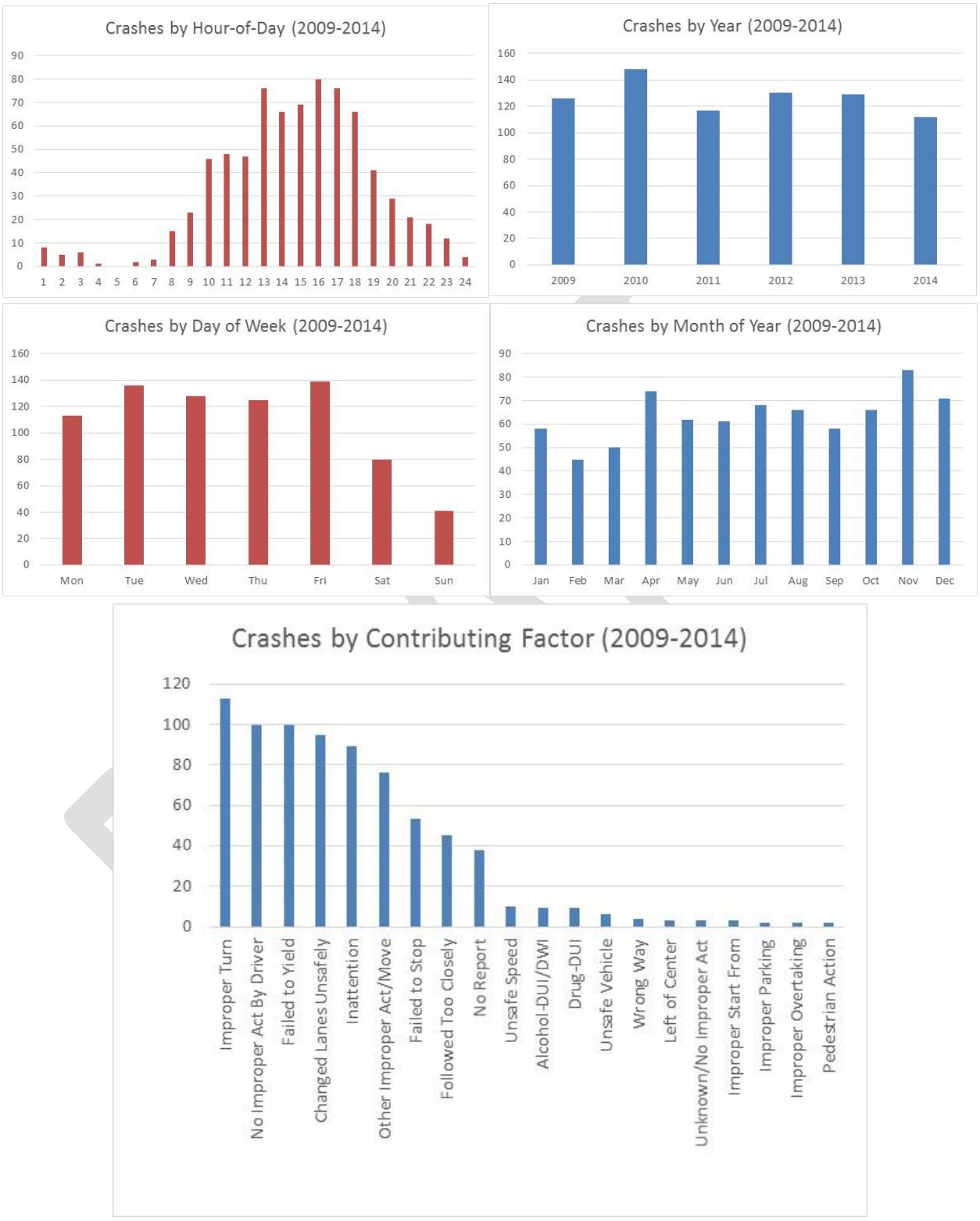

Figure 5. Summaries from Historical Crash Data along Main & Gray Streets (2009-2014)

2.0 OPERATIONS ANALYSIS

2.1 PERFORMANCE CRITERIA

The following set of multimodal performance goals and objectives were developed to guide the development of viable alternatives, initial screening of the alternatives, and further evaluation of alternatives. Weights were assigned to the goals to express their relative importance.

- **Goal: Provide for adequate Traffic Operations:** (40 points)
  - Objective: Process future traffic volumes with acceptable intersection LOS
  - Objective: Provide for acceptable traffic speed and progression
  - Objective: Accommodate railroad interruptions
- **Goal: Provide for Pedestrian and Bicycle Mobility and Safety** (30 points)
  - Objective: Minimize crossing distance for pedestrians
  - Objective: Provide acceptable spacing of controlled pedestrian crossings
  - Objective: Retain high quality sidewalk environment
- **Goal: Retain Access to Ample Parking Supply** (30 points)
  - Objective: Retain existing angled parking on Main and Gray Streets
  - Objective: Simplify and support access to downtown parking supply

2.2 ESTIMATES OF FUTURE TRAFFIC VOLUMES

An essential input into the assessment of converting Main and Gray Streets to two-way operation is the estimation of traffic volumes for the new operating pattern.

2.2.1 Reallocation of Traffic Movements from One-Way to Two-Way

Several distinct reallocations of existing traffic movements were made, as described below. Figures showing these traffic reallocations and the resulting net traffic turning movement volumes at each intersection are included in Appendix A.

1. Southbound Flood Avenue Left Turns – Half of existing southbound left turns from Flood Avenue to Main Street were moved to Gray Street
2. Westbound Traffic from East of Porter – Half of westbound through traffic on Gray Street at Porter Avenue was moved to Main Street at Porter Avenue

3. Northbound Right Turns from South of Main Street – Half of existing northbound right turns at Main Street were moved to northbound right turns at Gray Street (for streets between and including University and Crawford)
4. Southbound Left Turns from North of Gray Street – Half of existing southbound left turns at Main Street were moved to southbound left turns at Gray Street (for streets between and including University and Crawford, excluding Santa Fe)
5. Northbound Left Turns from South of Main Street – Half of existing northbound left turns at Gray Street were moved to northbound left turns at Main Street (for streets between and including Webster and Porter)
6. Southbound Right Turns from North of Gray Street – Half of existing southbound right turns at Gray Street were moved to southbound right turns at Main Street (for streets between and including Webster and Porter, excluding Santa Fe)
7. The traffic redistributed onto Main or Gray Street were then allocated to turn left or right at intersections consistent with existing turning movement percentages between Porter and Webster Avenues.
8. Westbound Gray Street at University Boulevard – At the westbound approach at University Boulevard, in the PM peak, 70% of diverted traffic was removed from the left turn and 30% from the through movement. The 30% through at University was equally adjusted (15% each) at westbound left turns at Lahoma Avenue and at Flood Avenue. For the AM peak hour, these percentages were changed to 60%/40% at University, with 20% from each of the left turns at Lahoma and Flood Avenues.

James Garner Boulevard Extension

In addition to the reallocation of existing one-way traffic to the proposed two-way operation of Main and Gray, additional adjustments were made to represent the proposed northward extension of James Garner Boulevard to Flood Avenue. The proposed extension of James Garner Boulevard is included in the Norman CTP, and to estimate the impacts of the proposed extension on the traffic patterns with the study limits of Main and Gray Streets and cross-streets, inferences from the travel demand model runs used in development of the CTP were used. The model indicated that the proposed extension of James Garner Boulevard would provide another important north-south connection across downtown serving as an alternative route to the use of Flood Avenue and Porter Avenue to pass through Downtown, and is estimated to carry approximately 8,000 vehicles per day in year 2035. The adjustments to the reallocated

two-way traffic in the study area to reflect the extension of James Garner Boulevard is included in Appendix A.

2.3 DEVELOPMENT AND SCREENING OF ALTERNATIVES

The set of possible reconfigurations of Main and Gray Streets were initially considered to include the following potential treatments, illustrated in Figure 6, that would fit within the street right-of-way, leave sidewalks at their current typical width, and allow parking along each side of the roadway. The evaluation of each alternative to meet the goals of the reconfiguration are summarized in Table 5.

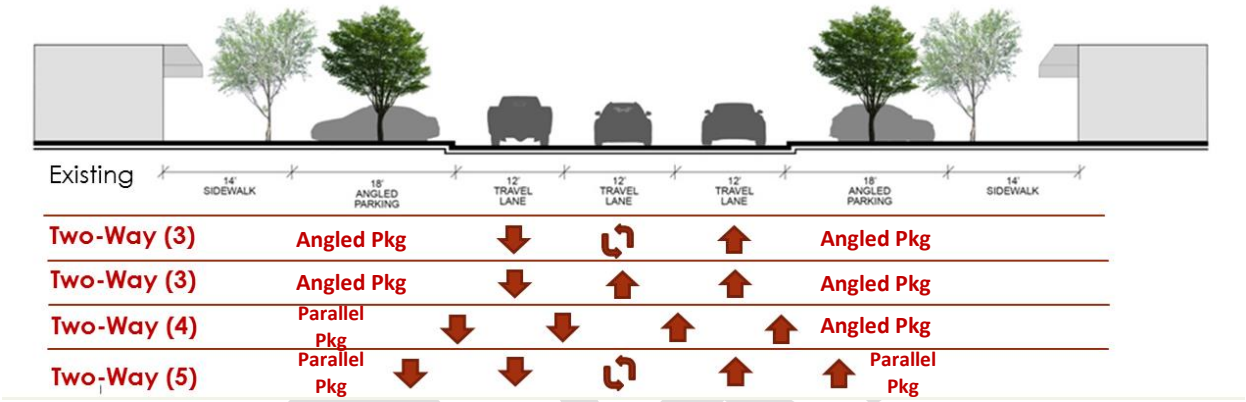

Figure 6. Feasible Lane Configurations Considered for Analysis

1. (Five lanes) Two travel lanes in each direction with a center left turn lane, channelized at intersections to provide a left turn bay. Lane widths would be reduced to 11 feet. The angled parking would be converted to parallel curbside parking and the sidewalk bulb-outs trimmed to match the new depth of the parking area. The crosswalk length would be increased from its current 36 feet to approximately 55 feet. This section provides ample capacity for existing and anticipated future traffic and accommodates queues during train crossings, but creates a street that is more intense for traffic and less pedestrian friendly and eliminates half of the storefront parking supply. Significant costs and business interruption would be required for the reconstruction of the sidewalk bulb-outs. *Screening evaluation score: 50 points.*

2. (Four lanes) Two travel lanes in each direction, but without a center left turn lane. Left turns would be executed from the leftmost of the two lanes, potentially delaying through traffic in that lane. Lane widths would be reduced to 11 feet. The angled parking on one side only would be converted to parallel curbside parking and the sidewalk bulb-outs trimmed to match the new depth of the

parking area. The crosswalk length would be increased from its current 36 feet to approximately 44 feet. This section provides ample capacity for existing and anticipated future traffic and accommodates queues during train crossing, but has left turns blocking through lanes at intersections and creates a street that is more intense for traffic. This section is somewhat less pedestrian friendly and eliminates one quarter of the storefront parking supply. Significant costs and business interruption to one side of the street would be required for the reconstruction of the sidewalk bulb-outs. *Screening evaluation score: 50 points.*

3. (Three lanes) Keeping the existing lane widths, provide two 12-foot travel lanes in one direction, one 12-foot travel lane in the other direction, but with no center left turn lane. The angled parking would be retained and the sidewalk bulb-outs would be retained, though some reconfiguration would be required near the corners to reflect the new traffic flow and parking directions. The crosswalk length would be retained at its current 36 feet. This typical section provides two lanes of through capacity in the currently predominant direction for existing and anticipated future traffic plus railroad crossing storage, facilitating the current heavy eastbound movement on Main Street. *Screening evaluation score: 80 points*

4. (Three lanes) Keeping the existing lane widths, provide one travel lane in each direction with the center lane used to create dedicated left turn bays at the intersections. Lane widths would remain as their current 12 feet. The angled parking would be retained and the sidewalk bulb-outs would be retained, though some reconfiguration would be required near the corners to reflect the new traffic flow and parking directions. The crosswalk length would remain at its current 36 feet. This typical section restricts the capacity for existing and anticipated future traffic, but creates a street that is less focused on throughput and more focused on access to local businesses. *Screening evaluation score: 80 points*

Table 5. Summary of the Screening of Viable Alternatives

Criteria	Max Score	Score of Alternative Configurations			
		5 Lanes	4 Lanes	3 Lanes (2–1)	3 Lanes (1-1 w LT)
Adequate Traffic Operations	40	40	30	25	25
Ped & Bike Safety/Mobility	30	5	10	30	30
Parking Supply & Access	30	5	10	25	25
Total Score	100	50	50	80	80

2.4 RECOMMENDED ALTERNATIVES FOR ANALYSIS

The two alternatives that scored best in the screening of possible alternatives were those that utilized the existing three traffic lanes of pavement. During review of the initial screening of alternatives, the project Focus Group confirmed the desire to have minimal impact to the existing streetscape and businesses along Main and Gray Streets. Keeping the two-way traffic within the three existing travel lanes on Main and Gray Streets was seen as the optimal treatment, though the other treatments were seen as potentially needed to accommodate traffic to attain the acceptable two way operations.

2.4.1 Two Options for Implementation of Two-way Operation

Thus, the alternatives initially developed and analyzed included the ones that would utilize the existing three travel lanes. Two possible alternatives include the following:

1. 2-1 Configuration: This alternative proposes converting one of the three lanes on Main and Gray Streets to a lane dedicated for travel in the opposing direction. This alternative retains two approach lanes at the railroad crossing providing as much storage capacity as possible. An illustration showing the lane conversion layout is shown in Figure 7.

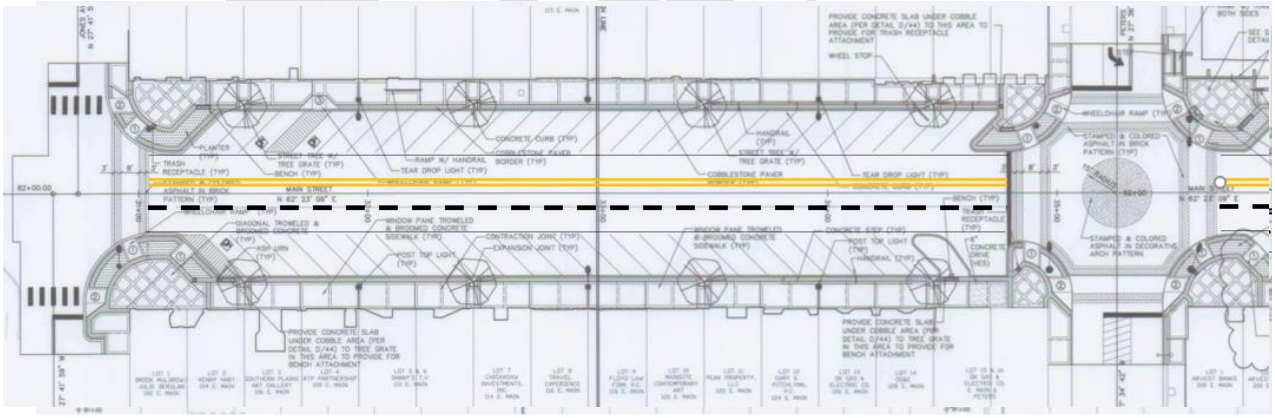

Figure 7. Layout showing 2-1 Configuration

2. 1-1 w/ LT Configuration: This alternative proposes one travel lane in each direction with the existing center lane used to create a left-turn bay at the intersections. On Main Street, between the left turn bays at the intersections, the space would have little utility. On Gray Street, due to the numerous mid-block driveways into off-street parking, the center lane should be striped as a continuous left turn lane. An illustration showing the lane conversion layout is shown in Figure 8.

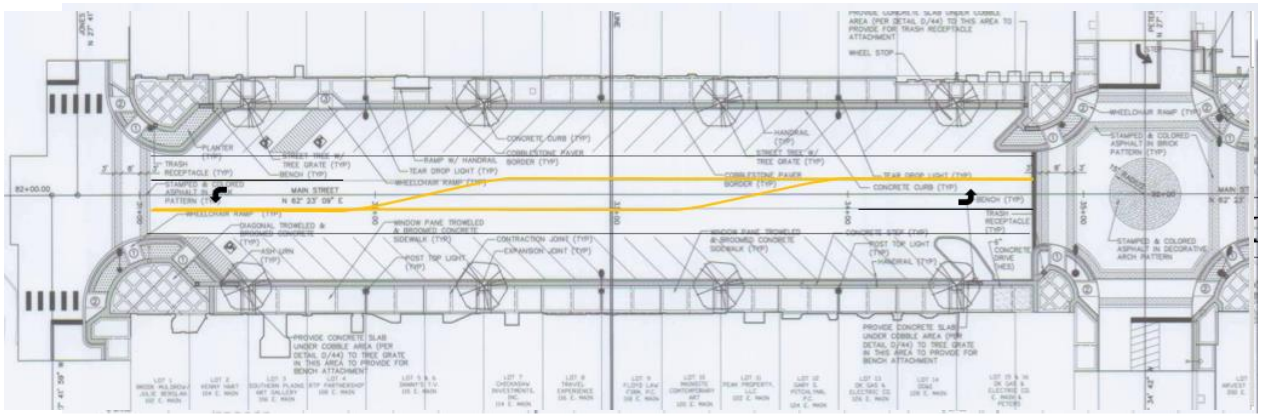

Figure 8. Layout showing 1-1 with LT Configuration

2.4.2 Comparison of the Two Options for Two-way Operations using Three Lanes

The 2-1 configuration provides better queue storage on eastbound Main and westbound Gray during train crossing events, reducing the queue lengths. However, this scenario provides only one travel lane opposing the two-lane direction, forcing all movements at the intersection to occur from one-lane which increases the delay for the eastbound travel along Gray Street and westbound travel along Main Street.

Project Focus Group comments on review of the screening of the alternatives indicated that it was important to keep the turn lanes at the intersections, which is a positive characteristic of the 1-1 with LT scenario at the intersections. The 1-1 with LT cross section is also the street configuration closest to that recommended in the City Center Form Based Code, shown in Figure 9.

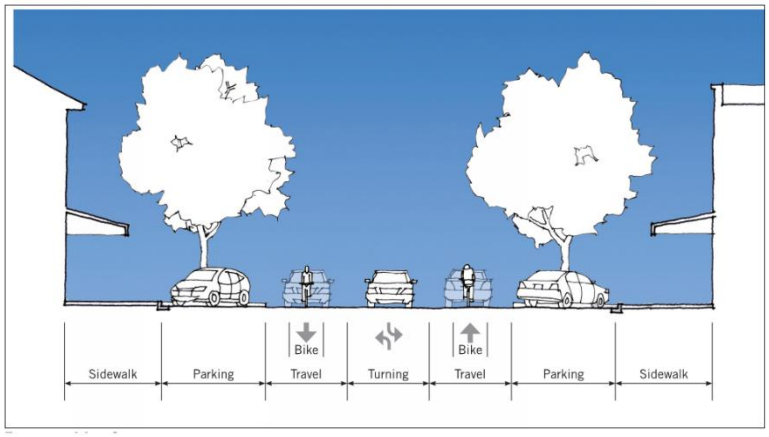

Figure 9. City Center District Concept for Main Street

For these reasons, the 1-1 with LT scenario was selected for further detailed operational evaluation. Permutations of the configuration could incorporate elements of the 2-1 configuration as needed to accommodate the anticipated traffic volumes, train interruptions or other operational issues.

2.5 FUTURE GROWTH IN TRAFFIC

Daily traffic volumes on Main and Gray Streets have remained relatively constant over the last several years, with much of the historical 1% annual growth in Norman occurring in the open areas away from the center city. With the improvements to Robinson Street and its new railroad underpass, much of the growth of traffic on Main and Gray Streets can be expected to be due to in-fill commercial development and densification in the Main/Gray corridor and its synergy with the University of Oklahoma (OU) campus. Even though the CTP model forecasted little or no increased daily traffic on the Main/Gray couplet in 2035, it was concurred with the Focus Group that some level of traffic volume growth should be accommodated by the proposed two-way conversion. After some discussion, it was decided that the two-way configuration should be able to accommodate 20% traffic growth (a factor of 1.20) above what was counted in 2015. As illustrated in Table 6 for compound annual growth rates, the 1.20 growth factor accommodates growth in the Main/Gray corridor at 0.5% year-over-year for 36 years or 1.0% consistently for the next 18 years.

Table 6. Growth Factors for a Range of Compound Annual Growth Rates

	Year	Compound Annual Growth Rate		
		0.5%	1.0%	1.5%
0	2015	1.00	1.00	1.00
1	2016	1.01	1.01	1.02
2	2017	1.01	1.02	1.03
3	2018	1.02	1.03	1.05
4	2019	1.02	1.04	1.06
5	2020	1.03	1.05	1.08
6	2021	1.03	1.06	1.09
7	2022	1.04	1.07	1.11
8	2023	1.04	1.08	1.13
9	2024	1.05	1.09	1.14
10	2025	1.05	1.10	1.16
11	2026	1.06	1.12	1.18
12	2027	1.06	1.13	1.20
13	2028	1.07	1.14	1.21
14	2029	1.07	1.15	1.23
15	2030	1.08	1.16	1.25
16	2031	1.08	1.17	1.27
17	2032	1.09	1.18	1.29
18	2033	1.09	1.20	1.31
19	2034	1.10	1.21	1.33
20	2035	1.10	1.22	1.35
21	2036	1.11		
22	2037	1.12		
23	2038	1.12		
24	2039	1.13		
25	2040	1.13		
26	2041	1.14		
27	2042	1.14		
28	2043	1.15		
29	2044	1.16		
30	2045	1.16		
31	2046	1.17		
32	2047	1.17		
33	2048	1.18		
34	2049	1.18		
35	2050	1.19		
36	2051	1.20		

2.6 TRAFFIC ANALYSIS METHODOLOGY

The analysis and testing of traffic operations under the various configurations was performed using Synchro 8 software. Synchro is a deterministic tool used to analyze signalized and unsignalized intersections, as well as arterial segments and networks. The operational analysis was performed for the existing and the proposed alternatives for all major intersections along Main and Gray Streets within the study limits. The Levels of Service (LOS) results for the directional movements are based on control delay, measured in seconds per vehicle (s/veh), and the LOS criteria per the Highway Capacity Manual (HCM 2010) are shown in Table 7. For peak hour traffic operations, it is desired that the directional movements at each intersection should operate at no worse than LOS D, though certain movements may be considered acceptable for operation at LOS E if mitigation measures would have a negative impact on the other goals of the project.

Table 7. LOS Criteria for Signalized and Unsignalized Intersections

Signalized Intersections		Unsignalized Intersections	
Control Delay (Sec/veh)	LOS	Control Delay (Sec/veh)	LOS
<=10	A	<=10	A
>10-20	B	>10-15	B
>20-35	C	>15-25	C
>35-55	D	>25-35	D
>55-80	E	>35-50	E
>80	F	>50	F

The data collected on the number of parking maneuvers for the on-street parking with in the peak hour was included in the analysis scenarios so that its impact on traffic operations is properly accounted. Also, the data collected on peak hour pedestrian counts was included in the operations analysis. For future scenarios, a peak hour factor of at least 0.92 (some existing counts are greater) was used in the analysis to account for anticipated peak spreading more evenly across and beyond the peak hour in the future.

2.7 TRAFFIC ANALYSIS OF EXISTING GEOMETRY

Traffic operations under the existing geometry with one-way operation was evaluated using the collected 2015 traffic counts. Another scenario with existing geometry, the James Garner Boulevard extension and 20% additional traffic volumes was evaluated as a future No-build scenario. The signal timing was optimized to reduce overall intersection delay. The results of the analysis for the critical PM peak hour are presented in Table 8.

Table 8. Synchro Analysis Results for Existing One-Way Configuration (PM Peak Hour)

Intersection	2015 Traffic		1.2 Growth Factor	
	Control Delay (Sec/veh)	LOS	Control Delay (Sec/veh)	LOS
Gray Street at Flood Avenue	12.6	B	10.9	B
Gray Street at Lahoma Avenue*	4.6	A	4.4	A
Gray Street at University Boulevard	10.5	B	10.2	B
Gray Street at Webster Avenue	5.5	A	10.5	B
Gray Street at Santa Fe Avenue	4.2	A	5.3	A
Gray Street at James Garner Boulevard*	3.4	A	20.8	C
Gray Street at Jones Avenue*	0.0	A	0.0	A
Gray Street at Peters Avenue	16.9	B	14.7	B
Gray Street at Crawford Avenue*	1.7	A	1.4	A
Gray Street at Porter Avenue	20.3	C	17.8	B
Main Street at Flood Avenue	32.8	C	37.3	D
Main Street at Lahoma Avenue*	31.7	D	63.8	F
Main Street at Downtown Shopping Center	13.9	B	3.7	A
Main Street at University Boulevard	11.7	B	15.8	B
Main Street at Webster Avenue	11.5	B	23.2	C
Main Street at Santa Fe Avenue	3.1	A	4.2	A
Main Street at James Garner Boulevard*	1.5	A	15.7	C
Main Street at Jones Avenue*	1.4	A	1.0	A
Main Street at Peters Avenue	7.5	A	8.8	A
Main Street at Crawford Avenue	4.0	A	6.6	A
Main Street at Porter Avenue	16.9	B	17.3	B

* Two-way stop controlled intersection. Delay based on HCM 2010 methodology

The analysis indicates that under the 2015 traffic volumes and geometry, Main and Gray Streets operate at LOS C or better except for the unsignalized intersection of Lahoma at Main Street which operates at LOS D. Adding 20% growth in traffic, the existing configuration would continue to operate at LOS C or

better along Gray Street. Along Main Street, even with the increase in the delay, most intersections would continue to operate at LOS C or better, with a few exceptions.

- The Flood Avenue intersection with Main Street would operate at LOS D, but with no directional movement operating worse than LOS D when timings are optimized.
- The increase in traffic along James Garner Boulevard due to the proposed extension would result in higher delay for the stop controlled northbound and southbound approaches at both Main and Gray. While the approaches along James Garner Boulevard would operate at LOS F, the overall intersections would operate at LOS C. For analysis of the two-way operations, the James Garner Boulevard intersections are considered to be signalized.
- The intersection of Lahoma Avenue would experience higher delay for the stop controlled northbound and southbound approaches at Main Street, and the intersection would operate at LOS F, so some changes in traffic control may be needed at that intersection as well. It is suggested that further assessment of the traffic control, access and circulation to the retail developments along Main Street between University and Flood Avenues be conducted.

2.8 TRAFFIC ANALYSIS OF 1-1 WITH LT CONFIGURATION

The proposed 1-1 with LT configuration along Main and Gray Streets was selected as the two-way alternative for detailed evaluation. Traffic volumes for analysis are those redistributed onto the two-way configuration, with the James Garner Boulevard extension, and grown by 20% as described earlier in the report. Traffic signal timing was optimized to minimize intersection delay. Two analysis scenarios were developed for the purpose of traffic analysis:

- The Base Scenario assumed roadway geometry and traffic control changes necessary to convert the traffic operation to two-way, and optimizing the traffic signal timing and phasing to allow for minimization of overall intersection delay and adjusting to have all directional movements operate at LOS D or better to the extent possible, and

- A Mitigation Scenario, building upon the Base Scenario, was developed to identify additional improvements necessary to achieve future intersection LOS of D or better and individual movement LOS of D or better, but allowing LOS E for specific movements if mitigation measures would be detrimental to the overall improvement or not economically feasible.

The following sections describe the major improvements under the Base 1-1 with LT Scenario and the corresponding needed mitigation measures.

2.8.1 Base 1-1 with LT Scenario

The Base 1-1 with LT scenario that was analyzed included the following changes, as compared to the existing conditions.

1. The existing 3-lane one-way section of Main Street between University Boulevard and Porter Avenue was converted to two-way operation with one travel lane in each direction and dedicated left turn bays at the intersections, and the needed lengths of the left turn lanes were determined.

2. The existing 3-lane one-way section of Gray Street between University Boulevard and Porter Avenue was converted to two-way operation with one travel lane in each direction and a center two-way left turn lane (TWLTL) and turn bays at the intersections. Additionally, the two westbound lanes on Gray Street between Flood Avenue and University Drive were changed to one westbound lane and a center TWLTL, while retaining the one eastbound lane.

3. The currently unsignalized intersection at Main Street and Lahoma Avenue was converted to a traffic signal for the purposes of this analysis. A further assessment should be performed to assess the need to two closely spaced traffic signals and whether some other form of traffic control or access management could be implemented.

4. To reflect the proposed extension of James Garner Boulevard, and accommodate the expected increase in traffic demand, traffic signals were added at its Main and Gray Street Intersections, with railroad signal preemption. James Garner Boulevard was widened to a three lane cross-section with a center turn lane from south of Main Street to north of Gray Street, with the center turn lane dedicated to left lane turn lanes at the approaches to Main and Gray Streets.

5. A left turn storage lane was added at northbound Peters Avenue at Main Street, replacing the existing striped median.

6. The leftmost northbound lane on Porter Avenue at Main Street was reallocated to a dedicated left turn lane, to provide the needed left turn capacity yet keep Porter Avenue within its current four lanes of pavement. This northbound force-off into a left turn lane resulted in only one northbound though lane, which is ample for the remaining northbound through movement once

traffic is allowed to turn westbound onto Main Street. The force-off left turn lane allowed the creation of a short left turn storage bay for southbound Porter Avenue at Main Street while retaining the two southbound through lanes. Northbound Porter Avenue is then provided a dedicated left turn bay at Gray Street.

The results of the operations analysis for the PM peak hour using grown traffic volumes is presented in Table 9. The PM peak hour was found to be the most critical of the peak hours during the day, and chosen for reporting of the alternatives analysis. More detailed results of the Synchro analysis, showing the performance of each movement by approach, are included in Appendix C.

Table 9. Synchro Analysis Results for Proposed 1-1 Configuration (PM) – Base Scenario

Intersection	Base Scenario 1.2 Growth Factor	
	Control Delay (Sec/veh)	LOS
Gray Street at Flood Avenue	6.5	A
Gray Street at Lahoma Avenue*	3.4	A
Gray Street at University Boulevard	12.0	B
Gray Street at Webster Avenue	9.0	A
Gray Street at Santa Fe Avenue	10.5	B
Gray Street at James Garner Boulevard	15.3	B
Gray Street at Jones Avenue*	5.8	A
Gray Street at Peters Avenue	8.4	A
Gray Street at Crawford Avenue*	5.4	A
Gray Street at Porter Avenue	20.2	C
Main Street at Flood Avenue	24.7	C
Main Street at Lahoma Avenue	4.1	A
Main Street at Downtown Shopping Center	3.3	A
Main Street at University Boulevard	47.4	D
Main Street at Webster Avenue	59.6	E
Main Street at Santa Fe Avenue	17.7	B
Main Street at James Garner Boulevard	34.9	C
Main Street at Jones Avenue*	29.6	D
Main Street at Peters Avenue	21.3	C
Main Street at Crawford Avenue	12.5	B
Main Street at Porter Avenue	37.2	D

* Two-way stop controlled intersection. Delay based on HCM 2010 methodology

The analysis indicates that with 20% increase in traffic volumes, intersections along Gray Street would continue to operate at LOS C or better. However, delay along Main Street would increase and some intersections would operate at LOS D and E. The intersection of University Boulevard at Main Street would worsen to LOS D due to increased delay especially in the eastbound direction, with the eastbound Main Street through movement operating at LOS E. The intersection of Webster Avenue at Main Street would operate at LOS E due to increased delay at the eastbound and northbound approaches, with the latter operating at LOS F. The intersection of Jones Avenue would experience significant delay at the stop-controlled northbound and southbound approaches due to limited gaps in the Main Street traffic. The intersection of Porter Avenue would operate at LOS D due to delays at the eastbound approach.

2.8.2 Mitigation Scenario

Various mitigation measures were tested on the Base 1-1 with LT Scenario with 20% additional traffic, aiming to improve the intersection LOS to D or better and the LOS of individual movements to LOS D or better if possible. Specific improvements that would be need to achieve this increased level of performance include the following:

1. The northbound University Boulevard approach to Main Street currently has two lanes, one through-and left lane and one right turn only. This lane assignment was converted to one dedicated left turn bay and one through-and-right lane. Improvement will be needed to the pavement in the existing right turn lane to better separate it from the adjacent development parking area.

2. Left lane storage lanes would need to be provided on Webster Avenue at the northbound and southbound approaches to Main and Gray Street, resulting in a three-lane cross-section on Webster Avenue between Main and Gray Streets. In order to create these left turn lanes, the bulb-out will need to be modified on the Webster Avenue approaches. With this mitigation, the intersection LOS would improve to LOS D and all directional movements would improve to LOS D or better except for the northbound left turn which would operate at LOS E.

3. The unsignalized intersection at Main Street at Jones Avenue was changed to a signalized intersection significantly reducing delay on the northbound and southbound approaches. The signalized intersection would operate at LOS B, with individual movements operating at LOS C or better. This improvement is particularly important due to the planned construction of an 800-

space parking garage south of Main Street between Jones and Peters Avenues. Due to its proximity to the railroad, signal preemption capabilities will be required.

The results of the operations analysis on the 1-1 with LT Scenario to include the mitigation measures is presented in Table 10. Diagrams showing the proposed pavement striping at each of the converted street intersections are included in Appendix B.

Table 10. Synchro Analysis Results for Proposed 1-1 Configuration (PM) – with Mitigation

Intersection	Base Scenario 1.2 Growth Factor		Mitigation Scenario 1.2 Growth Factor	
	Control Delay (Sec/veh)	LOS	Control Delay (Sec/veh)	LOS
Gray Street at Flood Avenue	6.5	A	6.4	A
Gray Street at Lahoma Avenue*	3.4	A	3.4	A
Gray Street at University Boulevard	12.0	B	12.2	B
Gray Street at Webster Avenue	9.0	A	6.8	A
Gray Street at Santa Fe Avenue	10.5	B	10.6	B
Gray Street at James Garner Boulevard	15.3	B	15.1	B
Gray Street at Jones Avenue*	5.8	A	5.8	A
Gray Street at Peters Avenue	8.4	A	11.0	B
Gray Street at Crawford Avenue*	5.4	A	5.4	A
Gray Street at Porter Avenue	20.2	C	20.3	C
Main Street at Flood Avenue	24.7	C	24.9	C
Main Street at Lahoma Avenue	4.1	A	4.0	A
Main Street at Downtown Shopping Center	3.3	A	3.4	A
Main Street at University Boulevard	47.4	D	35.4	D
Main Street at Webster Avenue	59.6	E	50.8	D
Main Street at Santa Fe Avenue	17.7	B	20.8	C
Main Street at James Garner Boulevard	34.9	C	35.9	D
Main Street at Jones Avenue*	29.6	D	10.6	B
Main Street at Peters Avenue	21.3	C	18.3	B
Main Street at Crawford Avenue	12.5	B	12.1	B
Main Street at Porter Avenue	37.2	D	37.7	D

* Two-way stop controlled intersection. Delay based on HCM 2010 methodology

2.9 IMPACT OF RAILROAD CROSSING

A BNSF railroad passes through downtown Norman crossing Main and Gray Streets at grade between James Garner Boulevard and Jones Avenue. About 28 trains pass though the downtown per day, with 2 to 3 crossings during each of the AM and PM peak hours. Typical crossing times range from 2 to 3 minutes during which traffic flow on Main and Gray Streets is interrupted. A typical rail crossing event with 2.5 minute crossing time was simulated using Synchro to evaluate the impact on queues along Main and Gray Street under the 1-1 with LT mitigation scenario with 20% additional traffic. The analysis shows that due to the reduction in the queue storage capacity along Main Street, the eastbound queues during the critical PM peak hour would extend more than three blocks to near University Boulevard. The westbound approach on Main Street and the eastbound and westbound approaches on Gray Street would accumulate queues extending not more than two blocks upstream of the railroad. This increased lengths of traffic queues for two to three times during the peak hour are a notable impact of the 1-1 configuration for the two-way conversion. The traffic queues dissipate and go back to normal within the next two full traffic signal cycles after the train clears the crossings.

2.10 IMPACT OF SPECIAL EVENTS

Traffic patterns near Downtown change significantly during OU football game weekends and Downtown events, such as the Art Walk, Norman Music Festival and multiple parades, as do the demand for parking and the volumes of pedestrian crossings. Travel lanes and parking supply tend to operate at capacity for a significant portion of the Friday and Saturday during the pre- and post-game events. Excessive queues and delays experienced during those times will also overwhelm the two-way Main and Gray Street operations. However, the proposed improvements in Downtown should accommodate some of the energy of the event to the advantage of the Downtown merchants:

- Planned parking garages should provide relief to the need for drivers to circle the roadway network looking for a parking spot near the destination.
- Retaining the existing sidewalk bulb-outs provide a large area for pedestrians to queue at the intersections and a minimal 36-foot distance to cross the street traffic lanes.
- The two-way street circulation on both Main and Gray Streets should make access and circulation to the Downtown sites more logical and provide better access and circulation to the off-street parking.

2.11 RECONFIGURATION OF ON-STREET PARKING

When two-way traffic operation is implemented on Main and Gray Streets, the existing angled parking that allows head-in entry into the parking spaces on either side of the one-way street, as shown in Figure 10, will now be incorrectly striped to be used for head-in parking by the new opposing direction.

2.11.1 Re-Stripe Angled Parking for Change in Adjacent Directional Flow

The current direction of angled parking for the one-way traffic flow, when converted to two-way traffic flow, would encourage traffic from the opposite side of the street to cross over and park heading the wrong direction adjacent to the newly added direction of travel. To address this situation, the angled parking on one side of the street would need to be restriped to provide for head-in entry from the newly added direction of traffic as shown in Figure 11.

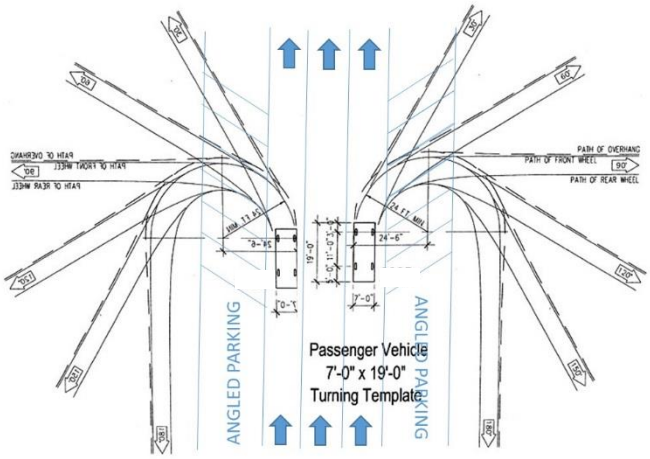

Figure 10. Use of Angled Parking under Existing One-Way Configuration

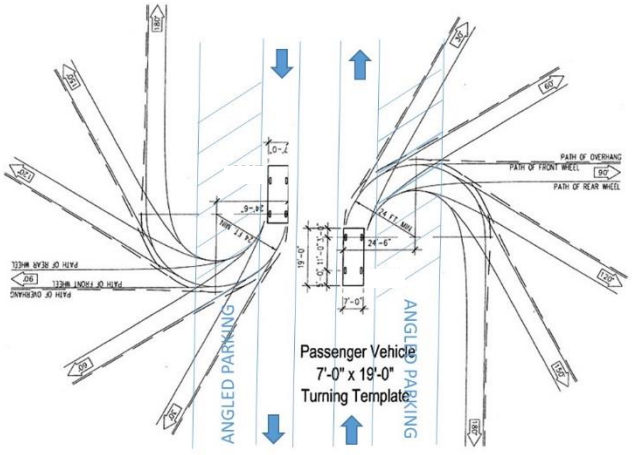

Figure 11. Use of Angled Parking under the Proposed Two-way Configuration

2.11.2 Access to Angled Parking in Opposite Direction Not Allowed

In the two-way configuration, the use of angled parking on the opposite side of the street from the direction of traffic flow becomes an issue. Legally, it is unlawful to turn more than 90 degrees on a city street, per Norman city ordinance *(Ord. No. 0-7273-67; Ord. No. 0-1213-43, § 1)*. Even if it were legal to do so, all but the smallest of passenger cars would have difficulty turning from the center turn lane to use the opposing side's angled parking. Larger vehicles would need to turn from the through lane to attempt to access parking on the opposite side of the street, which would impede the flow of traffic. These considerations are illustrated in Figure 12.

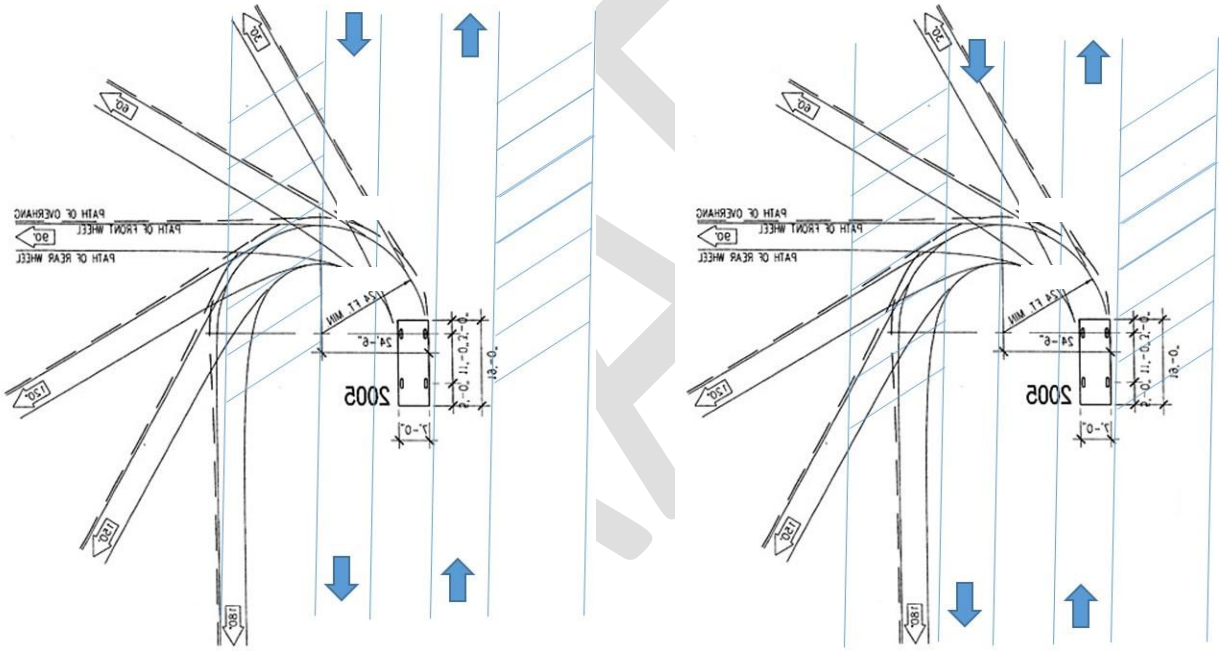

Figure 12. Use of Opposite Side Angled Parking under the Two-way Configuration

2.11.3 Back-in Angled Parking

Head-in angled parking requires drivers to back out with limited view of oncoming traffic, which has historically been a cause for collisions. A possible mitigation for these collisions would be creation of back-in angled parking. This parking operation has advantages compared to head-in:

- The exiting maneuver from a back-in parking space allows for very good driver view of the oncoming traffic for pulling out of the angled parking into the traffic lane.

- For the backing-in maneuver, though it does momentarily block the flow of traffic, the driver has control of the flow of traffic in the lane so they can signal their intent, slow down to stop, and back into the space in full view of the following vehicle.

2.11.4 Use and Enhancement of the Center Lane

Since turns across the median in between intersections will not be lawful nor functional, the space in the center median area between the two directions of travel will predominantly be used for creating left turn bays at intersections. Occasionally, an alley or driveway exists midblock, for which the center lane would be useful as a center two-way left turn lane to allow left turns across the median. When the center median area between the two opposing traffic lanes would not be fully consumed by the left turn bays or a midblock alley/driveway access, the center median area could be used for introducing streetscape. However, such enhancements could potentially limit use of the roadway for parades and for the mobility of emergency responders.

2.12 ESTIMATED COST OF IMPLEMENTATION

The costs to implement the two-way conversion of Main and Gray streets includes predominantly the costs of adding the necessary opposing direction traffic control signals and railroad crossing signals. Additional costs include additional improvements for establishing the railroad quiet zone, including constructing raised medians at the two crossings. Some side street enhancements are also needed to improve approach LOS. The currently programmed improvements to extend James Garner northward to Flood Avenue do not include any improvements south of Acres Street, so the improvements at the intersections with Main and Gray Street plus the widening to provide three lanes one the approaches to Main and Gray are included in this estimate. A summary of estimated costs is provided in Table 11.

Table 11. Preliminary Assessment of Implementation Costs Associated with Conversion

Improvement	Estimated Costs
Traffic Signal Modifications (opposite flow signal assembly at 7 intersections – foundations, poles, signal heads)	$350,000
Traffic Signal Modifications at University Boulevard intersections at Main and Gray Streets	$125,000
New traffic signals (4 intersections: James Garner Boulevard@ Main and Gray Streets; Lahoma and Jones Avenues @ Main Street)	$1,000,000

Intersection modification for WB Main Street @ Porter Avenue	$120,000
Intersection modification for NB University Boulevard @ Main Street	$200,000
Intersection modifications for Webster Avenue @ Main Street	$120,000
Pavement Markings and opposing direction signage	$200,000
Railroad Crossing Improvements at Main and Gray Streets (Quad Gates), and Supplemental Safety Devices for Railroad Quiet Zone	$2,000,000
Improvements to provide 3-lane James Garner Avenue plus sidewalks from 500' north of Gray Street to 500' south of Main Street	$1,000,000
Total Potential Cost	**$5,115,000**
Design Fees for Implementation	$750,000
Total Implementation Costs	**$5,865,000**

3.0 CONCLUSION

3.1 CONVERSION TO TWO-WAY IS FEASIBLE WITHIN EXISTING THREE LANES

Conversion of Main Street and Gray Street to two-way operation is feasible using the existing three lanes of pavement currently provided. Keeping the conversion within the footprint of the existing three travel lanes will save costs and construction impacts to Downtown businesses. The provision of one lane in each direction with a two-way left turn lane, preserving existing angled parking but converting it to back-in, will be an effective treatment that will suit the character of the Downtown street network and adjacent development. The configuration will adequately accommodate current daily traffic as well as future traffic conditions that would include the extension of James Garner Boulevard northward to Flood Avenue and allowance for 20 percent growth in traffic above what is currently experienced. There are both positive and negative aspects to this conversion, as summarized in Table 12.

Table 12. Positive and Negative Attributes Associated with Conversion

Factor	Positive Attributes	Negative Attributes
Traffic Operations	Creates a calmer traffic environment, better suited to Downtown destination. The new directional flow on both streets provides more direct access to destinations.	Higher average delay, lower LOS, parking interrupts flow of the one through lane.
Train Crossings	Queuing traffic still has two lanes in each direction spread across two streets, queues generally dissipate after one to two traffic signal cycle.	Traffic queues are about 1.5 to 2 times as long as existing, back of queue extends to over 3 blocks on Main Street during PM peak.
Pedestrian Crossings	The bulb-outs are retained, keeping crossing distances minimal with good pedestrian visibility and accommodations.	Pedestrians must watch for added conflicts from left and right turning vehicles from added traffic direction.
Parking	Retains angled parking on both sides of the street where provided.	Some cost to re-orient parking stalls and modify bulb-outs, no use of parking on opposite side from flow of traffic.
Special Events	Downtown functional as a destination with same amount of angled parking and new parking garage, traffic flow more logical for visitors.	High traffic generation events will not be as well accommodated for throughput.
Development	The two-way flow of traffic on both streets and the traffic calming allow for better visibility of businesses, less focus on passing through Downtown.	Current pass-thru traffic may divert to other routes, reducing exposure to businesses. Deliveries by truck will need to use side streets and alleys.

3.2 COMPARISON OF TRAFFIC OPERATIONS WITH AND WITHOUT CONVERSION

Table 13 compares the one-way and two-way operations, each with 20% more traffic than in 2015. Some intersections performed better and some worse under the two-way configuration, though all intersections would be at acceptable Level of Service. Notably better is Main @ Flood while notably worse are Main @ University, Webster James Garner and Porter.

Table 13. Comparison of Existing and Converted Traffic Operations with 20% Growth

Intersection	Existing Scenario 1.2 Growth Factor		Conversion Scenario 1.2 Growth Factor	
	Control Delay (Sec/veh)	LOS	Control Delay (Sec/veh)	LOS
Gray Street at Flood Avenue	10.9	B	6.4	A
Gray Street at University Boulevard	10.2	B	12.2	B
Gray Street at Webster Avenue	10.5	B	6.8	A
Gray Street at Santa Fe Avenue	5.3	A	10.6	B
Gray Street at James Garner Boulevard	20.8	C	15.1	B
Gray Street at Jones Avenue	0.0	A	5.8	A
Gray Street at Peters Avenue	14.7	B	11.0	B
Gray Street at Crawford Avenue	1.4	A	5.4	A
Gray Street at Porter Avenue	17.8	B	20.3	C
Main Street at Flood Avenue	37.3	D	24.9	C
Main Street at Downtown Shopping Center	3.7	A	3.4	A
Main Street at University Boulevard	15.8	B	35.4	D
Main Street at Webster Avenue	23.2	C	50.8	D
Main Street at Santa Fe Avenue	4.2	A	20.8	C
Main Street at James Garner Boulevard	15.7	C	35.9	D
Main Street at Jones Avenue (1)	1.0	A	10.6	B
Main Street at Peters Avenue	8.8	A	18.3	B
Main Street at Crawford Avenue	6.6	A	12.1	B
Main Street at Porter Avenue	17.3	B	37.7	D

(1) One-way scenario was left unsignalized, while two-way scenario included signalization due to planned parking garage location one-block south of Main Street.
(2) Detailed delay and LOS information for each movement on each approach is provided in Appendix C.

4.0 IMPLEMENTATION PLAN

4.1 COORDINATION WITH RAILROAD QUIET ZONE PROJECT

To establish a quiet zone, cities must mitigate the increased risk caused by the absence of a horn, according to Federal Railroad Administration (FRA) rules. Safety measures used for mitigation include four-quadrant gate systems, one way streets with gates, gates with medians, wayside horns or permanent closures of dangerous crossings.

While the crossings at Main and Gray streets are currently up to standard for a quiet zone, with gates blocking all lanes of the one-way street, should those streets be converted to two-way, additional cost would be required to implement a four-quadrant gate system or gates with medians to make intersections safe enough to meet quiet zone standards for two-way street operations. The approximate cost of upgrading the existing cross arms and the associated safety improvements at Main and Gray Streets could cost as much as $2 million.

The Quiet Zone is nearing approval by FRA, with an anticipated implementation in Fall 2016. Initial discussions between the City and the FRA indicate that any conversion of the one-way Main and Gray Streets would need to occur after the Quiet Zone is implemented. Otherwise, the process would be delayed and could potentially require more costly improvements. The FRA has indicated that it would be acceptable to convert Main and Gray Streets to two-way operation after the Quiet Zone is implemented, as long as quad gates are provided at the two railroad crossings.

4.2 ADOPTION OF CHANGE BY ORDINANCE

The operation of one-way streets is adopted by city ordinance. A revision to city ordinance will need to be prepared and approved by City Council to remove the one-way designation from Main Street between University Boulevard and Porter Avenue and from Gray Street between Porter Avenue and University Boulevard. The City may want to amend the current ordinance prohibiting U-turns on streets to allow turns up to 135 degrees in Downtown. The change in ordinance will need to be advertised in advance of City Council consideration.

4.3 FUNDING ALLOCATION

Currently, there are no funds in the City's Capital Improvement Program (CIP) to implement the conversion of Main and Gray Streets to two way streets.

4.4 PROCESS OF IMPLEMENTATION

The steps to transition the one-way couplet to a pair of two-way streets should be as follows:

1. Complete the design and cost estimate of the recommended improvements.
2. Install the opposite direction traffic signal poles and mast arms on new foundations.
3. Install the needed signal heads for the opposite direction of traffic flow and turn them or bag them to avoid side street driver confusion at the intersections. Perform needed operational testing late at night.
4. Coordinate with BNSF for the installation of the quad gates at the two railroad crossings. Have them be fully operational for both directions of travel.
5. Make the needed modifications to the side streets and corner bulb-outs.
6. Collaborate with Downtown business owners and city event planners to select a date for the conversion to two-way that will cause the least disruption to local businesses and traffic.
7. During the month before conversion to two-way, implement a multifaceted public relations outreach effort to advise all businesses and the general public of the intended date of conversion.
8. Coordinate with the needed pavement overlay of Main and Gray Streets to install the proposed new striping configuration approximately two weeks before the planned conversion to two-way. Use temporary construction tape/tabs for the lane line locations in the one-way configuration.
9. Two weeks prior to the conversion, locate dynamic message signs strategically along Main and Gray Streets to display the announcement of the conversion.
10. One to two days prior to the conversion, activate the traffic signals for the opposite direction of travel and bag them.
11. During the night before the lane conversions, remove the temporary striping tape/tabs and re-stripe the roadway for the two-way operations using the first application of pavement marking. Unbag the traffic signals for the opposite flow of traffic. Remove all traffic signs that had been in place for the control of the one-way street operations.
12. Follow up at a later date with the final thermoplastic pavement marking.

4.5 POTENTIAL FOR PHASED IMPLEMENTATION

One of the suggestions provided during a project focus group meeting was to evaluate the possibility of converting just Gray Street to two-way operation as the first phase of the implementation of the ultimate proposed conversion of both Main and Gray Streets to two-way operation. The following paragraphs discuss the traffic data, analysis, and summary of operations analysis results for the alternatives analyzed under the Phase-1 scenario representing conversion of Gray Street to two-way operations.

4.5.1 Logical Traffic Re-distributions for Phase-1

Several distinct reallocations of existing traffic movements were made, as described below. These traffic reallocations are depicted graphically in Appendix A for the PM Peak Hour, with the resulting net traffic turning movement volumes shown at each intersection. The AM peak hour volumes are less than the PM peak hour, so were not included in this assessment of Phase-1 implementation. Nor was the extension of James Garner Boulevard included in the conditions for Phase 1.

1. Southbound Flood Avenue Left Turns – Half of existing southbound left turns from Flood Avenue to Main Street were moved to Gray Street
2. Northbound Right Turns from South of Main Street – Half of existing northbound right turns at Main Street were moved to northbound right turns at Gray Street (for streets between and including University Boulevard and Crawford Avenue, excluding Santa Fe Avenue)
3. Southbound Left Turns from North of Gray Street – Half of existing southbound left turns at Main Street were moved to southbound left turns at Gray Street (for streets between and including University Boulevard and Crawford Avenue, excluding Santa Fe Avenue)
4. The traffic redistributed onto Gray Street were then allocated to turn left or right at intersections consistent with existing turning movement percentages between Porter and Webster Avenues.

4.5.2 Operations Analysis Results for Phase-1

Two scenarios for the conversion of Gray Street were analyzed. One with one-lane in each direction with a two-way left-turn lane in the middle (1-1 with LT), and another with two lanes in the westbound direction and one lane in the east bound direction. Below is a description of the analysis results for the two scenarios.

a. Gray Street (1-1 with LT)

   Under this scenario, all intersections along Gray Street are expected to operate at LOS C or better except the intersection of James Garner Boulevard. This intersection would need to be converted to a traffic signal which would then improve to LOS B.

b. Gray Street (2-1)

   Under this scenario, Gray Street would operate as two lanes in the westbound direction and one lane in the eastbound direction. Due to higher capacity in the westbound direction, the overall operations along the street would improve and all intersections would operate at LOS C or better along Gray Street.

The results of the analysis for the two scenarios using 2015 traffic volumes are presented in Table 14. Overall, the combined control delay for all intersections along Gray Street is lower by approximately 35% in the Gray (2-1) scenario due to higher capacity in the westbound direction compared to the Gray (1-1 with LT) scenario.

4.5.3 Railroad Crossing Impacts

A railroad crossing event was modeled in Synchro for both the Phase 1 scenarios, with a train crossing time of 2.5 minutes. Since the phase-1 scenarios reduce the capacity in the westbound direction, queue lengths in this critical direction were compared for both scenarios.

Under the Gray (1-1 with LT) scenario, the westbound queue lengths extended more than two blocks to upstream Crawford Avenue due to having only one westbound lane of queue storage capacity on either Main or Gray Streets. This extensive queue would interfere with the operations of traffic along Porter Street during longer rail crossing times.

Under the Gray (2-1) scenarios, having two lanes in the westbound direction on Gray Street would reduce queue lengths that would extend to Peters Avenue.

Table 14. Synchro Analysis Results for Phase-1 (2015-PM Peak Hour) with Gray Street (Two-way) & Main Street (Existing Configuration)

Intersection	Gray (1-1 with LT)		Gray (2-1)	
	Control Delay (Sec/veh)	LOS	Control Delay (Sec/veh)	LOS
Gray Street at Flood Avenue	10.0	B	10.1	A
Gray Street at Lahoma Avenue*	4.5	A	4.5	A
Gray Street at University Boulevard	5.6	A	7.3	C
Gray Street at Webster Avenue	19.4	B	16.5	B
Gray Street at Santa Fe Avenue	34.9	C	4.3	A
Gray Street at James Garner Boulevard	19.2	B	8.6	A
Gray Street at Jones Avenue*	17.9	C	13.0	B
Gray Street at Peters Avenue	14.7	B	9.1	A
Gray Street at Crawford Avenue*	13.6	B	7.9	A
Gray Street at Porter Avenue	16.0	B	17.7	C
Main Street at Flood Avenue	27.0	C	27.5	C
Main Street at Lahoma Avenue*	26.9	D	26.9	D
Main Street at Downtown Shopping Center	2.4	A	2.4	A
Main Street at University Boulevard	10.1	B	10.9	A
Main Street at Webster Avenue	9.7	A	8.8	B
Main Street at Santa Fe Avenue	3.0	A	2.6	A
Main Street at James Garner Boulevard*	1.6	A	1.6	A
Main Street at Jones Avenue*	1.4	A	1.4	A
Main Street at Peters Avenue	11.9	B	11.8	B
Main Street at Crawford Avenue	5.7	A	5.7	A
Main Street at Porter Avenue	14.0	B	13.9	A

* Two-way stop controlled intersection. Delay based on HCM 2010 methodology

4.5.4 Summary Observations of the Phase 1 Implementation Concept

In this Phase 1 scenario, considering Main and Gray Streets together, one lane is added in the eastbound direction bringing the total eastbound lanes to four, while westbound lanes are reduced to only one for the 1-1 with LT option. This creates a significant imbalance of travel lanes in the corridor. Under normal 2015 peak hour traffic volumes, the roadway network performs at acceptable level of service with these lane provisions. However, considering the very regular event of a train crossing Main and Gray Streets two or three times during the peak hour, the Gray Street 1-1 with LT configuration would be unacceptable

for Downtown traffic operations as a Phase 1 implementation of the two-way operations on Main and Gray Streets.

The 2-1 configuration for Gray Street as a Phase 1 implementation of two-way street operations provides acceptable traffic operations during the railroad crossing events. At University Boulevard, where traffic will continue to be channelized to transition to Main Street for continuation westbound, Gray Street would transition to a 1-1 with LT configuration to Flood Avenue. The 2-1 configuration will not have the left turn functionality of the 1-1 with LT, though the traffic operations are not significantly impacted at the intersections.

In order to convert Gray Street to two-way operations, the opposite-flow train crossing gates would need to be installed. It would be more economical for the opposite flow train crossing gates for Main Street to be installed concurrently with those for Gray Street. It would also be more economical for the City to have the opposite direction of traffic signal arms and heads be installed on Main Street at or about the same time as those are installed on Gray Street. Thus, much of the total cost of conversion would need to expended in order to just implement the conversion of Gray Street much in advance of Main Street. Or, if Gray Street is done separately from Main Street, the total installation costs to do so would be higher than the amount estimated in Table 11.

APPENDIX A
Traffic Counts and Redistribution of Traffic

APPENDIX B
Intersection Re-Configurations

APPENDIX C
Synchro Model Result Summaries