



May 10, 2019

Ms. Mona Aglan-Swick, P.E.  
Transportation Systems Management & Operations, Traffic Safety  
Arizona Department of Transportation  
1615 W. Jackson ST., MD 065R  
Phoenix, AZ 85007-3217

**RE: Highway Safety Improvement Program (HSIP) Project Determination and Application**

Agency: City of Glendale  
Project Name: Install FYA and Geometric Modifications to Improve Safety at Arterial Intersections  
Project Location: 1. Bell Rd at 63rd Ave, 2. Northern Ave at 56th Ave, 3. Northern Ave at 47th Ave,  
4. Olive Ave at 47th Ave, 5. Olive Ave at 55th Ave, 6. Butler Drive at 67th Ave

Dear Ms. Aglan-Swick:

The City of Glendale is submitting project application for Highway Safety Improvement Program (HSIP) funding. This road safety improvement project was identified through the Arizona network crash data screening process and meets all requirements of Title 23. The proposed request is for installation of the flashing yellow arrow (FYA) protected/permissive phasing for six intersections within the City of Glendale. Three of these intersections (63rd Ave at Bell Rd, Northern Ave at 56th Ave, Northern Ave at 47th Ave) currently have protected/permissive phasing and will be replaced with FYA signal heads, and pavement markings improvements will be made to eliminate negative offset for the left-turn lanes. For the remaining three intersections (Olive Ave at 47th Dr, Olive Ave at 55th Drive and Butler Dr at 67th Ave), there is no exclusive left-turn phasing for the left-turn movement from the major arterial. The crash experience at these intersections warrants left-turn phasing for left-turns from the major arterial. For these intersections, FYA protected/permissive phasing and pavement marking improvements to eliminate negative offset will be installed.

In addition, a 3" retroreflective yellow tape will be installed on the all the signal head at all the six intersections.

FYA operation has proven to enhance safety for left-turn operation because it is easier for drivers to understand and it is considered a safer condition than the circular green ball (i.e., FHWA suggests that if drivers are unsure, they will yield, rather than with a green ball, where drivers tend to assume the right-of-way). Creating a positive offset will give left-turning vehicles better sight distance, and retroreflective sheeting gives the signal better visibility and captures the driver's attention.

The City requests ADOT to administer the design, procurement and construction of this project. ADOT will hire a consultant to complete the design, then procure bids for a contractor to build the project. Minor ground disturbing activities, including drilling for foundations, and trenching is anticipated. It is anticipated that some minor utility relocations will need to happen.

**RE: Highway Safety Improvement Program (HSIP) Project Determination and Application**

Agency: City of Glendale

Project Name: Install FYA and Geometric Modifications to Improve Safety at Arterial Intersections

During the most recent five-year period, 2013 to 2017, ending December 2017, the City experienced 4 fatal and 8 incapacitating injury crashes related to left-turns movements at the six study intersections. A combined Crash Reduction Factor (CRF) of 43% is obtained from combined crash modification factors (CMFs) from: Clearinghouse ID: 4175 - for converting left-turn signal operation from permissive to flashing yellow arrow (FYA) protected/permissive, Clearinghouse ID: 4177 for converting protected, or protected/permissive to FYA, Clearinghouse ID: 6097 for improving left-turn lane offset to create a positive offset, and Clearinghouse ID 1410 for adding a three inch yellow retroreflective sheeting to signal backplates. All CMF's were obtained from the Crash Modification Clearinghouse, are ADOT 4/5 Star list for all left-turn and intersection crashes. The City could see a 5-year reduction of 6 crashes including 2 fatal and 4 serious injury crashes.

The City of Glendale has determined that, in accordance with 23 USC 148(a)(4)(A), this project is consistent with the MAG State's 2014 SHSP. It supports the emphasis area - roadway infrastructure and Operations and supporting strategy (Intersections). Reduce frequency and severity of intersection crashes through traffic-control, geometric and operational improvements.

B/C Ratio = 31.40

The City of Glendale has estimated the total project cost of this project to be \$786,764. In accordance with Title 23, the Federal share for safety improvement items are eligible to be funded at 100% Federal share per 23 U.S.C. 120(c) as described in Code of Federal Register 23 CFR Part 924. Therefore, the City of Glendale does not propose to contribute any match for the abovementioned project. Furthermore, the City of Glendale is not requesting reimbursement for staff time for installation. Attached table summarizes the anticipated cost estimate projected for this project.

The City of Glendale is aware that, if funded, additional HSIP funds above the attached estimated cost are not available to pay for excess costs and that other funds whether STP, local or other will have to be provided or secured by City of Glendale to cover the additional costs or the project will have to be withdrawn and resubmitted in the next call-for-projects.

The City of Glendale agrees to conduct and provide to ADOT TSS on a yearly basis a written before-and-after study utilizing the same crash data included in the countermeasure influence area in order to determine the effectiveness of the countermeasure on fatal and serious injury crashes.

The City of Glendale further understands that Federal funds can only be used once to install or upgrade either a spot or systemic countermeasure and that once installed, the City of Glendale will maintain the countermeasure at or above the standard to which it was installed.

If you have any questions, please contact me at 623-930-2939 or email [DAAlbert@glendaleaz.com](mailto:DAAlbert@glendaleaz.com),

Sincerely,



Debbie Albert, P.E., PTOE

City Traffic Engineer

City of Glendale

6210 W. Myrtle Ave STE#112, Glendale, AZ 85301

Attachments: Application (excel format) to include cost estimate, vicinity map and/or list of locations  
B/C Ratio and Crash Data

**FY 23 and FY24 HSIP Application**

<b>Agency:</b>	<b>City of Glendale</b>	<b>Title of Project:</b>	<b>Install FYA and Geometric Modifications to Improve Safety at Arterial Intersections</b>
<b>County:</b>	Maricopa	<b>COG/MPO:</b>	MAG
<b>District:</b>	Central	<b>Date:</b>	5/8/2019
<b>Contact:</b>		<b>Phone:</b>	<b>E-Mail:</b>
Kiran Guntupalli		623-930-2951	<a href="mailto:kguntupalli@glendaleaz.com">kguntupalli@glendaleaz.com</a>
<b>Type of Safety Improvement:</b>	<b>Spot:</b> <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	<b>Systemic:</b> <input type="checkbox"/> YES <input type="checkbox"/> NO	
<b>Mark all that apply to your project:</b> <input checked="" type="checkbox"/> Design <input checked="" type="checkbox"/> Construction <input checked="" type="checkbox"/> Procurement <input type="checkbox"/> Non-Infrastructure			
<b>Anticipated Total Cost Estimate:</b>		<b>\$561,266</b>	
<b>Anticipated dollar amount of HSIP Funding:</b>		<b>\$561,266</b>	
<b>Anticipated Dollar amount of Local Match (5.7%) (5.66%):</b>		<b>\$0.00</b>	
<b>Anticipated Dollar amount of Other:</b>		<b>\$0.00</b>	
<b>Funding Source:</b> <input checked="" type="checkbox"/> 100% HSIP <input type="checkbox"/> 94.3% <input type="checkbox"/> 94.34% HSIP	<b>Cost Estimate Tab:</b>		5. 100% Contract Install
<b>Administration of Project:</b>	<b>Agency:</b> <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO	<b>ADOT:</b> <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	
<b>Name and Title of COG/MPO Representative:</b>		Margaret Herrera, MAG Transportation Safety Program Manager	
<b>Basic Project Information</b>			
<b>Anticipated Design Year (Construction year cannot be the same):</b>		<input checked="" type="checkbox"/> FY23	
<b>If additional ROW is needed, what FY is purchase anticipated?:</b>		<input checked="" type="checkbox"/> FY23 <input type="checkbox"/> FY24	
<b>Anticipated Construction Year:</b>		<input checked="" type="checkbox"/> FY24	
<b>1.</b>	<b>Have lower cost countermeasures been considered or implemented?</b>		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
<b>1a.</b>	<b>If "Yes", describe: If "No", explain why not:</b>	Exclusive left-turn lane and left-turn phasing (Pt/PM) installed at 3 locations. Exclusive left-turn lane is installed at other 3 intersections	
<b>2.</b>	<b>Which 23 USC 148 highway safety improvement project category does this project come under?</b>		
<b>2a.</b>	1. Intersection safety improvement		
<b>3.</b>	<b>Describe your safety improvement project in detail: (50 words or less)</b>		
<b>3a.</b>	The scope of work includes three elements and a total of six intersection. The City intends to convert permissive, protected, and protected/permissive left-turns to Flashing Yellow Arrow (FYA) protected/permissive signal operation for 3 intersestion. Convert permissive only left-turn movement to FYA for 3 intersetions. The project will install carrots to eliminate negative left-turn lane offset and create positive offset at all six intersection and add 3" retroreflective sheeting to all signal back plates to improve visibility at all six intersections		

**FY 23 and FY24 HSIP Application**

<b>Agency:</b>	<b>City of Glendale</b>	<b>Title of Project:</b>	<b>Install FYA and Geometric Modifications to Improve Safety at Arterial Intersections</b>
<b>County:</b>	Maricopa	<b>COG/MPO:</b>	MAG
<b>District:</b>	Central	<b>Date:</b>	5/8/2019
<b>4.</b>	<b>Describe the location of this safety project:</b>		
<b>4a.</b>	Six intersection: Existing PM/PT signal to FYA at: 63rd Ave at Bell Rd, Northern Ave at 56th Lane, Northern Ave at 47th Ave, Existing permissive phasing to FYA: Olive Ave at 47th Ave, Olive Ave at 55th Ave, and Bulter Drive at 67th Ave		
<b>5.</b>	<b>What crash data screening method was used to identify this project?</b>		
<b>5a.</b>	ADOT Traffic Engineering Guidelines and Procedures 610 Left-turn Signal Phasing Crash Experience Warrants were analyzed to determine the need for protected left-turn phasing. All these existing intersections do not have positive offsets and signal has poor visibility during night time.		
<b>6.</b>	<b>What is the safety justification for the proposed project?</b>		
<b>6a.</b>	<p>1. NCHRP/FHWA have studied the use of Flashing Yellow Arrow signal operation and determined that it is safe and more effective than the circular green ball in conveying to drivers the need to yield before turning left. In addition, FYA tends to have a safer fail condition than the circular green in that drivers will yield on the FYA rather than proceed on a circular green.</p> <p>2. FHWA research has determined that a strategy of eliminating a negative left-turn lane offset has the potential to reduce total and target crashes.</p> <p>3. FHWA has published reports supporting the installation of 3" retroreflective sheeting (borders) on signal backplated to increase the visibility of traffic signals, especially at night, and identified it as a countermeasure to reduce crashes by improving driver awareness of signals.</p>		
<b>7.</b>	<b>Will there be ground disturbing activities?</b>	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
<b>8.</b>	<b>Is project within applicants permanent ROW?</b>	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
<b>8a.</b>	<b>If NO please explain:</b>		
<b>9.</b>	<b>Will any temporary right-of-way acquisitions be required?</b>	<input type="checkbox"/> YES	<input checked="" type="checkbox"/> NO
<b>10.</b>	<b>Will there be any utility relocation needed?</b>	<input checked="" type="checkbox"/> YES	<input type="checkbox"/> NO
<b>10a.</b>	<b>If YES please explain:</b>	minor utility relocation is anticipated for exiting signal pole replacement, where longer mast arms are necessary to accommodate the left-turn heads	
<b>11.</b>	<b>Does Section 4(f) apply to any portion of this project?</b>	<input type="checkbox"/> YES	<input checked="" type="checkbox"/> NO
<b>11a.</b>	<b>If YES please explain:</b>		
<b>12.</b>	<b>Are there any other issues that may impact or delay development or construction of this project?</b>	<input type="checkbox"/> YES	<input checked="" type="checkbox"/> NO

**FY 23 and FY24 HSIP Application**

<b>Agency:</b>	<b>City of Glendale</b>	<b>Title of Project:</b>	<b>Install FYA and Geometric Modifications to Improve Safety at Arterial Intersections</b>
<b>County:</b>	Maricopa	<b>COG/MPO:</b>	MAG
<b>District:</b>	Central	<b>Date:</b>	5/8/2019
<b>12a.</b>	If YES please explain:		
<b>13.</b>	Is this project in compliance with revised ADA Standards? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
<b>13a.</b>	If NO please explain:		
<b>14.</b>	Does the project support Arizona's Strategic Highway Safety Plan? <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
<b>15.</b>	Are there any Studies, RSA's or Other evaluations that support this project? <input type="checkbox"/> YES <input checked="" type="checkbox"/> NO		
<b>16.</b>	If the project is a traffic control device requiring a warrant, is a copy attached?		<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
<b>17.</b>	HSIP Roadway Functional Classification:		Urban Minor Arterial
<b>18.</b>	For projects on State System:	<b>BMP:</b>	<b>EMP:</b>
<b>19.</b>	Average Daily Traffic Volume and Year Collected:		ADT: ~25,000 Year: 2015
<b>20.</b>	What is the source of ADT?:	City of Glendale Bi-Annual count program	
<b>21.</b>	What is the posted speed limit?	min 40 mph (varies)	
<b>22.</b>	Detailed engineer's cost estimate attached: <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO		
<b>"Systemic" Safety Project</b>			
<b>23.</b>	Completed B/C Ratio Tabulation Sheet Attached (Required): <input type="checkbox"/> YES <input type="checkbox"/> NO		
<b>24.</b>	Most current 5 Years Crash Data from ADOT ALISS database sorted by year & severity (required):		
<b>25.</b>	What are the inclusive dates of the crash data?		
<b>26.</b>	Have all crashes that will not be influenced by this countermeasure been deleted from the crash list? (pedestrian, pedalcycle, etc. as applicable)		
<b>27.</b>	If purchasing equipment or materials, who will install?		<input type="checkbox"/> Town/City <input type="checkbox"/> County <input type="checkbox"/> Tribe <input type="checkbox"/> Contractor
<b>28.</b>	Does the project require proprietary Items (23CFR 635.411)? <input type="checkbox"/> Yes <input type="checkbox"/> No		
<b>29.</b>	Is a list of locations for systemic projects provided on the attached form? <input type="checkbox"/> Yes <input type="checkbox"/> No		
<b>30.</b>	How are (will) the proposed locations be prioritized for replacement? (explain below)		
<b>30a.</b>			
<b>31.</b>	Are the supporting structures in good condition, meet local standards and have an anticipated service life longer than the countermeasure being installed?		<input type="checkbox"/> Yes <input type="checkbox"/> No

**FY 23 and FY24 HSIP Application**

<b>Agency:</b>	<b>City of Glendale</b>	<b>Title of Project:</b>	<b>Install FYA and Geometric Modifications to Improve Safety at Arterial Intersections</b>
<b>County:</b>	Maricopa	<b>COG/MPO:</b>	MAG
<b>District:</b>	Central	<b>Date:</b>	5/8/2019
<b>"Spot" Improvement Projects Only</b>			
<b>32.</b>	<b>Completed B/C Ratio Tabulation Sheet Attached (required):</b>		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
<b>33.</b>	<b>Is the most current 5 Years Crash Data from ADOT ALISS database sorted by year &amp; severity attached and in correct format? (required):</b>		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
<b>34.</b>	<b>What are the inclusive dates of the crash data?</b>	2013-2017	
<b>35.</b>	<b>Have all crashes that will not be influenced by this countermeasure been deleted from the crash list? (pedestrian, pedalcycle etc. as applicable)</b>		yes
<b>36.</b>	<b>Have any infrastructure changes occurred within the work limits of this project during the years the crash data covers?</b>		<input type="checkbox"/> YES <input checked="" type="checkbox"/> NO
<b>37.</b>	<b>If YES please explain:</b>		
<b>38.</b>	<b>Project vicinity map is provided:</b>		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
<b>39.</b>	<b>Project work limits map is provided:</b>		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
<b>SHSP - All Projects</b>			
<b>40.</b>	<b>Which SHSP Emphasis Area (EA) does this project support?:</b>	Roadway_Infrastructure_and_Operations	
<b>40a.</b>	<b>Which EA Strategy does it support?:</b>	(Intersections) Reduce frequency and severity of intersection crashes through traffic-control and operational improvements.	
<b>40b.</b>	<b>Does this project support a second SHSP EA? If so, which EA.:</b>	Roadway_Infrastructure_and_Operations	
<b>40c.</b>	<b>Which EA Strategy supports the second EA?</b>	(Intersections) Reduce frequency and severity of intersection crashes through geometric improvements.	
<b>40d.</b>	<b>Does this project support a third SHSP EA? If so, which EA.:</b>		
<b>40e.</b>	<b>Which EA Strategy supports the third EA?</b>		
<b>41.</b>	<b>Does this project support one of the nine FHWA proven countermeasures?:</b>		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
<b>41a.</b>	<b>If so, which countermeasure?:</b>	Backplates with Retroreflective Borders	

FY 23 and FY24 HSIP Application

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<b>County:</b>	Maricopa	<b>COG/MPO:</b>	MAG
<b>District:</b>	Central	<b>Date:</b>	5/8/2019
<b>42.</b>	<b>Does this project support one of the three Arizona Focus Areas?:</b>		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
<b>42a.</b>	<b>If so, which focus area?:</b>	Intersection	
<b>43.</b>	<b>Which HSIP Improvement Category does this project support?:</b>	Intersection_Traffic_Control	
<b>43a.</b>	<b>Which HSIP Improvement Sub-Category does this project support?:</b>		
	Modify traffic signal – add flashing yellow arrow		
<b>44.</b>	<b>Does your COG/MPO have a Strategic Transportation Safety Plan (STSP)?:</b>		<input checked="" type="checkbox"/> YES <input type="checkbox"/> NO
<b>44a.</b>	<b>If "YES", does this project support an Emphasis Area in the COG/MPO STSP?:</b>		yes <input type="checkbox"/> NO
<b>44b.</b>	<b>List the EA:</b>	Eliminate Death and Injuries Related to Intersections	
<b>44c.</b>	<b>If your COG/MPO has a STSP and it was Federally Funded and you answered NO in 41a, explain why this project is being submitted over a STSP identified project. (For Local Agencies Only)</b>		
<b>44d.</b>	<b>Rational:</b>		
<b>45.</b>	<b>Are any temporary safety countermeasures needed prior to this permanent solution being installed?</b>		
<b>45a.</b>	<b>If yes, please explain:</b>		
<b>46.</b>	<b>For State Agencies, has the Regional Traffic Engineer been made aware of this potential project and does he/she concur with it?</b>		<input type="checkbox"/> YES <input type="checkbox"/> NO
<b>Strategic Transportation Safety Plans Funds (COG/MPO)</b>			
<b>47.</b>	<b>What is the date of your last STSP or update completed?</b>		
<b>48.</b>	<b>How many projects that were identified in your last STSP or update were submitted for HSIP funding?</b>		
<b>49.</b>	<b>What was the total dollar amount of the projects in question 45?</b>		
<b>50.</b>	<b>How many projects that were submitted for HSIP funding were eligible and funded by ADOT?</b>		
<b>51.</b>	<b>What was the total dollar amount of the projects in question 47?</b>		
<b>B/C Ratio</b>			
<b>52.</b>	<b>The calculated B/C Ratio is:</b>	<b>44.10</b>	<b>CMF ID Number:</b> 4175, 4177
			<b>2nd CMF ID No.:</b> 6097
			<b>3rd CMF ID NO.:</b> 1410

FY 23 and FY24 HSIP Application

Agency:	City of Glendale	Name of Project:	FYA + Median Offset + 3" Yellow Reflective Tape for Signals			Non-State Agency Cost Estimate - Countermeasure 100% HSIP Eligible				
HSIP Project Cost Estimate Worksheet										
Project Cost Estimate:	Description:	Unit of Measure	Quantity:	Unit Cost:	Total Cost	HSIP Eligible:	HSIP:	State Match:	Other Amt:	TOTAL COST
							100.00%	0.00%	0.00%	
Planning and Design		L.SUM	1	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00	\$ 150,000.00	\$ -	\$ -	\$ 150,000.00
Environmental and Utility Clearance		L.SUM	1	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	\$ 50,000.00	\$ -	\$ -	\$ 50,000.00
Non-Infrastructure (NI) Elements:		L.SUM	0	\$ -		\$ -	\$ -	\$ -	\$ -	\$ -
ADOT Admin Costs:		L.SUM	1	\$ 30,000.00	\$ 30,000.00	\$ 30,000.00	\$ 30,000.00	\$ -	\$ -	\$ 30,000.00
<b>Design Sub-Total</b>					<b>\$ 230,000.00</b>	<b>\$ 230,000.00</b>	<b>\$ 230,000.00</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 230,000.00</b>
Inflation Factor			5.00%		\$ 11,500.00	\$ 11,500.00	\$ 11,500.00	\$ -	\$ -	\$ 11,500.00
<b>Total Design Cost</b>					<b>\$ 241,500.00</b>	<b>\$ 241,500.00</b>	<b>\$ 241,500.00</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 241,500.00</b>
2020053	REMOVE (SIGN, FOUNDATION, AND POST)	EACH	12	200.00	\$ 2,400.00	\$ 2,400.00				\$ 2,400.00
6080005	WARNING, MARKER, OR REGULATORY SIGN PANEL	SQ.FT.	72	22.00	\$ 1,584.00	\$ 1,584.00				\$ 1,584.00
7015051	OBLITERATE PAVEMENT MARKING (ARROW, SYMBOL OR LEGEND)	EACH	24	150.00	\$ 3,600.00	\$ 3,600.00				\$ 3,600.00
7015052	OBLITERATE PAVEMENT MARKING (STRIPE)	L.FT.	3000	2.50	\$ 7,500.00	\$ 7,500.00				\$ 7,500.00
7040005	PAVEMENT MARKING (WHITE EXTRUDED THERMOPLASTIC) (0.090")	L.FT.	3000	1.00	\$ 3,000.00	\$ 3,000.00				\$ 3,000.00
7040006	PAVEMENT MARKING (YELLOW EXTRUDED THERMOPLASTIC) (0.090")	L.FT.	3000	1.00	\$ 3,000.00	\$ 3,000.00				\$ 3,000.00
7040072	PAVEMENT MARKING (TRANSVERSE) (THERMOPLASTIC) (ALKYD) (0.090")	L.FT.	3000	1.50	\$ 4,500.00	\$ 4,500.00				\$ 4,500.00
7040073	PAVEMENT LEGEND (EXTRUDED THERMOPLASTIC) (ALKYD) (0.090")	EACH	120	15.00	\$ 1,800.00	\$ 1,800.00				\$ 1,800.00
7040074	PAVEMENT SYMBOL (EXTRUDED THERMOPLASTIC) (ALKYD) (0.090")	EACH	24	200.00	\$ 4,800.00	\$ 4,800.00				\$ 4,800.00
7310130	POLE (TYPE Q)	EACH	4	8500.00	\$ 34,000.00	\$ 34,000.00				\$ 34,000.00
7310140	POLE (TYPE R)	EACH	2	8700.00	\$ 17,400.00	\$ 17,400.00				\$ 17,400.00
7310320	POLE FOUNDATION (TYPE R)	EACH	2	2600.00	\$ 5,200.00	\$ 5,200.00				\$ 5,200.00
7310371	POLE FOUNDATION (TYPE Q116, GLENDALE)	EACH	4	2400.00	\$ 9,600.00	\$ 9,600.00				\$ 9,600.00
7310610	MAST ARM (50 FT.) (TAPERED)	EACH	4	3200.00	\$ 12,800.00	\$ 12,800.00				\$ 12,800.00
7310635	MAST ARM (60 FT.) (TAPERED)	EACH	2	4000.00	\$ 8,000.00	\$ 8,000.00				\$ 8,000.00
7320650	CONDUCTORS	L.SUM	6	9100.00	\$ 54,600.00	\$ 54,600.00				\$ 54,600.00
7330070	TRAFFIC SIGNAL FACE (TYPE G)	EACH	24	1000.00	\$ 24,000.00	\$ 24,000.00				\$ 24,000.00
7330310	TRAFFIC SIGNAL MOUNTING ASSEMBLY (TYPE II)	EACH	6	150.00	\$ 900.00	\$ 900.00				\$ 900.00
7330330	TRAFFIC SIGNAL MOUNTING ASSEMBLY (TYPE IV)	EACH	6	500.00	\$ 3,000.00	\$ 3,000.00				\$ 3,000.00
7330360	TRAFFIC SIGNAL MOUNTING ASSEMBLY (TYPE VII)	EACH	12	450.00	\$ 5,400.00	\$ 5,400.00				\$ 5,400.00
9010001	MOBILIZATION	L.SUM	2	12000.00	\$ 24,000.00	\$ 24,000.00				\$ 24,000.00
9250001	CONSTRUCTION SURVEYING AND LAYOUT	L.SUM	1	9000.00	\$ 9,000.00	\$ 9,000.00				\$ 9,000.00
7010001	TRAFFIC CONTROL	L.SUM	1	18000.00	\$ 18,000.00	\$ 18,000.00				\$ 18,000.00
			0			\$ -	\$ -	\$ -	\$ -	\$ -
<b>Sub-Total</b>			0		<b>\$ 258,084.00</b>	<b>\$ 258,084.00</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 258,084.00</b>
Sales Tax:	(if applicable)		0.00%		\$ -	\$ -	\$ -	\$ -	\$ -	\$ -
<b>Sub-Total</b>					<b>\$ 258,084.00</b>	<b>\$ 258,084.00</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 258,084.00</b>
Construction Admin :		L.SUM	7.00%		\$ 18,065.88	\$ 18,065.88	\$ 18,065.88	\$ -	\$ -	\$ 18,065.88
Contingencies :		L.SUM	5.00%		\$ 12,904.20	\$ 12,904.20	\$ 12,904.20	\$ -	\$ -	\$ 12,904.20
Post Design:		L.SUM	1.00%		\$ 2,580.84	\$ 2,580.84	\$ 2,580.84	\$ -	\$ -	\$ 2,580.84
Communications:		L.SUM	5.00%		\$ 12,904.20	\$ 12,904.20	\$ 12,904.20	\$ -	\$ -	\$ 12,904.20
						\$ -	\$ -	\$ -	\$ -	\$ -
						\$ -	\$ -	\$ -	\$ -	\$ -
						\$ -	\$ -	\$ -	\$ -	\$ -
						\$ -	\$ -	\$ -	\$ -	\$ -
						\$ -	\$ -	\$ -	\$ -	\$ -
<b>Post Sub-Total</b>					<b>\$ 46,455.12</b>	<b>\$ 46,455.12</b>	<b>\$ 46,455.12</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 46,455.12</b>
<b>Construction Sub-Total</b>					<b>\$ 304,539.12</b>	<b>\$ 304,539.12</b>	<b>\$ 304,539.12</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 304,539.12</b>
Inflation Factor			5.00%		\$ 15,226.96	\$ 15,226.96	\$ 15,226.96	\$ -	\$ -	\$ 15,226.96
<b>Construction Total</b>					<b>\$ 319,766.08</b>	<b>\$ 319,766.08</b>	<b>\$ 319,766.08</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 319,766.08</b>
<b>TOTAL REQUEST</b>					<b>\$ 561,266.08</b>	<b>\$ 561,266.08</b>	<b>\$ 561,266.08</b>	<b>\$ -</b>	<b>\$ -</b>	<b>\$ 561,266.08</b>

**FY 23 and FY24 HSIP Application**

<b>Required for all HSIP Applications</b>					
<b>Agency:</b>	CITY OF GLENDALE	<b>Title of Project:</b>	Installation of FYA, 3" reflective tape, & removing negative off-set		
Benefit / Cost Ratio Tabulation					
Annual Benefit Tabulation					
Severity	Annual Average	Estimated CRF* Reduction	Total Reduction	Unit Cost	Annual Benefit
Fatal	<b>0.80</b>	<b>43%</b>	0.35	\$9,515,371	\$3,307,155
Incapacitating Injury	<b>1.60</b>	<b>43%</b>	0.70	\$550,499	\$382,662
Total Annual Benefits					\$3,689,817
Costs					
Total Project Cost					\$561,266
Project Life (years)					10
Interest Rate (%)					8%
Capital Recovery Factor					0.1490
Annual Construction Cost					\$83,645
Annual Maintenance Cost					\$0.00
Total Annual Costs					\$83,645
Benefit / Cost					
Annual Benefit		Annual cost		Benefit / Cost Ratio	
\$3,689,817		\$83,645		44.1	
<b>*REQUIRED: Use 4 and 5 star CMFs from ADOT Lists <u>Only</u> at Tabs 11 - 12 preferred. The CMF's CRF is used in the above calculation</b>					

**Required for all HSIP Applications**

<b>Agency:</b>	City of Glendale	<b>Title of Project:</b>	Installation of FYA, median improvements to reduced negative offset, & high visibility signal heads
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**Benefit / Cost Ratio Tabulation: Bell Rd at 63rd Ave**

**Annual Benefit Tabulation**

Severity	Annual Average	Estimated CRF* Reduction	Total Reduction	Unit Cost	Annual Benefit
Fatal	<b>0.20</b>	<b>32%</b>	0.06	\$9,515,371	\$602,818
Incapacitating Injury	<b>0.40</b>	<b>32%</b>	0.13	\$550,499	\$69,750
Total Annual Benefits					\$672,568

**Costs**

Total Project Cost	\$78,500
Project Life (years)	10
Interest Rate (%)	8%
Capital Recovery Factor	0.1490
Annual Construction Cost	\$11,699
Annual Maintenance Cost	\$0.00
Total Annual Costs	\$11,699

**Benefit / Cost**

Annual Benefit	Annual cost	Benefit / Cost Ratio
\$672,568	\$11,699	57.4

**\*REQUIRED: Use 4 and 5 star CMFs from ADOT Lists Only at Tabs 11 - 12 preferred. The CMF's CRF is used in the above calculation**

**Required for all HSIP Applications**

<b>Agency:</b>	City of Glendale	<b>Title of Project:</b>	Installation of FYA, median improvements to reduced negative offset, & high visibility signal heads
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**Benefit / Cost Ratio Tabulation: Northern Ave at 56th Ave**

**Annual Benefit Tabulation**

Severity	Annual Average	Estimated CRF* Reduction	Total Reduction	Unit Cost	Annual Benefit
Fatal	<b>0.20</b>	<b>65%</b>	0.13	\$9,515,371	\$1,237,531
Incapacitating Injury	<b>0.00</b>	<b>65%</b>	0.00	\$550,499	\$0
Total Annual Benefits					\$1,237,531

**Costs**

Total Project Cost	\$78,500	
Project Life (years)	10	
Interest Rate (%)	8%	
Capital Recovery Factor	0.1490	
Annual Construction Cost	\$11,699	
Annual Maintenance Cost	\$0.00	
Total Annual Costs		\$11,699

**Benefit / Cost**

Annual Benefit	Annual cost	Benefit / Cost Ratio
\$1,237,531	\$11,699	105.7

**\*REQUIRED: Use 4 and 5 star CMFs from ADOT Lists Only at Tabs 11 - 12 preferred. The CMF's CRF is used in the above calculation**

**Required for all HSIP Applications**

<b>Agency:</b>	City of Glendale	<b>Title of Project:</b>	Installation of FYA, median improvements to reduced negative offset, & high visibility signal heads
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**Benefit / Cost Ratio Tabulation: Northern Ave at 47th Ave**

**Annual Benefit Tabulation**

Severity	Annual Average	Estimated CRF* Reduction	Total Reduction	Unit Cost	Annual Benefit
Fatal	<b>0.00</b>	<b>15%</b>	0.00	\$9,515,371	\$0
Incapacitating Injury	<b>0.40</b>	<b>15%</b>	0.06	\$550,499	\$33,030
Total Annual Benefits					\$33,030

**Costs**

Total Project Cost	\$78,500	
Project Life (years)	10	
Interest Rate (%)	8%	
Capital Recovery Factor	0.1490	
Annual Construction Cost	\$11,699	
Annual Maintenance Cost	\$0.00	
Total Annual Costs		\$11,699

**Benefit / Cost**

Annual Benefit	Annual cost	Benefit / Cost Ratio
\$33,030	\$11,699	2.8

**\*REQUIRED: Use 4 and 5 star CMFs from ADOT Lists Only at Tabs 11 - 12 preferred. The CMF's CRF is used in the above calculation**

**Required for all HSIP Applications**

<b>Agency:</b>	City of Glendale	<b>Title of Project:</b>	Installation of FYA, median improvements to reduced negative offset, & high visibility signal heads
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**Benefit / Cost Ratio Tabulation: Olive Ave at 47th Ave**

**Annual Benefit Tabulation**

Severity	Annual Average	Estimated CRF* Reduction	Total Reduction	Unit Cost	Annual Benefit
Fatal	<b>0.20</b>	<b>35%</b>	0.07	\$9,515,371	\$670,072
Incapacitating Injury	<b>0.40</b>	<b>35%</b>	0.14	\$550,499	\$77,532
Total Annual Benefits					\$747,605

**Costs**

Total Project Cost	\$108,589
Project Life (years)	10
Interest Rate (%)	8%
Capital Recovery Factor	0.1490
Annual Construction Cost	\$16,183
Annual Maintenance Cost	\$0.00
Total Annual Costs	\$16,183

**Benefit / Cost**

Annual Benefit	Annual cost	Benefit / Cost Ratio
\$747,605	\$16,183	46.1

**\*REQUIRED: Use 4 and 5 star CMFs from ADOT Lists Only at Tabs 11 - 12 preferred. The CMF's CRF is used in the above calculation**

**Required for all HSIP Applications**

<b>Agency:</b>	City of Glendale	<b>Title of Project:</b>	Installation of FYA, median improvements to reduced negative offset, & high visibility signal heads
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**Benefit / Cost Ratio Tabulation: Olive Ave at 55th Ave**

**Annual Benefit Tabulation**

Severity	Annual Average	Estimated CRF* Reduction	Total Reduction	Unit Cost	Annual Benefit
Fatal	<b>0.20</b>	<b>45%</b>	0.09	\$9,515,371	\$862,378
Incapacitating Injury	<b>0.20</b>	<b>45%</b>	0.09	\$550,499	\$49,892
Total Annual Benefits					\$912,270

**Costs**

Total Project Cost	\$ 108,589.00
	10
Interest Rate (%)	8%
Capital Recovery Factor	0.1490
Annual Construction Cost	\$16,183
Annual Maintenance Cost	\$0.00
Total Annual Costs	\$16,183

**Benefit / Cost**

Annual Benefit	Annual cost	Benefit / Cost Ratio
\$912,270	\$16,183	56.3

**\*REQUIRED: Use 4 and 5 star CMFs from ADOT Lists Only at Tabs 11 - 12 preferred. The CMF's CRF is used in the above calculation**

**Required for all HSIP Applications**

<b>Agency:</b>	City of Glendale	<b>Title of Project:</b>	Installation of FYA, median improvements to reduced negative offset, & high visibility signal heads
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**Benefit / Cost Ratio Tabulation: Butler Dr at 67th Ave**

**Annual Benefit Tabulation**

Severity	Annual Average	Estimated CRF* Reduction	Total Reduction	Unit Cost	Annual Benefit
Fatal	<b>0.00</b>	<b>76%</b>	0.00	\$9,515,371	\$0
Incapacitating Injury	<b>0.20</b>	<b>76%</b>	0.15	\$550,499	\$83,268
Total Annual Benefits					\$83,268

**Costs**

Total Project Cost	\$108,589	
Project Life (years)	10	
Interest Rate (%)	8%	
Capital Recovery Factor	0.1490	
Annual Construction Cost	\$16,183	
Annual Maintenance Cost	\$0.00	
Total Annual Costs		\$16,183

**Benefit / Cost**

Annual Benefit	Annual cost	Benefit / Cost Ratio
\$83,268	\$16,183	5.1

**\*REQUIRED: Use 4 and 5 star CMFs from ADOT Lists Only at Tabs 11 - 12 preferred. The CMF's CRF is used in the above calculation**

**ADOT Standard Crash Report: 63rd Ave at Bell Rd**

Incident ID	Incident Date & Time	Incident On Road	Incident Crossing Feature	Incident Offset	Incident Injury Severity Description	Incident First Harmful Description	Incident Collision Manner Desc	Incident Light Condition Desc	Incident Weather Desc	Incident Intersection Type Desc	Incident Junction Relation Desc	Incident Traffic Way Type Desc	Unit Body Style Desc	Unit Travel Direction Desc	Unit Action Desc
2948494	1/27/2015 7:06:00 AM	07 BELL RD	63rd Ave	0	Suspected Serious Injury	Motor Vehicle In Transport	Left Turn	Daylight	Cloudy	FOUR_WAY_INTERSECTION	Intersection Non Interchange	Unknown	PASSENGER_4D SD_SEDAN_4_D R	4 - West	Making Left Turn
3201911	4/21/2016 10:51:00 AM	07 BELL RD	63rd Ave	0	Fatal	Motor Vehicle In Transport	Angle (Front To Side)(Other Than Left Turn)	Daylight	Clear	FOUR_WAY_INTERSECTION	Intersection Non Interchange	Two Way Divided Positive Median Barrier	PASSENGER_4D SW_STATION_W AGON_4_DR	4 - West	Going Straight Ahead
3234414	3/14/2017 2:12:00 PM	07 63RD AVE	Bell Rd	0	Suspected Serious Injury	Motor Vehicle In Transport	Angle (Front To Side)(Other Than Left Turn)	Daylight	Clear	FOUR_WAY_INTERSECTION	Intersection Non Interchange	Two Way Divided Unprotected Painted 4 Feet Median	PASSENGER_4D SW_STATION_W AGON_4_DR	3 - East	Going Straight Ahead



# Standard Crash Report: Northern Ave at 56th Lane

Incident ID	Incident Date & Time	Incident On Road	Incident Crossing Feature	Incident Offset	Incident Injury Severity Description	Incident First Harmful Description	Incident Collision Manner Desc	Incident Light Condition Desc	Incident Weather Desc	Incident Intersection Type Desc	Incident Junction Relation Desc	Incident Traffic Way Type Desc	Unit Body Style Desc	Unit Travel Direction Desc	Unit Action Desc
3317825	11/26/2017 7:20:00 PM	07 NORTHERN AVE	56th Ln	0	Fatal	Motor Vehicle In Transport	Left Turn	Dark Lighted	Clear	FOUR_WAY_INTERSECTION	Intersection Non Interchange	Two Way Not Divided With Continuous Left Turn Lane	PASSENGER_4D SW_STATION_WAGON_4_DR	4 - West	Making Left Turn



### Standard Crash Report: Northern Ave at 47th Ave

Incident ID	Incident Date & Time	Incident On Road	Incident Crossing Feature	Incident Offset	Incident Injury Severity Description	Incident First Harmful Description	Incident Collision Manner Desc	Incident Light Condition Desc	Incident Weather Desc	Incident Intersection Type Desc	Incident Junction Relation Desc	Incident Traffic Way Type Desc	Unit Body Style Desc	Unit Travel Direction Desc	Unit Action Desc
2971104	3/25/2015 12:06:00 PM	07 NORTHERN AVE	47th Ave	75	Suspected Serious Injury	Motor Vehicle In Transport	Rear End	Daylight	Clear	Not Reported	Thru Roadway	Unknown	PASSENGER_4D SD_SEDAN_4_D R	3 - East	Going Straight Ahead
3030506	9/16/2015 6:42:00 AM	07 47TH AVE	Northern Ave	0	Suspected Serious Injury	Motor Vehicle In Transport	Angle (Front To Side)(Other Than Left Turn)	Daylight	Clear	FOUR_WAY_INT ERSECTION	Intersection Non Interchange	Unknown	PASSENGER_4D SD_SEDAN_4_D R	3 - East	Going Straight Ahead



### Standard Crash Report Olive Ave at 47th Ave

Incident ID	Incident Microfilm	Incident Date & Time	Incident On Road	Incident Crossing Feature	Incident Injury Severity Description	Incident First Harmful Description	Incident Collision Manner Desc	Incident Light Condition Desc	Incident Weather Desc	Incident Intersection Type Desc	Incident Junction Relation Desc	Incident Traffic Way Type Desc	Unit Body Style Desc	Unit Travel Direction Desc	Unit Action Desc
2773075		9/3/2013 9:33:00 PM	07 OLIVE AVE	47th Ave	Suspected Serious Injury	Motor Vehicle In Transport	Rear End	Dark Lighted	Cloudy	FOUR_WAY_INTERSECTION	Intersection Related Non Interchange	Two Way Not Divided	PASSENGER_4D SD_SEDAN_4_D R	4 - West	Going Straight Ahead
2782091		9/26/2013 3:31:00 AM	07 OLIVE AVE	47th Ave	Fatal	Motor Vehicle In Transport	Left Turn	Dark Lighted	Cloudy	FOUR_WAY_INTERSECTION	Intersection Non Interchange	One Way Trafficway	MOTORCYCLE_ MC_MOTORCYCLE	4 - West	Making Left Turn
2795069		11/14/2013 12:11:00 PM	07 OLIVE AVE	47th Ave	Suspected Serious Injury	Motor Vehicle In Transport	Rear End	Daylight	Clear	FOUR_WAY_INTERSECTION	Intersection Non Interchange	Unknown	PASSENGER_12 PU_PICKUP_1_2 _TON	3 - East	Slowing In Trafficway



# Standard Crash Report Olive Ave at 55th Ave

Incident ID	Incident Microfilm	Incident Date & Time	Incident On Road	Incident Crossing Feature	Incident Injury Severity Description	Incident First Harmful Description	Incident Collision Manner Desc	Incident Light Condition Desc	Incident Weather Desc	Incident Intersection Type Desc	Incident Junction Relation Desc	Incident Traffic Way Type Desc	Unit Body Style Desc	Unit Travel Direction Desc	Unit Action Desc
2962648		3/9/2015 8:32:00 AM	07 OLIVE AVE	55th Ave	Fatal	Motor Vehicle In Transport	Left Turn	Daylight	Clear	FOUR_WAY_INTERSECTION	Intersection Non Interchange	Two Way Not Divided With Continuous Left Turn Lane	PASSENGER_COUPE	3 - East	Making Left Turn
3268411		6/20/2017 12:14:00 AM	07 OLIVE AVE A	55th Ave	Suspected Serious Injury	Motor Vehicle In Transport	Angle (Front To Side)(Other Than Left Turn)	Dark Lighted	Clear	FOUR_WAY_INTERSECTION	Intersection Interchange	Two Way Divided Unprotected Painted 4 Feet Median	PASSENGER_12 PU_PICKUP_1_2_TON	2 - South	Going Straight Ahead



### Standard Crash Report Butler Dr at 67th Ave

Incident ID	Incident Microfilm	Incident Date & Time	Incident On Road	Incident Crossing Feature	Incident Injury Severity Description	Incident First Harmful Description	Incident Collision Manner Desc	Incident Light Condition Desc	Incident Weather Desc	Incident Intersection Type Desc	Incident Junction Relation Desc	Incident Traffic Way Type Desc	Unit Body Style Desc	Unit Travel Direction Desc	Unit Action Desc
2817336		2/2/2014 8:10:00 PM	07 BUTLER DR	67th Ave	Suspected Serious Injury	Motor Vehicle In Transport	Left Turn	Dark Lighted	Clear	FOUR_WAY_INTERSECTION	Intersection Non Interchange	Two Way Not Divided With Continuous Left Turn Lane	PASSENGER_4D SD_SEDAN_4_D R	5 - Northwest	Making Left Turn



**Figure 1: Glendale, Arizona**

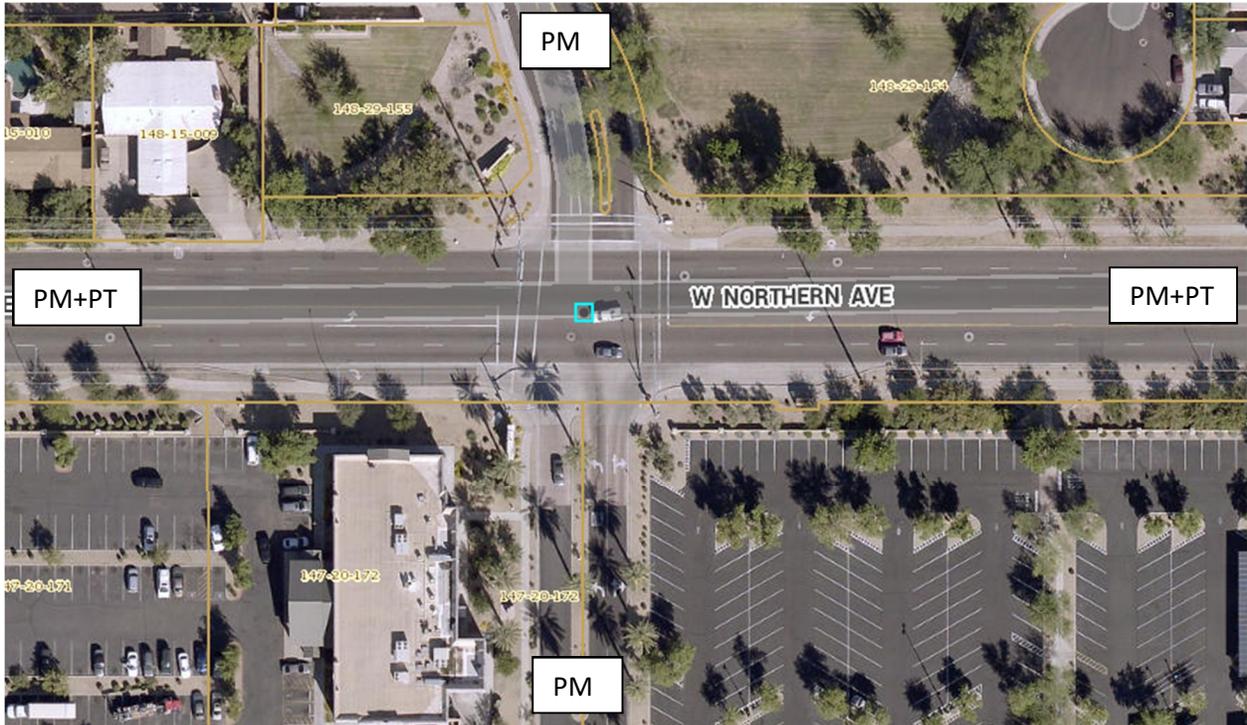


**Figure 2 – Site Location Map**

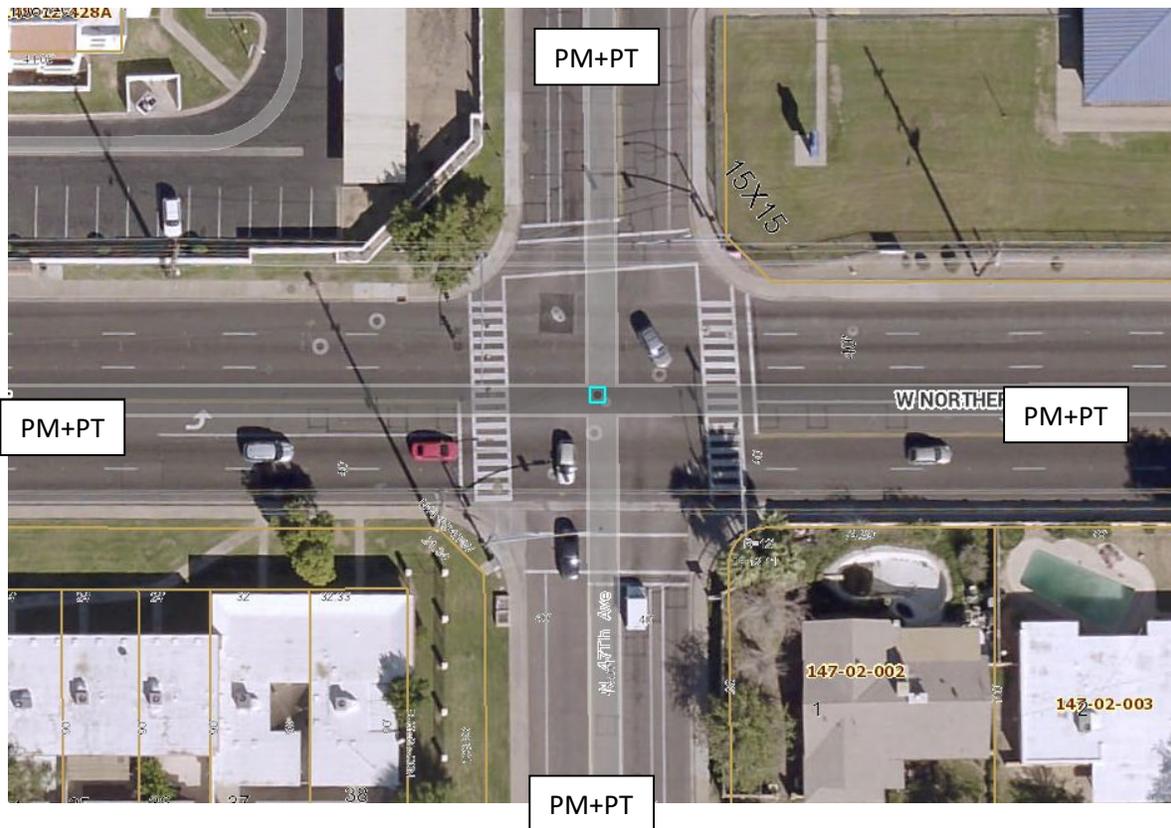
**Bell Road and 63<sup>rd</sup> Avenue**



Northern Avenue and 56<sup>th</sup> Lane



Northern Avenue and 47<sup>th</sup> Avenue



Olive Avenue and 47<sup>th</sup> Avenue



Olive Avenue and 55<sup>th</sup> Avenue



Butler Drive and 67<sup>th</sup> Avenue



Exclusive Left-turn Phasing - Analysis

Intersections with Existing Left-turn Phasing (Perm/Prot) - No Analysis needed for these intersections

Existing  
PM/PT

Bell Road and 63rd Avenue - Existing PM/PT					Northern Avenue and 56th Lane - Existing PM/PT					Northern Avenue and 47th Avenue - Existing PM/PT				
Movement	NBLT	SBLT	EBLT	WBLT	Movement	NBLT	SBLT	EBLT	WBLT	Movement	NBLT	SBLT	EBLT	WBLT
1 Year One Approach	1	0	0	4	1 Year One Approach	0	1	2	2	1 Year One Approach	1	1	1	1
1 Year Warrant Met	No	No	No	Yes	1 Year Warrant Met					1 Year Warrant Met				
2 Year One Approach	2	0	1	5	2 Year One Approach	0	1	3	2	2 Year One Approach	1	1	1	3
2 Year Warrant Met	No	No	No	No	2 Year Warrant Met					2 Year Warrant Met				
1 Year Two Opposing	1		4		1 Year Two Opposing	1		4		1 Year Two Opposing	2		2	
2 Year Two Opposing	2		6		2 Year Two Opposing	1		5		2 Year Two Opposing	2		4	
1 Year Warrant Met	No		No		1 Year Warrant Met					1 Year Warrant Met				
2 Year Warrant Met	No		No		2 Year Warrant Met					2 Year Warrant Met				

No  
Left-turn  
Phasing

Butler Drive and 67th Avenue					Olive Avenue and 47th Avenue					Olive Avenue and 55th Avenue				
Movement	NBLT	SBLT	EBLT	WBLT	Movement	NBLT	SBLT	EBLT	WBLT	Movement	NBLT	SBLT	EBLT	WBLT
1 Year One Approach	4	0	0	0	1 Year One Approach	2	2	3	2	1 Year One Approach	0	1	1	4
1 Year Warrant Met	Yes	No	No	No	1 Year Warrant Met	No	No	No	No	1 Year Warrant Met	No	No	No	Yes
2 Year One Approach	4	1	1	0	2 Year One Approach	2	2	6	4	2 Year One Approach	0	1	1	7
2 Year Warrant Met	No	No	No	No	2 Year Warrant Met	No	No	Yes	No	2 Year Warrant Met	No	No	No	Yes
1 Year Two Opposing	4		0		1 Year Two Opposing	4		5		1 Year Two Opposing	1		5	
2 Year Two Opposing	5		1		2 Year Two Opposing	4		10		2 Year Two Opposing	1		8	
1 Year Warrant Met	No		No		1 Year Warrant Met	No		No		1 Year Warrant Met	No		No	
2 Year Warrant Met	No		No		2 Year Warrant Met	No		Yes		2 Year Warrant Met	No		No	

Intersections with No Exclusive Left-turn Phasing - Meets the warrant requirements for left-turn phasing



## CMF / CRF Details

**CMF ID: 1410**

### Add 3-inch yellow retroreflective sheeting to signal backplates

**Description:**

**Prior Condition:** *No Prior Condition(s)*

**Category:** Intersection traffic control

**Study:** [Safety Impact of Increased Traffic Signal Backboards Conspicuity, Sayed et al., 2005](#)

**Star Quality Rating:** ★★★★★ [View score details]

#### Crash Modification Factor (CMF)

**Value:** 0.85

**Adjusted Standard Error:**

**Unadjusted Standard Error:** 0.005

#### Crash Reduction Factor (CRF)

**Value:** 15 (This value indicates a **decrease** in crashes)

**Adjusted Standard Error:**

**Unadjusted Standard Error:** 0.5

#### Applicability

**Crash Type:** All

**Crash Severity:** All

**Roadway Types:** Not specified

**Number of Lanes:**

**Road Division Type:**

**Speed Limit:**

**Area Type:** Urban

<b>Traffic Volume:</b>	
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	All
<b><i>If countermeasure is intersection-based</i></b>	
<b>Intersection Type:</b>	Roadway/roadway (not interchange related)
<b>Intersection Geometry:</b>	
<b>Traffic Control:</b>	Signalized
<b>Major Road Traffic Volume:</b>	
<b>Minor Road Traffic Volume:</b>	
<b>Average Major Road Volume :</b>	
<b>Average Minor Road Volume :</b>	

#### Development Details

<b>Date Range of Data Used:</b>	
<b>Municipality:</b>	
<b>State:</b>	
<b>Country:</b>	
<b>Type of Methodology Used:</b>	Before/after using empirical Bayes or full Bayes
<b>Sample Size (sites):</b>	17 sites after

#### Other Details

<b>Included in Highway Safety Manual?</b>	No
<b>Date Added to Clearinghouse:</b>	Dec-01-2009
<b>Comments:</b>	

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This site is funded by the U.S. Department of Transportation Federal Highway Administration and maintained by the University of North Carolina Highway Safety Research Center

For more information, contact Karen Scurry at karen.scurry@dot.gov

*The information contained in the Crash Modification Factors (CMF) Clearinghouse is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The U.S. Government assumes no liability for the use of the information contained in the CMF Clearinghouse. The information contained in the CMF Clearinghouse does not constitute a standard, specification, or regulation, nor is it a substitute for sound engineering judgment.*



## CMF / CRF Details

**CMF ID: 6097**

### Improve left-turn lane offset to create positive offset

**Description:** Improve left-turn lane offset to make the left-turn lanes with positive offset

**Prior Condition:** Left-turn lanes with negative offset

**Category:** Intersection geometry

**Study:** [Safety Evaluation of Offset Improvements for Left-Turn Lanes, Persaud et al., 2009](#)

**Image:** [View the countermeasure image.](#)

**Star Quality Rating:** [\[View score details\]](#)

#### Crash Modification Factor (CMF)

**Value:** 0.62

**Adjusted Standard Error:**

**Unadjusted Standard Error:** 0.089

#### Crash Reduction Factor (CRF)

**Value:** 38 *(This value indicates a **decrease** in crashes)*

**Adjusted Standard Error:**

**Unadjusted Standard Error:** 8.9

#### Applicability

**Crash Type:** Left turn

**Crash Severity:** All

**Roadway Types:** Not specified

**Number of Lanes:**

**Road Division Type:**

**Speed Limit:**

<b>Area Type:</b>	Not specified
<b>Traffic Volume:</b>	
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	All
<b><i>If countermeasure is intersection-based</i></b>	
<b>Intersection Type:</b>	
<b>Intersection Geometry:</b>	4-leg
<b>Traffic Control:</b>	
<b>Major Road Traffic Volume:</b>	Minimum of 7,150 to Maximum of 29,200 Annual Average Daily Traffic (AADT)
<b>Minor Road Traffic Volume:</b>	Minimum of 2,200 to Maximum of 13,350 Annual Average Daily Traffic (AADT)
<b>Average Major Road Volume :</b>	18,892 Annual Average Daily Traffic (AADT)
<b>Average Minor Road Volume :</b>	6,668 Annual Average Daily Traffic (AADT)

#### Development Details

<b>Date Range of Data Used:</b>	1983 to 2005
<b>Municipality:</b>	
<b>State:</b>	WI
<b>Country:</b>	
<b>Type of Methodology Used:</b>	Before/after using empirical Bayes or full Bayes
<b>Sample Size (crashes):</b>	287 crashes before, 59 crashes after
<b>Sample Size (sites):</b>	12 sites before, 12 sites after
<b>Sample Size (site-years):</b>	87 site-years before, 33 site-years after

#### Other Details

<b>Included in Highway Safety Manual?</b>	No
<b>Date Added to Clearinghouse:</b>	Dec-08-2014
<b>Comments:</b>	CMF of shifting the left-turn lane further away from the adjacent through lane and result in a less negative offset or no offset.

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## CMF / CRF Details

CMF ID: 4175

**Changing left turn phasing from at least one permissive approach to flashing yellow arrow (FYA)**

**Description:** CMFs are calculated the intersection level and not the treated approach(es) level.

**Prior Condition:** At least one treated approach had permissive left turn

**Category:** Intersection traffic control

**Study:** [\*Evaluation of Safety Strategies at Signalized Intersections, Srinivasan, et al., 2011\*](#)

**Star Quality Rating:**



[\[View score details\]](#)

### Crash Modification Factor (CMF)

**Value:** 0.635

**Adjusted Standard Error:**

**Unadjusted Standard Error:** 0.126

### Crash Reduction Factor (CRF)

**Value:** 36.5 (This value indicates a **decrease** in crashes)

<b>Adjusted Standard Error:</b>	
<b>Unadjusted Standard Error:</b>	12.6

### Applicability

<b>Crash Type:</b>	Left turn
<b>Crash Severity:</b>	All
<b>Roadway Types:</b>	Not Specified
<b>Number of Lanes:</b>	
<b>Road Division Type:</b>	
<b>Speed Limit:</b>	
<b>Area Type:</b>	Urban
<b>Traffic Volume:</b>	
<b>Time of Day:</b>	Not specified

### *If countermeasure is intersection-based*

<b>Intersection Type:</b>	Roadway/roadway (not interchange related)
<b>Intersection Geometry:</b>	4-leg
<b>Traffic Control:</b>	Signalized
<b>Major Road Traffic Volume:</b>	8260 to 43000 Annual Average Daily Traffic (AADT)
<b>Minor Road Traffic Volume:</b>	600 to 13745 Annual Average Daily Traffic (AADT)

### Development Details

<b>Date Range of Data Used:</b>	
<b>Municipality:</b>	

<b>State:</b>	NC, OR, WA
<b>Country:</b>	USA
<b>Type of Methodology Used:</b>	Before/after using empirical Bayes or full Bayes
<b>Sample Size Used:</b>	Crashes
<b>Before Sample Size Used:</b>	93 Crashes
<b>After Sample Size Used:</b>	33 Crashes

<b>Other Details</b>	
<b>Included in Highway Safety Manual?</b>	No
<b>Date Added to Clearinghouse:</b>	Dec-06-2012
<b>Comments:</b>	

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## CMF / CRF Details

**CMF ID: 4177**

### Changing left turn phasing from protected-permissive to flashing yellow arrow (FYA)

**Description:** CMFs are calculated the intersection level and not the treated approach(es) level.

**Prior Condition:** All treated approaches had protected-permissive left turn

**Category:** Intersection traffic control

**Study:** [Evaluation of Safety Strategies at Signalized Intersections, Srinivasan, et al., 2011](#)

**Image:** [View the countermeasure image.](#)

Star Quality Rating:  [View score details]

#### Crash Modification Factor (CMF)

**Value:** 0.806

**Adjusted Standard Error:**

**Unadjusted Standard Error:** 0.146

#### Crash Reduction Factor (CRF)

**Value:** 19.4 (This value indicates a **decrease** in crashes)

**Adjusted Standard Error:**

**Unadjusted Standard Error:** 14.6

#### Applicability

**Crash Type:** Left turn

**Crash Severity:** All

**Roadway Types:** Not Specified

**Number of Lanes:**

**Road Division Type:**

<b>Speed Limit:</b>	
<b>Area Type:</b>	Urban
<b>Traffic Volume:</b>	
<b>Average Traffic Volume:</b>	
<b>Time of Day:</b>	Not specified
<b><i>If countermeasure is intersection-based</i></b>	
<b>Intersection Type:</b>	Roadway/roadway (not interchange related)
<b>Intersection Geometry:</b>	4-leg
<b>Traffic Control:</b>	Signalized
<b>Major Road Traffic Volume:</b>	Minimum of 8260 to Maximum of 43000 Annual Average Daily Traffic (AADT)
<b>Minor Road Traffic Volume:</b>	Minimum of 600 to Maximum of 13745 Annual Average Daily Traffic (AADT)
<b>Average Major Road Volume :</b>	22575 Annual Average Daily Traffic (AADT)
<b>Average Minor Road Volume :</b>	4285 Annual Average Daily Traffic (AADT)

#### Development Details

<b>Date Range of Data Used:</b>	
<b>Municipality:</b>	
<b>State:</b>	NC, OR, WA
<b>Country:</b>	USA
<b>Type of Methodology Used:</b>	Before/after using empirical Bayes or full Bayes
<b>Sample Size (crashes):</b>	134 crashes before, 47 crashes after

#### Other Details

<b>Included in Highway Safety Manual?</b>	No
<b>Date Added to Clearinghouse:</b>	Dec-06-2012
<b>Comments:</b>	

[View the Full Study Details](#)

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