

CITY OF FULLERTON  
Engineering Department

August 17, 2005

Ref: 4-219 (Ex) - NCHRP 3-54, Flashing Yellow Arrow

Regina S. McElroy  
Director,  
Office of Transportation Operations  
Federal Highway Administration  
400 Seventh Street, S.W.  
Washington, D.C. 20590

Dear Ms. McElroy:

The City of Fullerton is requesting approval for experimentation with the Flashing Yellow Arrow Protected/Permissive (PPLT) Operation at four additional intersections. The four intersections are proposed to be converted from "protected only" made left turns to PPLT. The four intersections are:

1. Dorothy Lane at State College Boulevard (north/south direction)
2. Malvern Avenue at Burning Tree Road (east/west direction)
3. Orangethorpe Avenue at Acacia Avenue (east/west. direction)
4. Orangethorpe Avenue at Highland Avenue (east/west direction)

Presently, the City is very pleased with the operation of the existing three intersections under experimentation since February 2005.

Per your October 6, 2004 letter, the City will provide regular progress reports upon completion of each year of data availability and a copy of the final results within 3 months following availability of the third year of "after" data.

If you have any questions, please contact Mark Miller, City Traffic Engineer, at (714) 738-6330.

Respectfully Submitted,  
Donald K. Hopp Director of Engineering  
DH/MMiller

Fullerton: 100 Years of Community Pride  
303 West Commonwealth Avenue, Fullerton, California 92832-1775  
(714) 738-6845  
Fax (714) 738-3115  
Web Site: [www.ci.fullerton.ca.us](http://www.ci.fullerton.ca.us)

Federal Highway Administration  
400 Seventh Street, SW  
Washington, DC 20590

October 6, 2004  
Refer to: HOTO-1

Mr. Don Hoppe  
Director of Engineering  
City of Fullerton  
303 West Commonwealth Avenue  
Fullerton, CA 92832-1775

Dear Mr. Hoppe

Thank you for your September 29 letter, sent by fax, requesting permission to experiment with the flashing yellow arrow for protected-permissive left-turn (PPLT) movements at three intersections in the city of Fullerton.

We approve your request to experiment with the flashing yellow arrow for PPLT at the three intersections, as per your proposal. This approval is granted for a period not to exceed 4 years, on the condition that the city of Fullerton collect and summarize crash data annually over a 3-year period following implementation. It is our understanding that all three intersections in question are being converted from "protected only" mode left turns to PPLT. "Before and after" studies are not appropriate because they would not be comparable to the other locations being studied under NCHRP project 3-54 research, where a previously-existing PPLT phase was converted from circular green display to flashing yellow arrow. However, 3 years of crash data for this location after the flashing yellow arrow displays are installed would be useful for comparison to the "after" data of the other locations. Please note that we are requesting regular progress reports upon completion of each year of data availability and a copy of the final results within 3 months following availability of the third year of "after" data.

We very much appreciate the willingness of the city of Fullerton to participate in the continuing evaluations of the flashing yellow arrow display. We look forward to the results and the possibility of a new traffic control operation that will improve the mobility and safety of our roads. Please note that we have assigned your approved request the following official experimentation number and title: "4-219(Ex)--NCHRP 3-54, Flashing Yellow Arrow."

Please refer to this number in future correspondence. If you have any questions, please call Mr. Scott Wainwright at 202-366-0857.

Thank you again for your interest in traffic safety and operations.  
Sincerely yours,

Regina S. McElroy  
Director, Office of Transportation Operations

CITY OF EL CAJON  
PUBLIC WORKS  
February 8, 2005

Ms. Regina S. McElroy, Director  
Federal Highway Administration  
Office of Transportation Operations, HOTO-1  
400 Seventh Street, SW, Room 3408  
Washington, DC 20590

Dear Ms. McElroy:

Attached for your review and consideration is the City's Request for Experimentation with Flashing Yellow Arrow Display for protected permissive left turns at two locations in the City of El Cajon.

Should you have any questions regarding this submittal, please contact Trev Holman of my staff at (619) 441-1665.

Sincerely,

E. C. KRULIKOWSKI City Traffic Engineer

cc: Traffic Commission

200 E. MAIN STREET  
EL CAJON, CA 92020-3996  
TEL: (619) 441-1653  
FAX: (619) 579-5254

**Request to the Federal Highway Administration For Experimentation by  
Implementation of the Flashing Yellow Arrow Display At the Intersections of  
Magnolia Avenue & Park Avenue Madison Avenue and Johnson Avenue**

**By the City of El Cajon, CA**

**A participant in the NCHRP Project 3-54 Project,  
Evaluation of Traffic Signal Displays for Protected Permitted Left Turn Control  
February 7, 2005**

**Request to Experiment by Implementation of the Flashing Yellow Arrow Display**

Preface

The research project, NCHRP 3-54, Evaluation of Traffic Signal Displays for Protected Permitted Left Turn Control, conducted by Kittelson and Associates, Inc. (KAI) as the prime contractor, has completed the field implementation of the flashing yellow arrow display for the permissive indication at protected/permitted left turns. The flashing yellow arrow has shown good results for driver understanding and safety. The implementation of the flashing yellow arrow display should continue in order to collect additional field data even though the NCHRP 3-54 research project will not be conducting any analysis of this field data under the current contract. To that end, The City of El Cajon, California (herein after referred to as "El Cajon") is submitting to FHWA for approval for experimental use of this test display.

### **Statement of the Problem**

The objective of the NCHRP 3-54 project is to evaluate the safety and effectiveness of different signal displays and phasing for protected/permissive left-turn control (PPLT). Many agencies have sought alternatives to the green ball indication used in PPLT since the green ball can produce yellow trap situations if not used properly (i.e., lead/lag phasing schemes). NCHRP 3-54 has conducted several studies of both the green ball permissive display and several other displays. The flashing yellow arrow appears to be the most promising alternative display to the green ball display.

The NCHRP 3-54 Project Panel has asked that additional field data on flashing yellow arrow installations be obtained. That data is needed to further evaluate the effectiveness of the flashing yellow arrow and to confirm results of earlier tests.

### **Description of the Proposed Change**

The proposed change would allow the use of a flashing yellow arrow indication as the permissive interval associated with the protected/permissive left-turn control. The proposed flashing yellow display is recommended for experimental testing based upon the results of several studies conducted within the NCHRP 3-54 project. Research has demonstrated that driver understanding is lower with the green ball permitted display as compared to other permitted displays being used in various parts of the country. The flashing yellow arrow display is better understood than the green ball display and has few fail critical errors (drivers turning left without the right-of-way).

The flashing yellow arrow provides versatility in application. The flashing yellow arrow display enables all of the following turning movement modes of operation:

- Protected/permissive
- Protected only
- Permissive only
- Prohibited (No Left Turn)

The flashing yellow arrow can be used for left- or right-turn treatments; although it is recognized that the left-turn treatment will be the most predominant use.

The flashing yellow arrow display eliminates the left turn "trap". The protected phase can operate as a leading or lagging movement without regard for the type of operation and phase sequence in the other direction, and can change between leading and lagging sequences during the day. Side street phases can be skipped and a leading left turn safely re-introduced (sometimes called "backing up"). The protected turn phase can be vehicle actuated and skipped in the absence of demand, regardless of the phase sequence.

### **Proposed Flashing Yellow Arrow Display Arrangements**

The research team, in partnership with project panel and technical advisory group members, has identified several display arrangements that demonstrate good motorist understanding. Different display arrangements are recommended for an exclusive left-turn display and shared display.

There are several recommended PPLT signal displays for installation of the flashing yellow arrow display at a location where there is an exclusive left-turn lane and the left-turn display is a separate display (not used by the adjacent through movements).

El Cajon requests FHWA approval to test the 4 section display and described as follows:

Top Head, Solid Red Arrow = Stop. No left turns allowed,  
Second from Top, Solid Yellow Arrow = Prepare to stop.  
Second from bottom, Flashing Yellow Arrow = Left turns allowed, but first yield to oncoming traffic and pedestrians.  
Bottom, Solid Green Arrow = Left turns allowed. Proceed with caution.

One, and only one, of the four arrows are illuminated at all times. The flashing yellow arrow is illuminated when traffic can safely turn by yielding to opposing through traffic and/or pedestrians (permissive operation). The other three arrows are used as in the normal three-color exclusive left turn display. The red arrow is displayed when it is unsafe to make a left turn movement. The green arrow is displayed when the left turn movement can be made with no conflicting simultaneous vehicle or pedestrian movement (protected operation). The steady yellow arrow is illuminated for a few seconds as a clearance indication following the green arrow. The steady yellow arrow is also illuminated for a few seconds as a clearance indication following the flashing yellow arrow, but only when the flashing yellow arrow terminates and the next phase to be serviced is NOT the protected left turn in the same display. When the next phase to be serviced IS the protected left turn in the same display, the flashing yellow arrow terminates and is immediately followed by the green arrow.

### **Proposed Work Plan**

#### **Magnolia Ave. and Park Ave.**

The intersection of Magnolia and Park is an existing signalized intersection. Magnolia Avenue has two lanes in each direction- for the north/south movements- as well as

dedicated left turn lane pockets with protected left turn phasing. The side street has one lane in each direction and all movements are controlled concurrently. The PPLT will be installed on Magnolia only. The posted speed limit is 30 MPH with an 85th percentile of 36.8 MPH. This location has no unique geometric or operational features and should be a very good candidate for PPLT.

### **Madison Ave. and Johnson Ave.**

The intersection of Madison Avenue and Johnson Avenue Park is an existing signalized intersection. Johnson Avenue has two lanes in each direction for the north/south movements as well as dedicated left turn lane pockets with protected left turn phasing. The side street has one lane in each direction and all movements are controlled concurrently. The PPLT will be installed on Johnson Ave. only. The posted speed limit is 40 MPH with an 85th percentile of 40.4 MPH. This location has no unique geometric or operational features and should also be a very good candidate for PPLT.

### **Anticipated Changeover Implementation Issues**

El Cajon has identified the following implementation issues relevant to its participation in the research project:

Both of these intersections have existing traffic signals using the City's standard 170 Controller and Assembly. The software is a BiTrans 200SA prom module and will be modified by BiTrans to accommodate the flashing arrow feature.

### **Length of Experimentation**

The experiment is proposed to last until El Cajon has access to three years of reported crash data after implementation.

### **Evaluation Plan**

El Cajon will collect 3 years of "after" crash data and will forward to FHWA for later follow up analysis.

Volunteering agencies responsibilities are:

- Identifying intersections for installing the flashing yellow arrow display on at least one intersection approach.
- Install or retrofit the appropriate signal arrangements (head).
- Make the necessary modifications, if any, to the existing signal controller and controller conflict monitor.
- Provide intersection data sheets for each location, which includes geometrics, and traffic volumes for all movements, approach posted speed limit, and pertinent operational data.

- Provide three years of "after" crash data. It is requested that volunteer agency supply a total of three years of after data and this data would be forwarded directly to FHWA for further study at a later date. Track and report change over costs and implementation issues.
- Submit overall qualitative statement on the flashing yellow arrow operation.

### **Site Restoration**

El Cajon agrees to restore the experiment site to a state complying with the provisions of the MUTCD as adopted by the California State Department of Transportation:

- within 3 months following the end of the time period of the experiment, or
- at any time that the participating agency determines that significant hazards are directly or indirectly attributable to the experimentation, or
- if requested to do so by the FHWA

If, as a result of experimentation, a request is made that the MUTCD be changed to include flashing yellow arrow permissive indications, then the experimental device may remain in place until an official rulemaking action has occurred.

### **Reporting**

Reporting will be done by El Cajon following the collection of three years of "after" crash data. A copy of the final results will be sent to FHWA, HHS-10, within 3 months of this time. All reports will be submitted to:

W. Scott Wainwright, P.E., PTOE  
Highway Engineer, MUTCD  
Team Federal Highway Administration  
Office of Transportation Operations, HOTO-1  
400 Seventh Street, SW, Room 3408  
Washington, DC 20590

**Project Administration** El Cajon will be responsible for administering this experiment under the direction of:

E. C. Krulikowski, City Traffic Engineer City of El Cajon 200 East Main Street El Cajon, CA 92021 [eckrulikowski@aci.el-cajon.ca.us](mailto:eckrulikowski@aci.el-cajon.ca.us)

U.S. Department of Transportation  
Federal Highway Administration  
400 Seventh St., S.W.  
Washington, D.C. 20590

February 25, 2005  
Refer to: HOTO-1

Mr. E. C. Krulikowski  
City Traffic Engineer  
City of El Cajon Public Works 200 East  
Main Street El Cajon, CA 92020-3996

Dear Mr. Krulikowski:

Thank you for your February 8 letter requesting permission to experiment with the flashing yellow arrow display for a total of four protected-permissive left-turn (PPLT) movements at two intersections in the city of El Cajon. At both of these intersections, the left turn movements proposed for use of the flashing yellow arrow are currently operating in the "protected only" mode and will be converted to PPLT mode.

Although NCHRP Project 3-54 is completed, the Federal Highway Administration (FHWA) is interested in further experimentation with the flashing yellow arrow. We anticipate that there will be a follow-up study to analyze crash data for all the participating locations with the flashing yellow arrow, after 3 years of "after" data are available. The follow-up study will review the crash data to determine whether that would affect the preliminary conclusions that were reached by the NCHRP project, which used conflicts data but not actual crash data to evaluate safety effects.

We approve your request to experiment with the flashing yellow arrow for PPLT at the two intersections in El Cajon, as per your proposal, using the four-section "all arrows" signal head display. This approval is granted for a period not to exceed 4 years, on the condition that Pasadena will collect and summarize the "after" condition crash data annually over a 3-year period following implementation of the flashing yellow arrows.

Please note that we are requesting regular progress reports upon completion of each year of data availability and a copy of the final results within 3 months following availability of the third year of "after" data. Also, please note that El Cajon is required to immediately terminate this experimentation at any time that it determines that significant safety concerns are directly or indirectly attributable to this experimentation, and that the FHWA Office of Transportation Operations has the right to terminate the experiment at any time if there is an indication of safety concerns.

We very much appreciate the willingness of El Cajon to participate in the continuing evaluations of the flashing yellow arrow display. We look forward to the results. If you have any questions, please email Mr. Scott Wainwright at [scott.wainwright@fhwa.dot.gov](mailto:scott.wainwright@fhwa.dot.gov) or call him at 202-366-0857. Please note that we have assigned your request the following official experimentation number and title: "4-219(Ex) -NCHRP 3-54, Flashing Yellow Arrow." Please refer to this number in future correspondence.

Sincerely yours,



Regina S. McElroy  
Director, Office of Transportation Operations  
cc: Mr. Jim Baron, ATSSA

DEPARTMENT OF TRANSPORTATION

January 20, 2005

Mr. Scott Wainwright  
Office of Transportation Operations (HOTO)  
Federal Highway Administration  
400 Seventh Street SW Room 3408  
Washington, DC 20590

RE: Flashing Yellow Arrow Request for Experimentation

Dear Mr. Wainwright:

The City of Pasadena, within Los Angeles County, California, is requesting FHWA approval to implement Protected Permissive Left Turn (PPLT) phasing using experimental Flashing Yellow (FYA) at ten signal approaches at three different intersections. Attached is the required documentation for this experiment.

Each intersection is adjacent to the Gold Line Light Rail Transit and is equipped with railroad pre-emption features. Eight approaches on two intersections have traditional PPLT operation. The third intersection has two approaches that are currently "split" phased. They are proposed to be changed to PPLT operation to reduce delays. This intersection is Arroyo Parkway at Glenarm Street, which is currently controlled by California Department of Transportation (Caltrans). Upon receiving FHWA's approval, the City intends to request Caltrans formal approval of this operation at the Arroyo Parkway/Glenarm intersection.

The City of Pasadena has already applied and received approval from the California Traffic Control Devices Committee (CTCDC) to proceed with this experimentation (see attached). As part of CTCDC approval, however, the City was instructed to also receive FHWA's approval for this project.

We appreciate your immediate consideration of this request and look forward to helping establish the usage of the very promising FYA method to PPLT operation.

Mr. Scott Wainwright  
Federal Highway Administration  
Flashing Yellow Arrow - Request for Experimentation January 20, 2005

Please feel free to contact me at the phone number and e-mail address shown below if you have any questions.

BAHMAN JANKA, P.E.  
Transportation Administrator Department of Transportation City of Pasadena  
(626) 744-4610  
[bjanka@cityofpasadena.net](mailto:bjanka@cityofpasadena.net)

Attachments:

1. Request for Experimentation Report
2. Letter of Approval from the California Traffic Control Devices Committee (CTCDC)

cc: Joyce Y. Amerson, Director of Transportation Norman Baculinao, Traffic Engineering Manager Yi Tsau, Caltrans Sheik Moinuddin, Caltrans

Request to the Federal Highway Administration for Experimentation by Implementation of the Flashing Yellow Arrow Display

To: Scott Wainwright  
Office of Transportation Operations (HOTO)  
Federal Highway Administration  
400 Seventh Street SW Room 3408  
Washington, DC 20590

By: Bahman Janka, P. E.  
Transportation Administrator  
City of Pasadena  
221 East Walnut Street, # 210  
Pasadena, California 91101  
Phone: (626) 744-4610  
Fax: (626) 396-8693  
E-mail: [bjanka@cityofpasadena.net](mailto:bjanka@cityofpasadena.net)

January 20, 2005

## **Request to Experiment by Implementation of the Flashing Yellow Arrow Display**

### **Preface**

The research project, NCHRP 3-54, Evaluation of Traffic Signal Displays for Protected Permitted Left Turn Control, conducted by Kittelson and Associates, Inc. (KAI) as the prime contractor, has completed the field implementation of the flashing yellow arrow display for the permissive indication at protected/permitted left turns. The flashing yellow arrow has shown good results for driver understanding and safety. The implementation of the flashing yellow arrow display should continue in order to collect additional field data even though the NCHRP 3-54 research project will not be conducting any analysis of this

field data under the current contract. To that regard, City of Pasadena is submitting to FHWA for approval for experimental use of this test display.

### **Statement of the problem**

The NCHRP 3-54 project evaluated the safety and effectiveness of different signal displays and phasing for protected/permmissive left-turn control (PPLT). Many agencies have sought alternatives to the green ball indication used in PPLT since the green ball can produce yellow trap situations if not used properly (i.e., lead/lag phasing schemes). NCHRP 3-54 has conducted several studies of both the green ball permmissive display and several other displays. The flashing yellow arrow has been shown to be the most promising alternative display to the green ball display.

### **Description of the Proposed Change**

The proposed change would allow the use of a flashing yellow arrow indication as the permmissive interval associated with the protected/permmissive left-turn control. The proposed flashing yellow display is recommended for experimental testing based upon the results of several studies conducted within the NCHRP 354 project. Research has demonstrated that driver understanding is lower with the green ball permitted display as compared to other permitted displays being used in various parts of the country. The flashing yellow arrow display is better understood than the green ball display and has few fail critical errors (drivers turning left without the right-of-way).

The flashing yellow arrow provides versatility in application. The flashing yellow arrow display enables all of the following turning movement modes of operation:

- Protected/permmissive
- Protected only
- Permmissive only
- Prohibited (No Left Turn)

The flashing yellow arrow can be used for left- or right-turn treatments, although it is recognized that the left-turn treatment will be the most predominant use.

The flashing yellow arrow display eliminates the left turn "trap." The protected phase can operate as a leading or lagging movement without regard for the type of operation and phase sequence in the other direction, and can change between leading and lagging sequences during the day. Side street phases can be skipped and a leading left turn safely re-introduced (sometimes called "backing up"). The protected turn phase can be vehicle actuated and skipped in the absence of demand, regardless of the phase sequence.

### **Proposed Flashing Yellow Arrow Display Arrangements**

The research team, in partnership with project panel and technical advisory group members, has identified several display arrangements that demonstrate good motorist

understanding. Different display arrangements are recommended for an exclusive left-turn display and shared display.

### **Exclusive Display Arrangements**

There are at least four possible PPLT signal displays that are recommended for installation of the flashing yellow arrow display at a location where there is an exclusive left-turn lane and the left-turn display is a separate display (not used by the adjacent through movements). Those alternative displays are shown in Figure 1 below. The City of Pasadena requests FHWA approval to test display number 1 shown in Figure 1.

*[Image not shown: Proposed flashing arrow display arrangements. Figure 1: Four vertically stacked arrows pointing left. Top arrow is red, second arrow is yellow, third is flashing yellow, bottom is green. Figure 2 is three vertically stacked arrows pointing left. Top arrow is red, middle is yellow and bottom is flashing yellow. Figure 3 is four horizontal arrows pointing left. From left to right the arrows are red, yellow, flashing yellow, and green. Figure 4 is three horizontal arrows pointing left. From left to right the arrows are red, yellow, and flashing yellow. (See the PDF version to view images)]*

It is noted that the basic signal arrangement is a four-section arrangement. However, if bi-modal lens is employed (bottom or far right section), then a three-section arrangement can be used. The three-section arrangement may be desired for clearance purposes or for ease of implementation if an existing three-section arrangement is available. The signal arrangement can be mounted either vertically or horizontally.

One, and only one, of the four arrow's are illuminated at all times. The flashing yellow arrow is illuminated when traffic can safely turn by yielding to opposing through traffic and/or pedestrians (permissive operation). The other three arrows are used as in the normal three-color exclusive left turn display. The red arrow is displayed when it is unsafe to make a left turn movement. The green arrow is displayed when the left turn movement can be made with no conflicting simultaneous vehicle or pedestrian movement (protected operation). The steady yellow arrow is illuminated for a few seconds as a clearance indication following both the green arrow and the flashing yellow arrow.

### **Proposed Work Plan**

1. The City of Pasadena will install the flashing yellow arrow display for ten signal approaches at three intersections. Each location is considered to be a typical intersection containing no unique geometric or operational features; however, each intersection is adjacent to the Gold Line Light Rail Transit and is equipped with railroad pre-emption features. The proposed protected/permissive left turn (PPLT) intersections have a right angle relationship to all intersecting approaches. The approach for which the FYA will be installed has an exclusive left-turn lane. There is a small vertical grade on many of the approaches. All lanes meet current design standards, as much as possible (12-foot travel lanes). Eight approaches on two intersections have traditional PPLT operation. These two intersections are Arroyo Parkway at Del Mar Boulevard and Arroyo Parkway at

California Boulevard. The two intersections will not receive any improvements during the study period and will be used as control site intersections. The third intersection has two approaches that are currently "split" phased. They are proposed to be changed to PPLT operation to reduce delays. This intersection is Arroyo Parkway at Glenarm Street which is currently controlled by Caltrans. Intersection widening is proposed at this location to provide a "free" eastbound right turn movement.

### **Anticipated Changeover Implementation Issues**

Past experience with implementing flashing indications has identified various obstacles or issues that may be a factor in future implementations.

#### Issues with replacement head size / mounting

This implementation of the flashing yellow arrow will utilize a 12-inch lens for all vehicle displays. There will be no conflict of head sizes.

#### Potential need for additional cabling

Due to the flashing indication, additional cabling will be necessary in order for the flashing display to be controlled by its own circuit and to be displayed concurrently with the opposing green ball phase.

#### Controller logic issues

In a typical PPLT situation, it is possible for the green ball display and green arrow display to illuminate simultaneously. However, by converting to the flashing yellow arrow display, the flashing yellow arrow and green arrow displays cannot illuminate simultaneously.

Further, in a shared-head arrangement there could be an issue related to an agency's requirement of a red clearance interval following the protected interval display (the green arrow followed by steady yellow arrow). In a shared-head arrangement, a leading green arrow could be illuminated concurrently with a green ball for parallel through traffic. With such a display, a red ball cannot be illuminated for clearing the protected left turn movements, as it would conflict with the green ball.

In unusual situations, additional or different phases could serve as parent phases to drive the flashing yellow arrow overlap. The same overlap logic can also be used to drive right turn arrows where appropriate.

The City of Pasadena currently uses the BI Tran 233 software program for Model 2070 controllers at Arroyo Parkway/Del Mar Boulevard and Arroyo Parkway/California Boulevard. At the Caltrans controlled intersection of Arroyo Parkway Glenarm Street, a Model 2070 controller with Traffic Signal Control Program (TSCP) is used.

#### Conflict monitor issues

Past applications of flashing indications have required the use of special external logic units to prevent the conflict monitor from detecting a signal malfunction. The City of

Pasadena will upgrade existing conflict monitors to provide proper FYA operation with the Model 2070 controllers.

### **Evaluation Plan**

The City of Pasadena will obtain the most recent three years of "Before" crash data and will send that data to FHWA for later analysis. "after" crash data will be collected and sent to FHWA for later follow up analysis.

City of Pasadena responsibilities are:

- Identifying intersections for installing the flashing yellow arrow display on at least one intersection approach.
- Install or retrofit the appropriate signal arrangements (head).
- Make the necessary modifications, if any, to the existing signal controller and controller conflict monitor.
- Provide intersection data sheets for each location, which includes geometrics, and traffic volumes for all movements; approach posted speed limit, and pertinent operational data.
- Provide three years of before crash data and three years after crash data.

Three years of after data will be forwarded directly to FHWA for further study at a later date. The Before data will be submitted upon project approval.

- Track and report change over costs and implementation issues.
- Submit overall qualitative statement on the flashing yellow arrow operation.

### **Site Restoration**

The City of Pasadena agrees to restore the experiment site to a state complying with the provisions of the MUTCD:

- within three months following the end of the time period of the experiment, or
- the experimentation, or
- if requested to do so by the Office of Traffic Operations.

If, as a result of experimentation, a request is made that the Manual be changed to include flashing yellow arrow permissive indications, then the experimental device may remain in place until an official rulemaking action has occurred.

### **Reporting**

City of Pasadena will provide semi-annual progress reports until the experiment is completed. A copy of the final results will be sent to FHWA, HHS-10, within three months following completion of experimentation. All reports will be submitted to:

Regina S. McElroy Director  
Office of Transportation Operations HOTO Room 3401  
400 7th Street, S.W.  
Washington, D.C. 20590

### **Project Administration**

City of Pasadena will be responsible for administering this experiment under the direction of Bahman Janka, Transportation Administrator, located at 221 East Walnut Street, #210, Pasadena, California 91101.

### **California Traffic Control Devices Committee**

- MEMBER AGENCIES -

California Department of Transportation California Highway Patrol California State  
Association of Counties League of California Cities California State Automobile  
Association  
Automobile Club of Southern California  
(916) 654-4715

December 17, 2004

Mr. Bahman Janka, P.E.  
Transportation Administrator City of Pasadena  
221 East Walnut Street, Room 210  
Pasadena, CA 91101

Dear Mr. Janka:

Thank you for your presentation to the California Traffic Control Devices Committee (CTCDC) on December 8, 2004 requesting permission to experiment with the "flashing yellow arrow" for protected permissive left-turn (PPLT) movements at a maximum three intersection:

1. Arroyo Parkway/Glenarm Street -two approaches: east/west
2. Arroyo Parkway/California Boulevard - four approaches
3. Arroyo Parkway/Delmar Boulevard - four approaches

The CTCDC has approved your experiment request during the December 8, 2004 meeting, contingent upon obtaining approval to experiment from the Federal Highway Administration. The following are the experiment outlines for your information: The time periods for experimentation are normally not be less than six months nor more than two years. A written status report must be forwarded to the sponsor 45 days prior to each public meeting. Status reports shall describe the progress of the work, any particular deviation from the work plan and anticipated time of conclusion. A final report must be completed within 90 days of the terminal date of the experimentation and forwarded to

the Executive Secretary. The final report shall contain, as a minimum, the basic information on the problem, the preliminary investigations, the proposed solutions, the study procedures, the detailed analysis of the data, the results of the work, a discussion of the results, and whatever conclusions are drawn. If a change in the California Supplement is proposed, specific wording of this change should be included.

The project must terminate at the end of the approved period unless an extension is granted, and all experimental devices and applications must be removed unless specific permission is given for continued operation. The Committee may, at any time, terminate approval of experimentation if significant safety hazards are indicated to be directly or indirectly attributable to the experimentation. All experimentation installations shall be removed upon termination of the experiment when a decision is made by the Committee that a change in the State Traffic Manual to permit the device is not warranted

Sincerely,

JOHN E. FISHER Chairman, CTCDC

Address: Department of Transportation.  
Division of Traffic Operations MS 36  
Attention: Executive Secretary CTCDC  
P.O. Box 942874  
Sacramento, CA 94274-0001

Federal Highway Administration  
400 Seventh Street, SW  
Washington, DC 20590

October 6, 2004  
Refer to: HOTO-1

Mr. Don Hoppe  
Director of Engineering  
City of Fullerton  
303 West Commonwealth Avenue  
Fullerton, CA 92832-1775

Dear Mr. Hoppe

Thank you for your September 29 letter, sent by fax, requesting permission to experiment with the flashing yellow arrow for protected-permissive left-turn (PPLT) movements at three intersections in the city of Fullerton.

We approve your request to experiment with the flashing yellow arrow for PPLT at the three intersections, as per your proposal. This approval is granted for a period not to exceed 4 years, on the condition that the city of Fullerton collect and summarize crash



data annually over a 3-year period following implementation. It is our understanding that all three intersections in question are being converted from "protected only" mode left turns to PPLT. "Before and after" studies are not appropriate because they would not be comparable to the other locations being studied under NCHRP project 3-54 research, where a previously-existing PPLT phase was converted from circular green display to flashing yellow arrow. However, 3 years of crash data for this location after the flashing yellow arrow displays are installed would be useful for comparison to the "after" data of the other locations. Please note that we are requesting regular progress reports upon completion of each year of data availability and a copy of the final results within 3 months following availability of the third year of "after" data.

We very much appreciate the willingness of the city of Fullerton to participate in the continuing evaluations of the flashing yellow arrow display. We look forward to the results and the possibility of a new traffic control operation that will improve the mobility and safety of our roads. Please note that we have assigned your approved request the following official experimentation number and title: "4-219(Ex)--NCHRP 3-54, Flashing Yellow Arrow."

Please refer to this number in future correspondence. If you have any questions, please call Mr. Scott Wainwright at 202-366-0857.

Thank you again for your interest in traffic safety and operations.  
Sincerely yours,

Regina S. McElroy  
Director, Office of Transportation Operations

U.S. Department of Transportation  
Federal Highway Administration  
400 Seventh St., S.W.  
Washington, D.C. 20590

February 9, 2005  
Refer to: HOTO-1

Mr. Bahman Janka  
Transportation Administrator  
Department of Transportation  
City of Pasadena  
221 East Walnut Street, Room 210  
Pasadena, CA 91101

Dear Mr. Janka:

Thank you for your January 20 letter requesting permission to experiment with the flashing yellow arrow display for a total of ten protected-permissive left-turn (PPLT)

movements at three intersections in the city of Pasadena. At two of these three intersections, the left turn movements are currently operating in the PPLT mode. At the third intersection, the two left turn movements proposed for use of the flashing yellow arrow display are being converted from "split phase" operation to PPLT mode and a change in intersection geometrics is also being made.

Although NCHRP Project 3-54 is completed, the Federal Highway Administration (FHWA) is interested in further experimentation with the flashing yellow arrow. We anticipate that there will be a follow-up study to analyze crash data for all the participating locations with the flashing yellow arrow, after 3 years of "after" data are available. The follow-up study will review the crash data to determine whether that would affect the preliminary conclusions that were reached by the NCHRP project, which used conflicts data but not actual crash data to evaluate safety effects.

We approve your request to experiment with the flashing yellow arrow for PPLT at the three intersections in Pasadena, as per your proposal, using the four-section "all arrows" signal head display. This approval is granted for a period not to exceed 4 years, on the condition that Pasadena will collect and summarize crash data annually over a 3-year period both before and following implementation for the eight left-turn movements that are currently operating in the PPLT mode. For the two left-turn movements that are being converted from "split-phase" to PPLT mode, only the 3 years of "after" data are required.

Please note that we are requesting regular progress reports upon completion of each year of data availability and a copy of the final results within 3 months following availability of the third year of "after" data. Also, please note that Pasadena is required to immediately terminate this experimentation at any time that it determines that significant safety concerns are directly or indirectly attributable to this experimentation, and that the FHWA Office of Transportation Operations has the right to terminate the experiment at any time if there is an indication of safety concerns.

We very much appreciate the willingness of Pasadena to participate in the continuing evaluations of the flashing yellow arrow display. We look forward to the results. If you have any questions, please email Mr. Scott Wainwright at [scott.wainwright@fhwa.dot.gov](mailto:scott.wainwright@fhwa.dot.gov) or call him at 202-366-0857. Please note that we have assigned your request the following official experimentation number and title: "4-219(Ex)-NCHRP 3-54, Flashing Yellow Arrow." Please refer to this number in future correspondence.

Sincerely yours,

Regina St McElroy Director,  
Office of Transportation Operations

cc: Mr. Roger Wentz, ATSSA