Safety and Operations of Pedestrian Hybrid Beacons (HAWKs)

Speakers

- Mike Cynecki – moderator
  - City of Phoenix
- Richard Nassi
  - Retired, City of Tucson
- Kay Fitzpatrick
  - Researcher, Texas Transportation Institute
- George Branyan
  - Pedestrian Program Coordinator, District of Columbia

Tucson: HAWK

2009 MUTCD: Pedestrian Hybrid Beacon (PHB)

Slight change in sign and guidance statements

Sequence for Pedestrian Hybrid Beacon

Legend

SY	Steady yellow
FY	Flashing yellow
SR	Steady red
FR	Flashing red

1. Dark Until Activated

2. Flashing Yellow Upon Activation

3. Steady Yellow

4. Steady Red During Pedestrian Walk Interval

5. Alternating Flashing Red During Pedestrian Clearance Interval

6. Dark Again Until Activated

BACKGROUND AND CONCERNS WITH HAWK

James W. Sparks is deputy street transportation director in charge of the Traffic Operations Division of the City of Phoenix

Pedestrian Warning Flashers in an Urban Environment: Do They Help?

ITE JOURNAL - JANUARY 1990

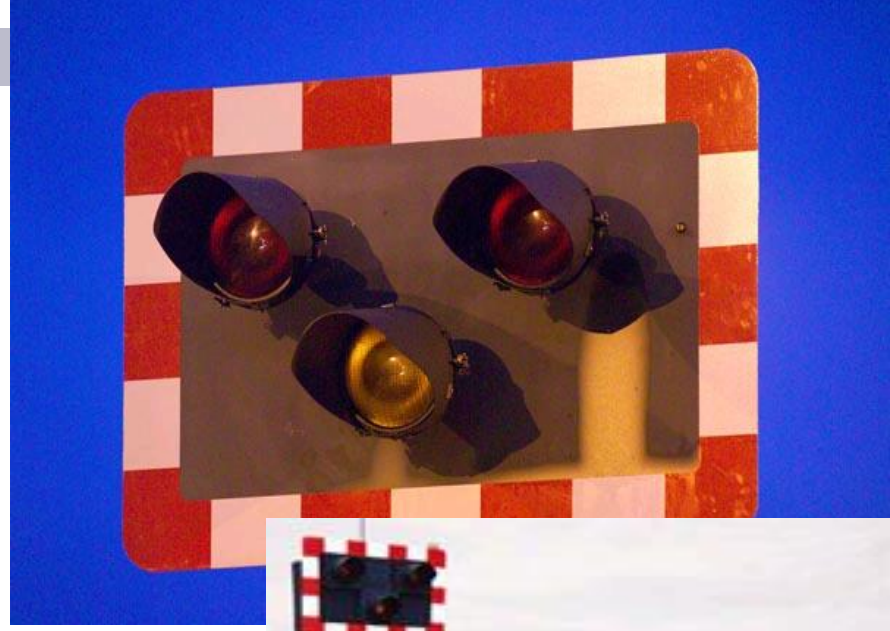
BY JAMES W. SPARKS AND MICHAEL J. CYNECKI

"In summary, national literature and local experience in Phoenix, Arizona, show that flashers offer no benefit for intermittent pedestrian crossings in an urban environment. In addition, the longer the flasher operates, the more it becomes part of the scenery and eventually loses any effectiveness."

CITY OF FOUNDED 1775 TUCSON

History

- Better pedestrian treatment needed
- Inspiration (European beacon Newcastle)
- Modification made over years to address concerns



Common Questions/Concerns During Development

1. Dark beacon may be confusing
2. Side street drivers may be confused
3. Will cause proliferation of devices
4. Creates non-uniformity
5. Driver understanding of alternating flashing red

1. Dark Beacon Confuses Drivers

- Has not been observed during scientific studies by UNC & TTI
- Tucson experience shows that vehicles do not stop at a dark beacon
- Dark beacon critical to overcome 1/2 signal concerns
- Similar device used in Europe for last 60 years

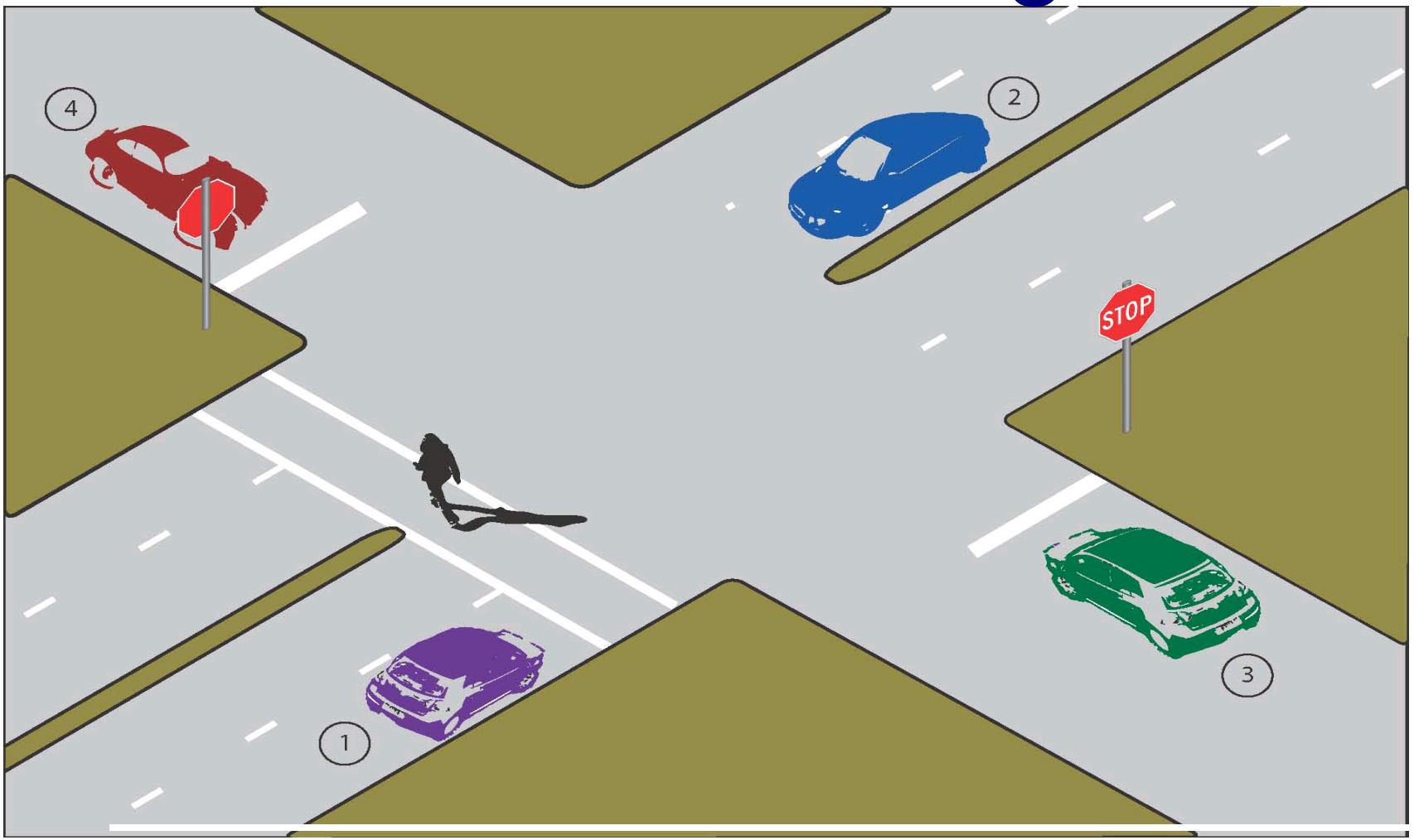
2. Drivers on Side Street May be Confused

- Drivers on side street do not know who has the right-of-way

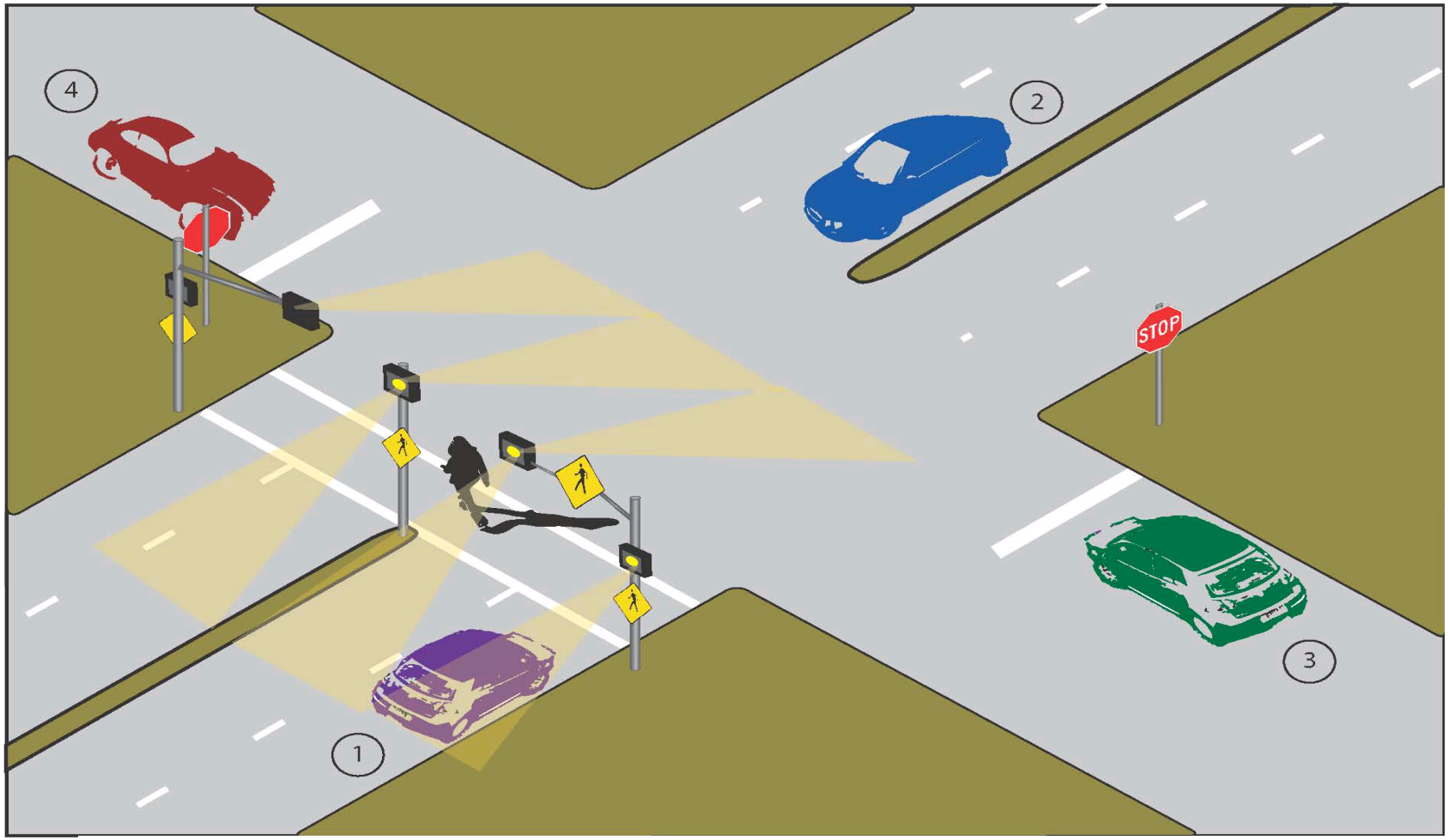
Findings from Studies

- 1999: City of Seattle Study: found no significant driver confusion issues
- 2004: Canadian Study: found issues were minimal and it (1/2 signal) is an appropriate traffic control device
- 2006: Tucson HDR Study: found no significant driver confusion issues and normal right of way codes apply at a Pedestrian HAWK Beacon

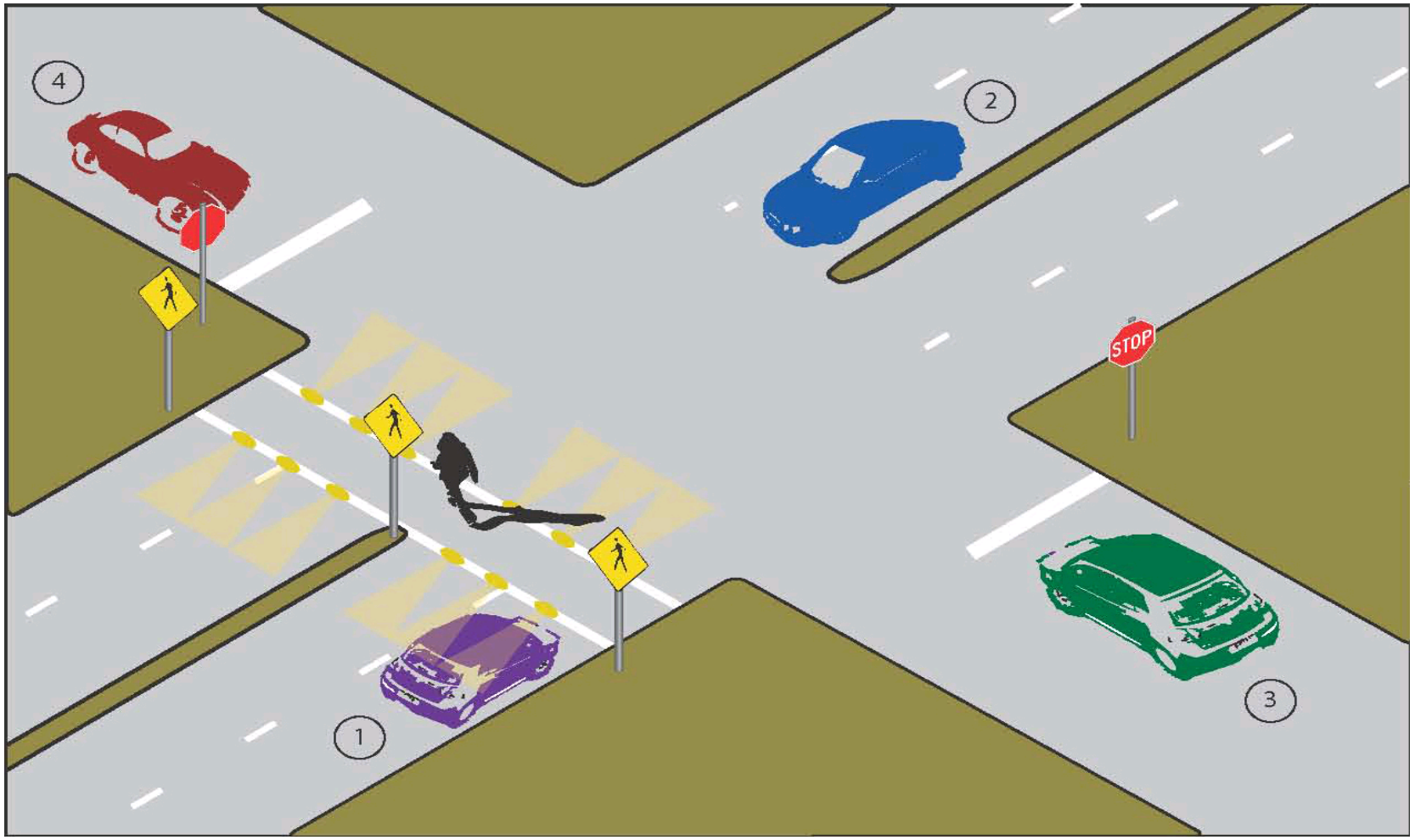
Uniform Vehicle Code: Normal Crosswalk Right of Way



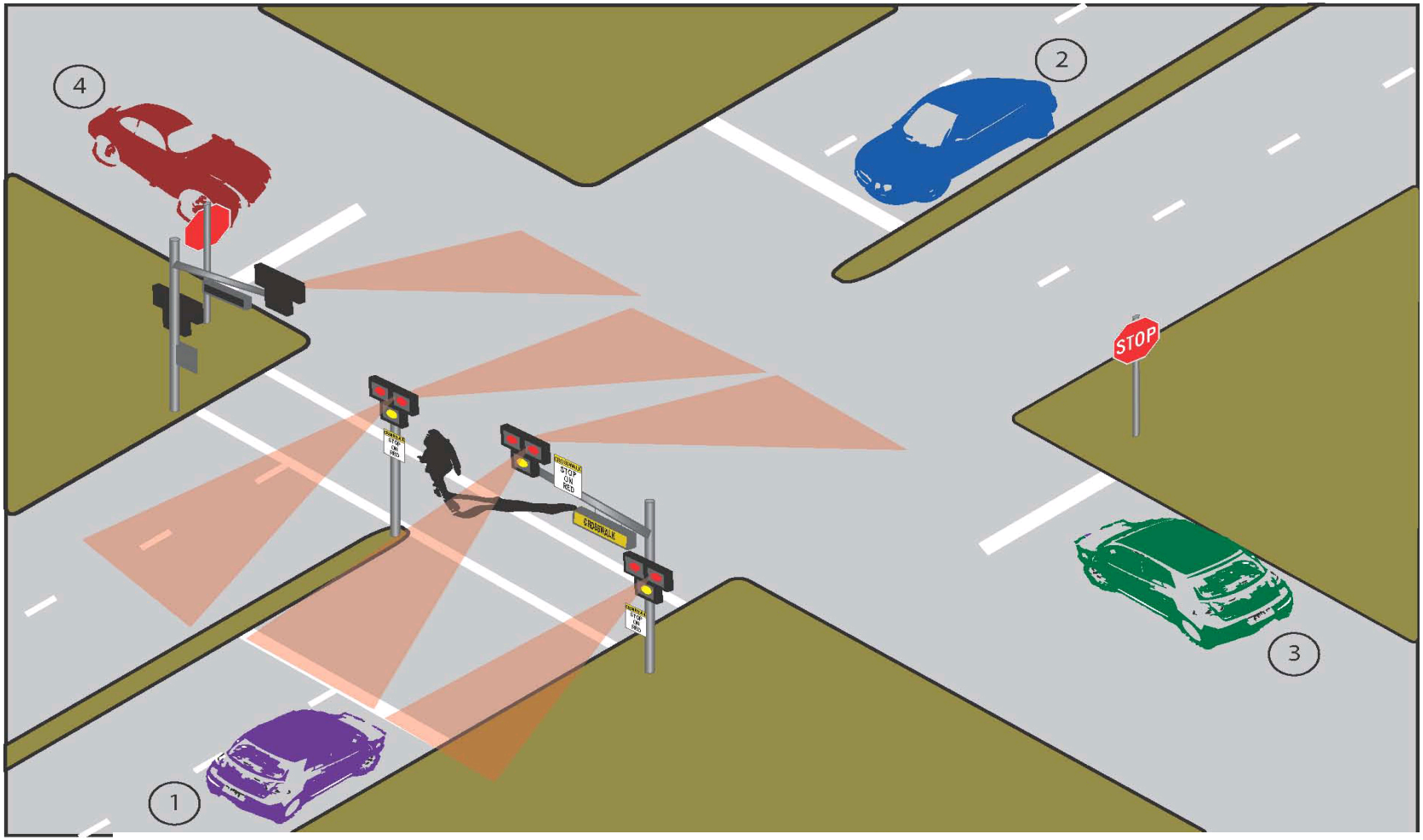
Flashing Beacon Crossing Right of Way: NO CHANGE



Flashing In-Road Lights
Right of Way: NO CHANGE



Pedestrian Hybrid Beacon Right of Way: NO CHANGE



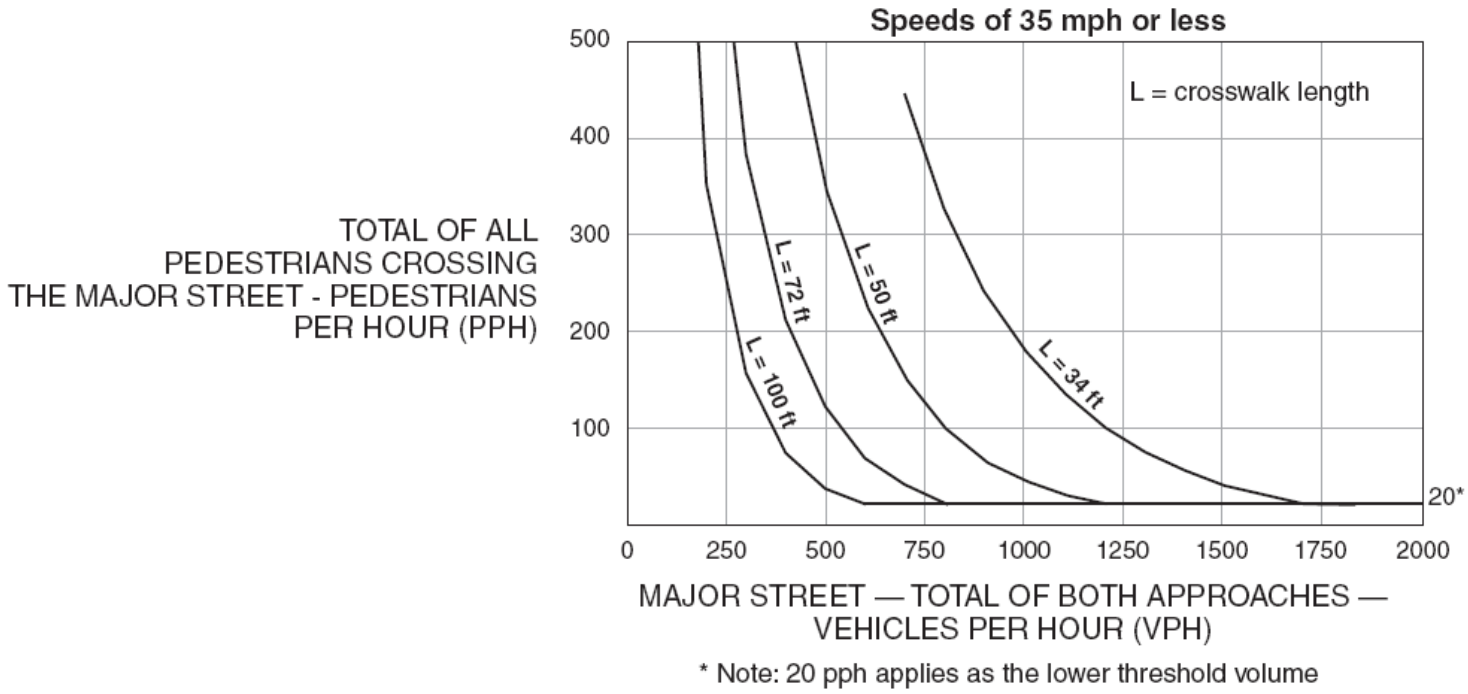
Confusion with Right-of-Way?

- The HAWK…
  - Is a supplement to the crosswalk
  - Does not change the right-of-way rules, therefore acts more as a beacon than as a signal

3. Proliferation of Devices

- Beacons normally do not have a numeric warrant, but warrants are in the MUTCD for the Pedestrian Hybrid Beacon

Figure 4F-1. Guidelines for the Installation of Pedestrian Hybrid Beacons on Low-Speed Roadways



* Note: 20 pph applies as the lower threshold volume

Proliferation of Devices (cont)

- There is a need for a device at crosswalks that is more than a yellow flasher, but a full signal is not warranted or appropriate
  - Avoid side street “defacto arterial”
  - Allows for main street progression
  - Reduces delay via ½ cycle operations, flashing red, split phase operations
- Pedestrian hybrid beacon can reduce the political and community pressures to install unwarranted full traffic signals

4. Creates Non-Uniformity

- Concern that the HAWK will further proliferate non-uniform designs and installations
- Already have non-uniformity → there are numerous variations in use throughout the nation currently now

Boulder, Colorado

Florida Crossing Eyes

Seattle Flashing Beacon

King County Flashing Beacon

Massachusetts Flashing Yield Sign and Beacons

Utah Flashing Double Beacon

Ohio Flashing Yield Sign

Ohio Yield Sign

California Flashing Beacon

Louisiana Crossing Flasher

Photo Illustration by Melissa Humble

Rectangular Rapid Flashing Beacon

In-Pavement Lights

Portland: 1/2 Signals

Seattle: 1/2 Signals

L.A. Midblock Signals

(Signal rests in GREEN UPWARD ARROW, Changes to Flashing RED)

5. Alternating Flashing Red

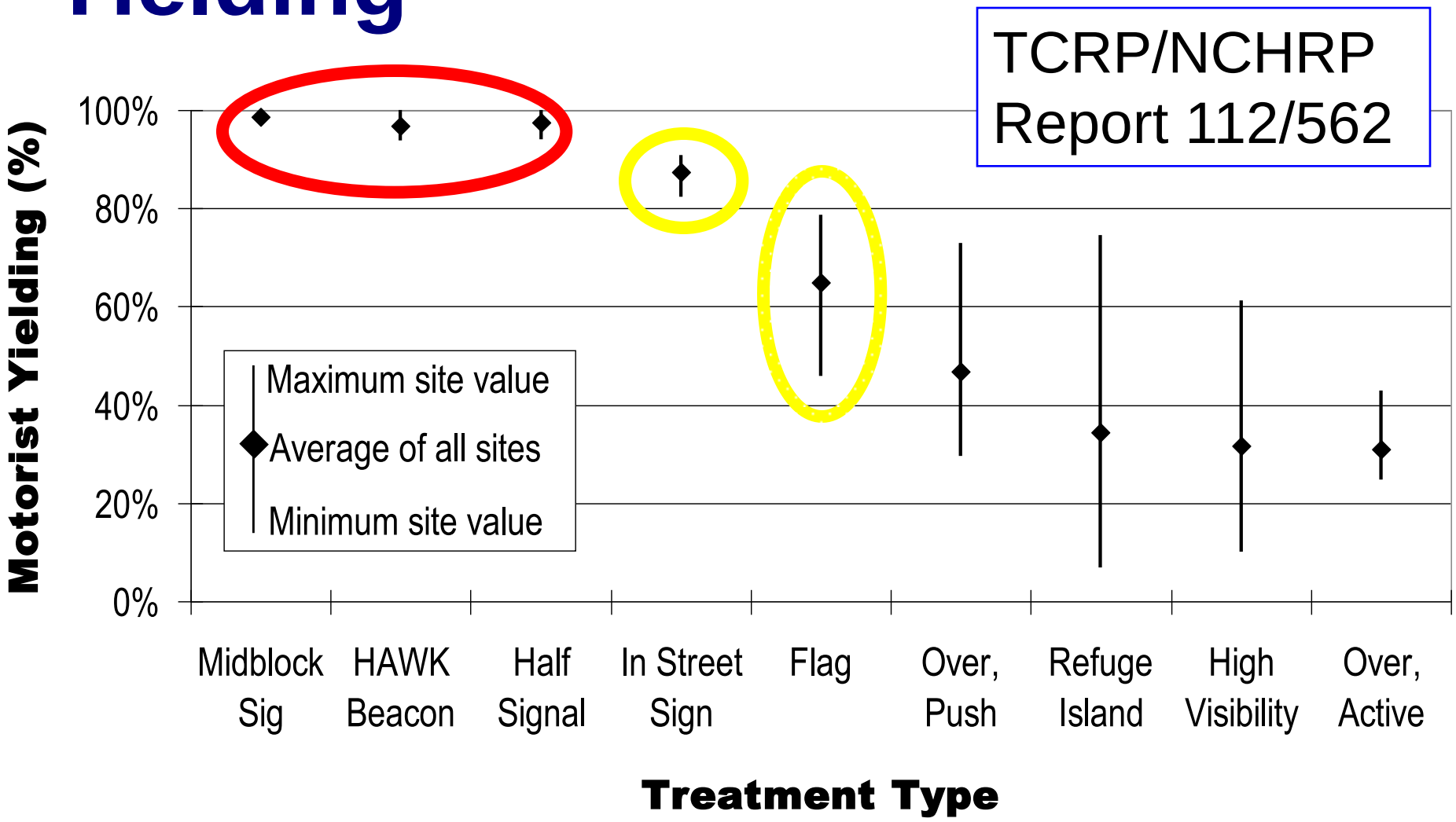
- Drivers not proceeding in a stop-and-go format during alternating flashing red and crosswalk is clear
  - Sign
  - Education
- Drivers not stopping during alternating flashing red phase
  - Targeted enforcement
  - Education

Ongoing Debate

- 2009 MUTCD included following **guidance** (Section 4F.02, page 509) not previously seen by NCUTCD:
  - "…should be installed at least 100 feet from side streets or driveways that are controlled by STOP or YIELD signs."

EFFECTIVENESS

Effectiveness Yielding

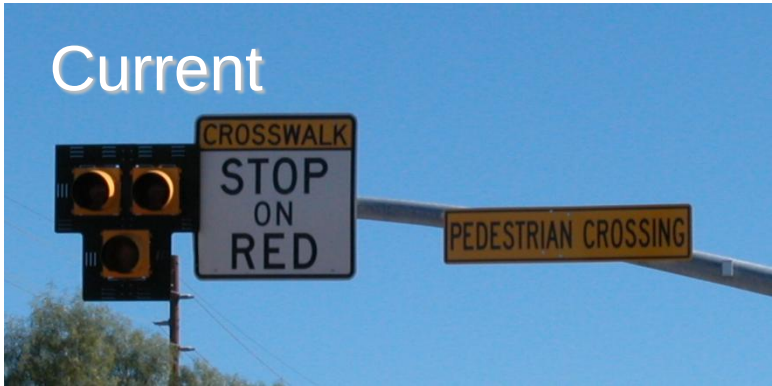


Effectiveness
Safety

- Anecdotal evidence = yes
- FHWA sponsored research
  - Comprehensive
  - Before-after safety evaluation
  - Empirical Bayes
  - Study started fall 2007

Treatment Site Selection November 2006 List of Sites

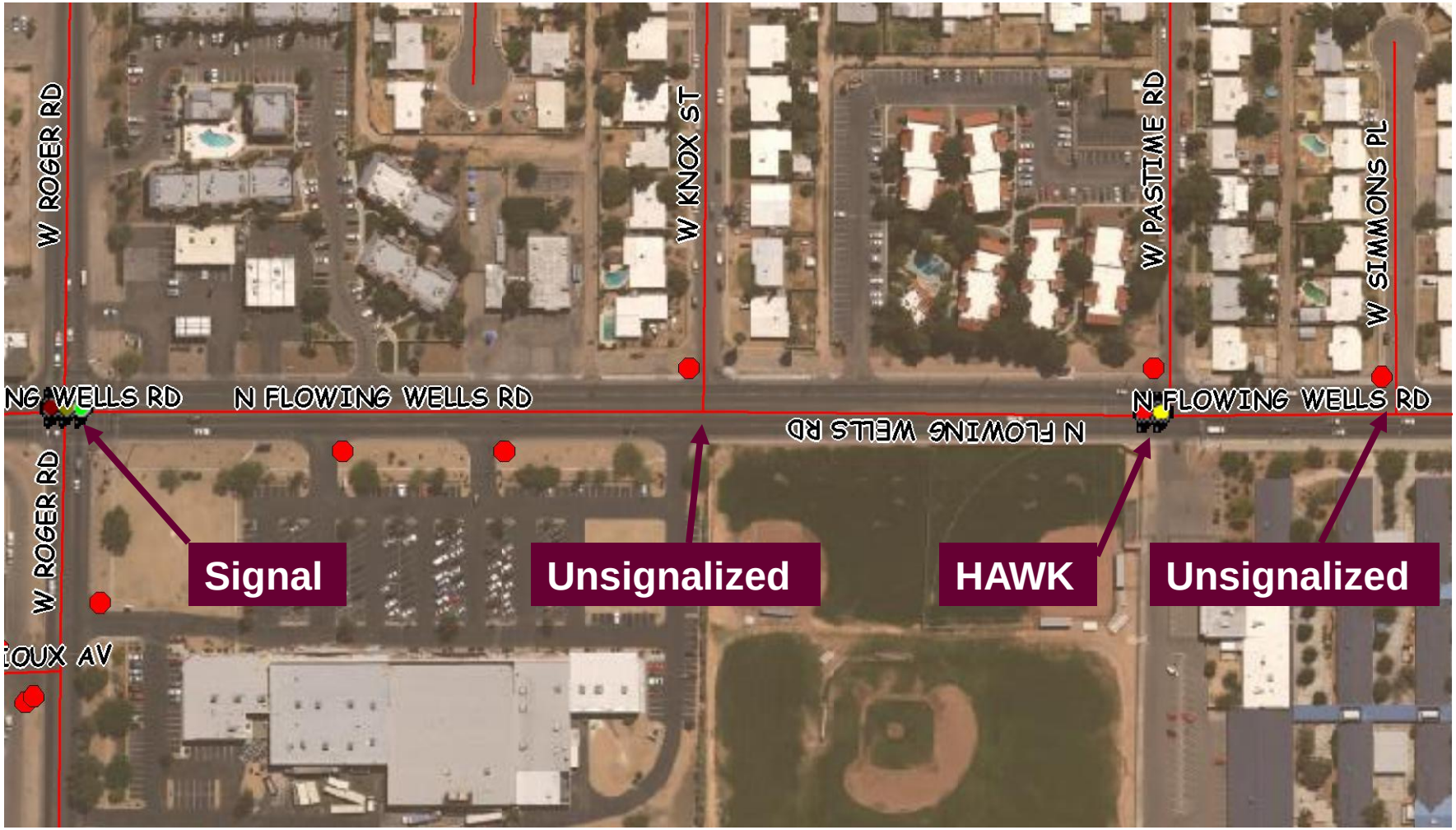
- 35 locations = HAWKs upgraded from vertical arrangement to current (Mickey Mouse) configuration
- **21 locations = HAWK with current configuration initially installed**
- 4 locations = In place for <18 months at time of study or planned



Reference Site Selection
TDOT Online Map

- Aerial view
  - Lane configuration
  - Intersection layout
  - Etc.
- Overlays with
  - Speed limits
  - Bike lane
  - Traffic control

Reference Group
103 Unsignalized Intersec



Volume

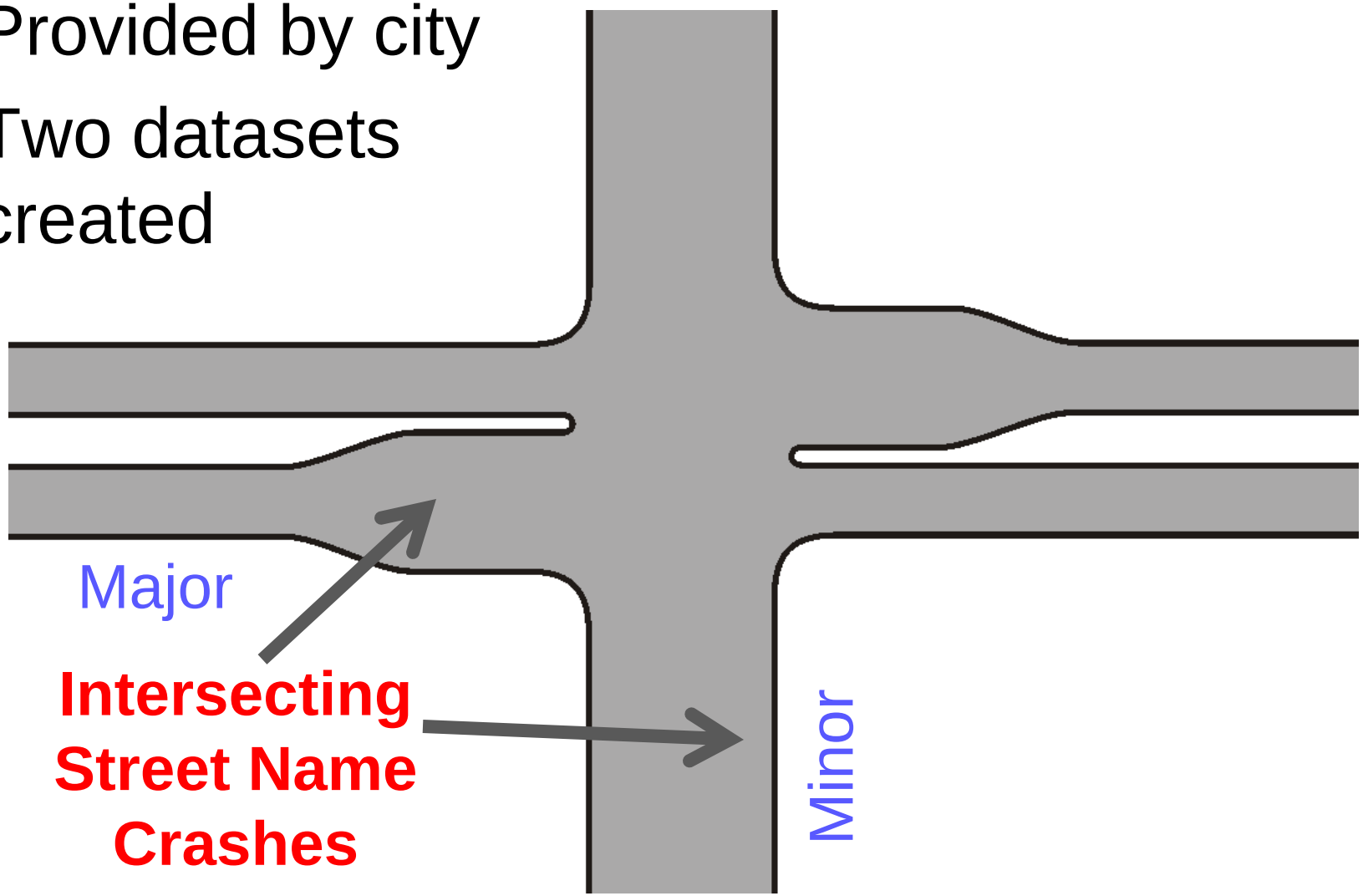
- Counts available from:
  - Tucson website (limited number of locations)
  - Pima County roadway segment traffic counts
    - Most recent data on web
    - Historical data received from COG
- Pedestrian counts & some roadway counts
  - Data collection firm
- As needed, counts adjusted to reflect growth or reduction in volume over time

Study Periods

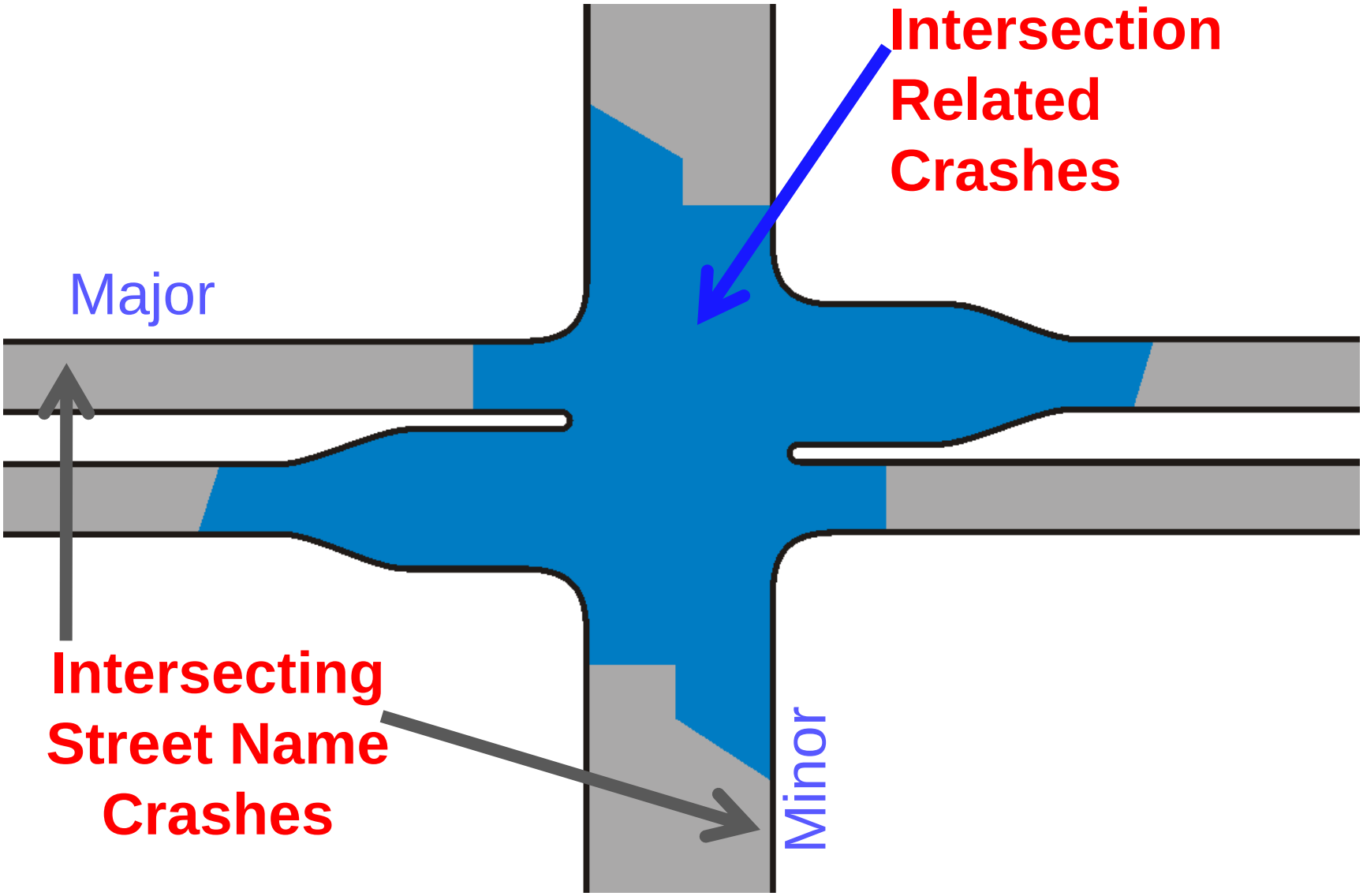
- Goal = 36 months before and after
- Assumed
  - 2 months construction
  - 2 months learning
- Before = 36 months
- After = up to Dec 31 2007 (limit of crash data), 80% of the sites had 24 months or more

Crash Data

- Provided by city
- Two datasets created



Crash Data


Intersection Related Crashes
Major
Intersecting Street Name Crashes
Minor

Crash Types

- Total crashes
- Severe crashes
- Pedestrian crashes
  - Treatment designed to decrease this crash type

Preliminary Observation

Simple B-A Comparisons!

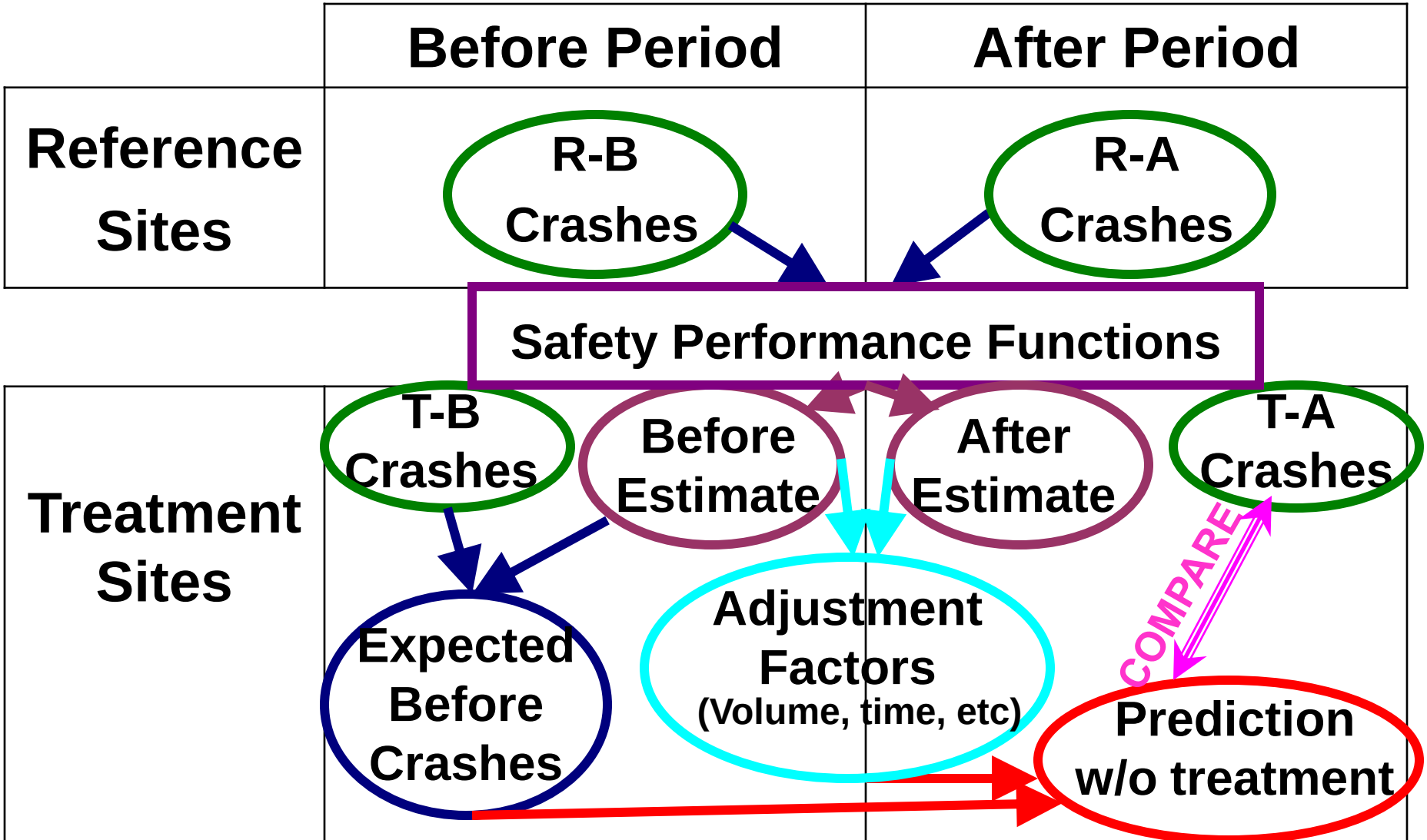
Intersecting Street Name Crashes		Crash/MEV&P		% change
		Before	After	
HAWK 21 sites	Total	0.755	0.624	-17
	Ped	0.029	0.005	-83
Unsignalized 103 sites	Total	0.412	0.427	+4
	Ped	0.006	0.011	+93

Preliminary Observation

Simple B-A Comparisons!

Intersection-Related Crashes		Crash/MEV&P		% change
		Before	After	
HAWK 21 sites	Total	0.345	0.225	-35
	Ped	0.017	0.002	-86
Unsignalized 103 sites	Total	0.163	0.150	-8
	Ped	0.001	0.003	+143

Empirical Bayes Overview



Intersecting Street Name Crashes Empirical Bayes Results

HAWK SITES	103 Unsig		
	Total	Severe	Ped
After Crashes	508	173	4
Crashes Predicted	624.5	198.1	12.8
% Reduction	19	13	69
Statistically significant?	Yes	No	Yes

Intersection-Related Crashes Empirical Bayes Results

HAWK SITES	103 Unsig		
	Total	Severe	Ped
After Crashes	183	77	2
Crashes Predicted	256.4	90.1	5.5
% Reduction	29	15	65
Statistically significant?	Yes	No	Yes

Summary

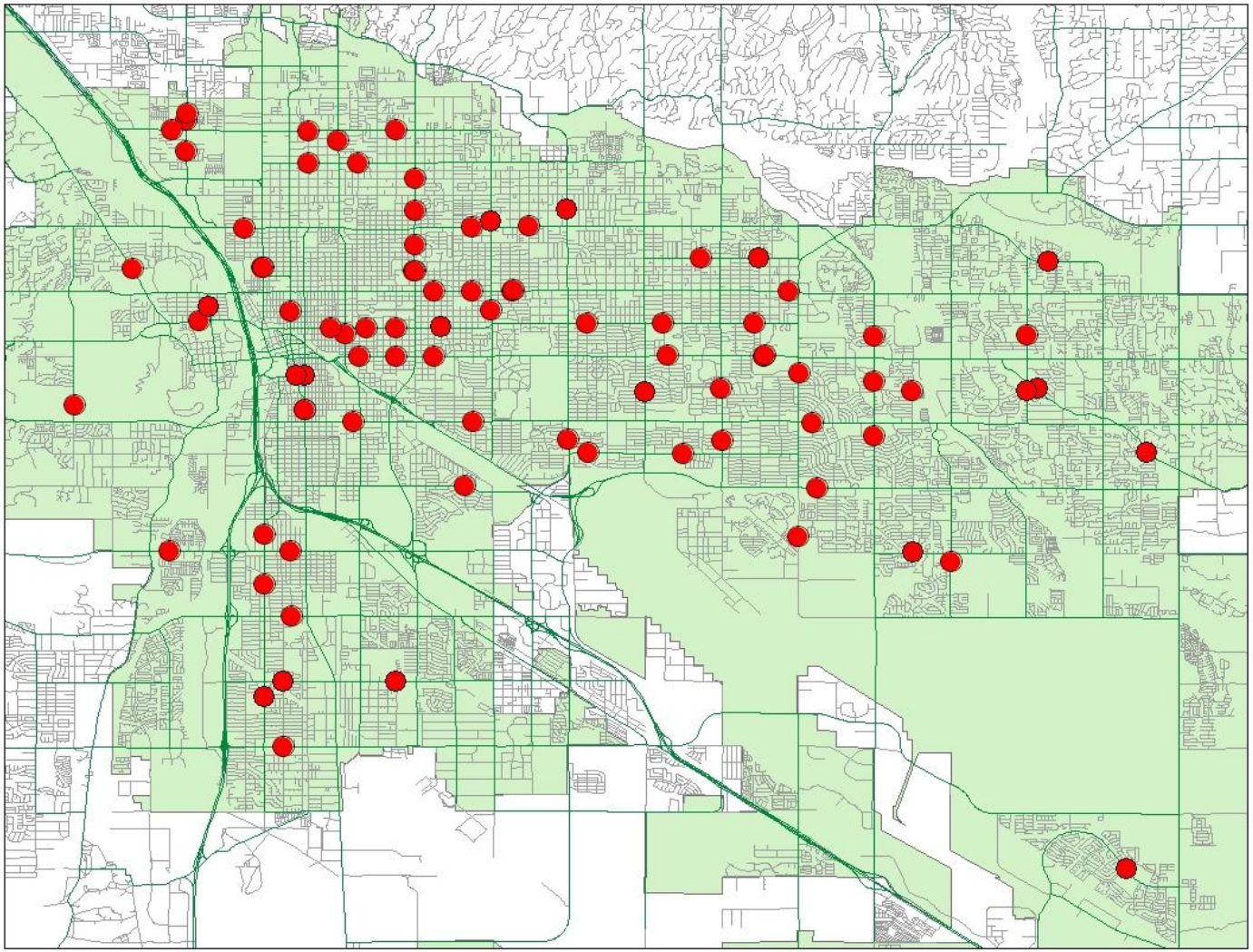
- Safety evaluation of HAWK beacon using Empirical Bayes method
- Before-After
  - 21 treatment sites
    - All at stop-controlled intersections/major driveways
  - Reference sites groups:
    - 103 unsignalized intersections
- Statistical significant changes:
  - 29% reduction in total crashes
  - 69% reduction in pedestrian crashes

References

- *Safety Effectiveness of the HAWK Pedestrian Crossing Treatment*
  - TechBrief, FHWA-HRT-10-045
    - http://www.fhwa.dot.gov/publications/research/safety/10045/10045.pdf
  - Research Report, FHWA-HRT-10-042
    - http://www.fhwa.dot.gov/publications/research/safety/10042/10042.pdf
- *Improving Pedestrian Safety at Unsignalized Crossings* (TCRP/NCHRP 112/562)
  - http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_562.pdf

OPERATIONS

HAWK Locations



Regional Transportation Authority

- Half-cent sales tax
- City has installed 17 HAWK crossings in 2+ years, many at schools
- No school district contribution required

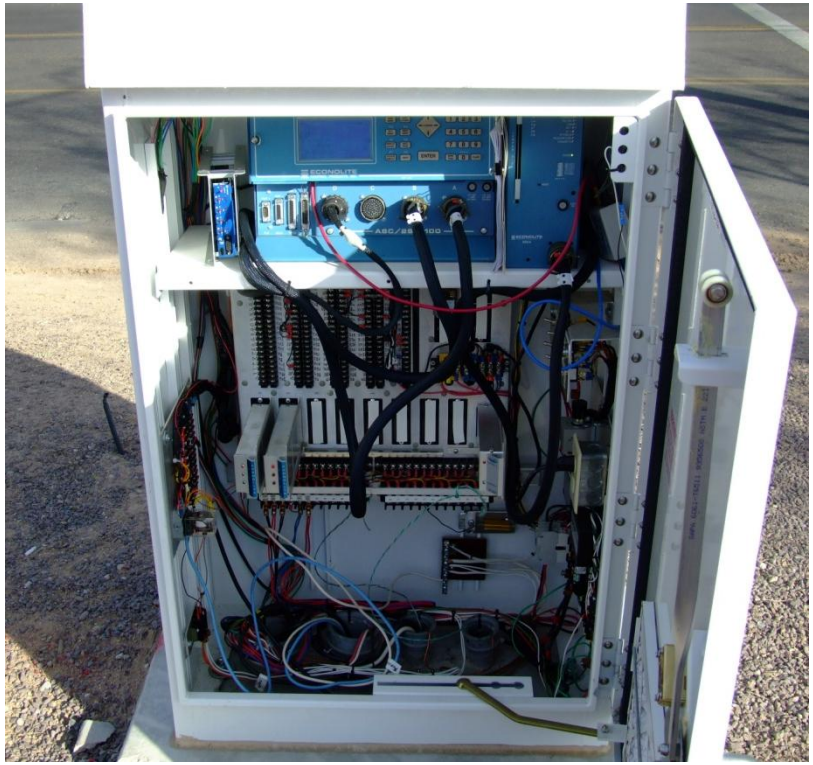
Tucson Criteria

- School crossing?
- Crossing activity
- Traffic speeds
- Gaps
- Crash experience
- Number of travel lanes and traffic volumes
- Spacing

Equipment

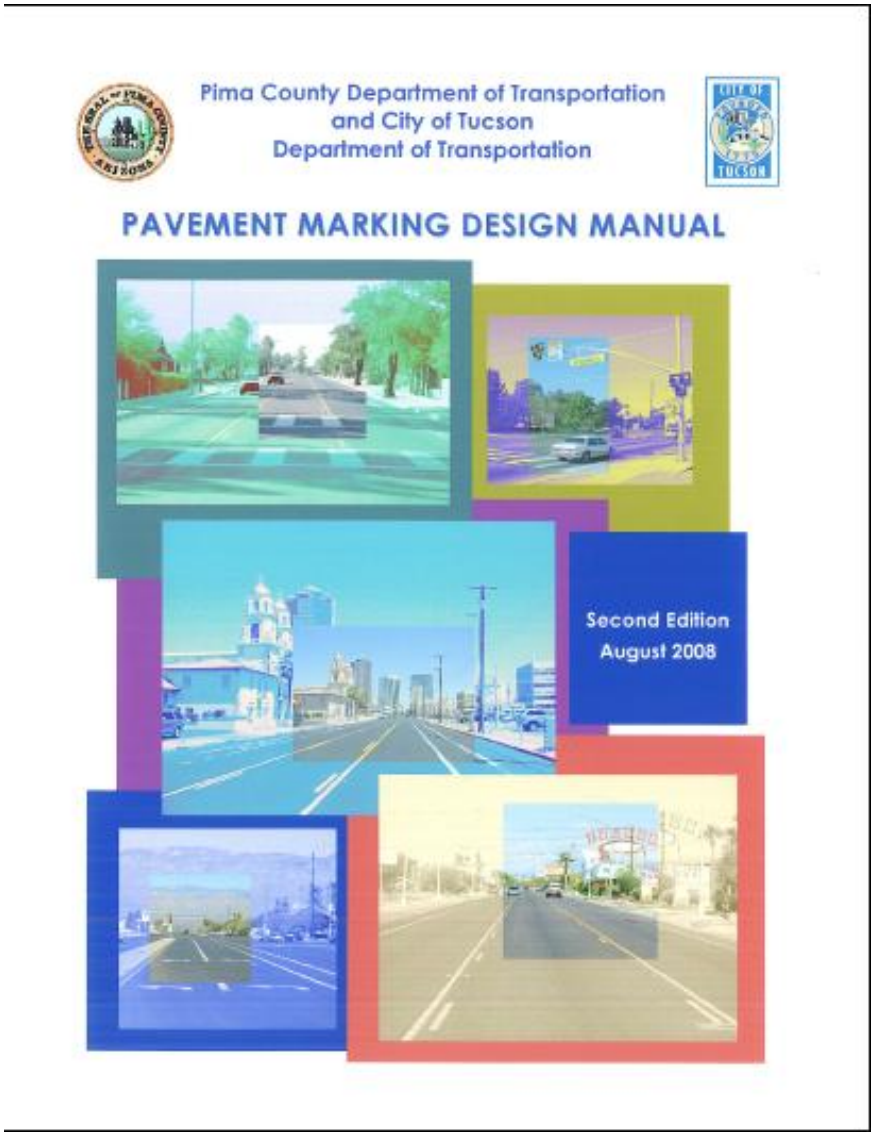
- Standard equipment
- Total cost $100,000 - $150,000
- Street lighting recommended
- Commercial power
- Use of on-call contractor

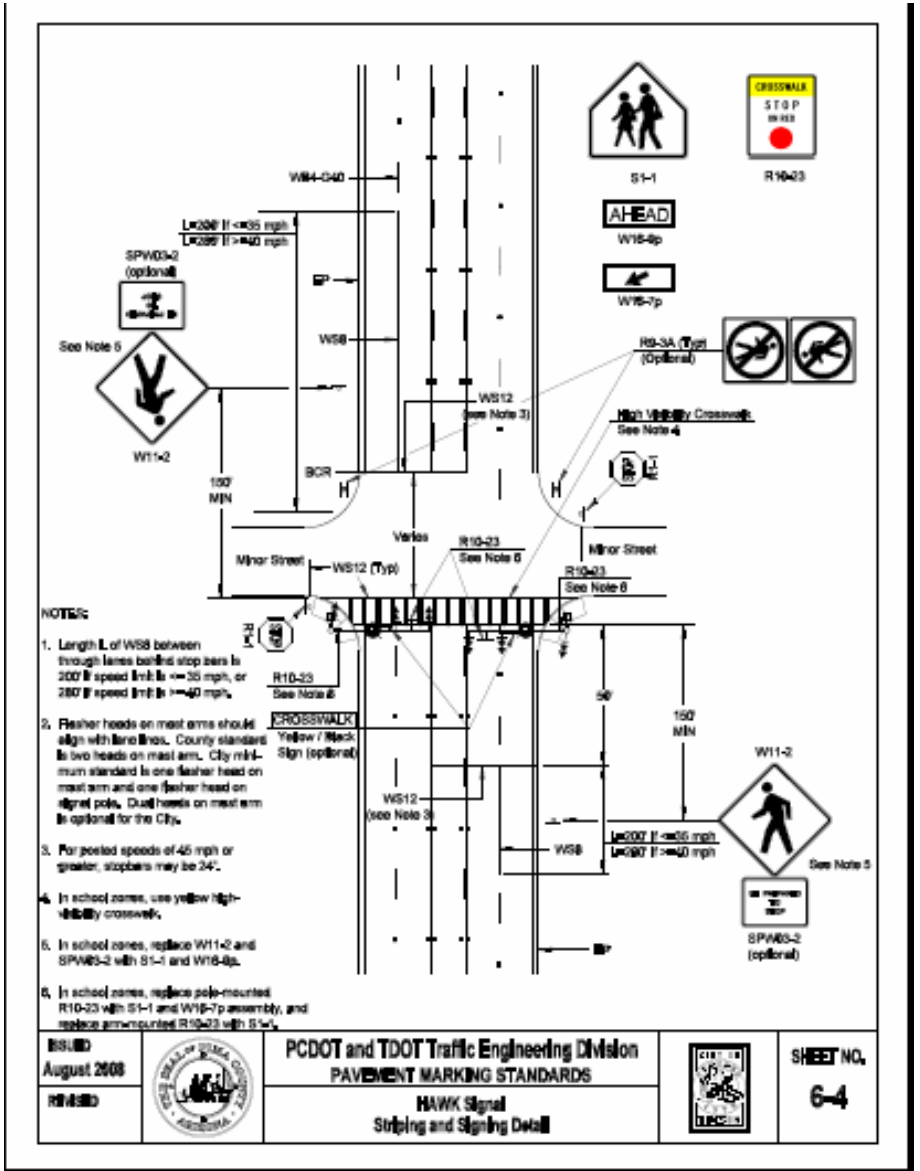
Controller



- Standard controllers
- Econolite ASC-2 controller require special firmware, remapping of functions, and changes to write-protected memory
- ASC-3 controllers accommodate HAWK timing right out of the box

Signing and Striping





STOP ON RED (R10-23)

Progression

Signing

- Use R10-23 except in school zones
- Advance warning signs in fluorescent yellow, with Diamond Grade sheeting (DG^3)
- Illuminated CROSSWALK sign
- Special push button sign
- Signs prohibiting pedestrians crossing leg w/o beacon (optional)

School Signing

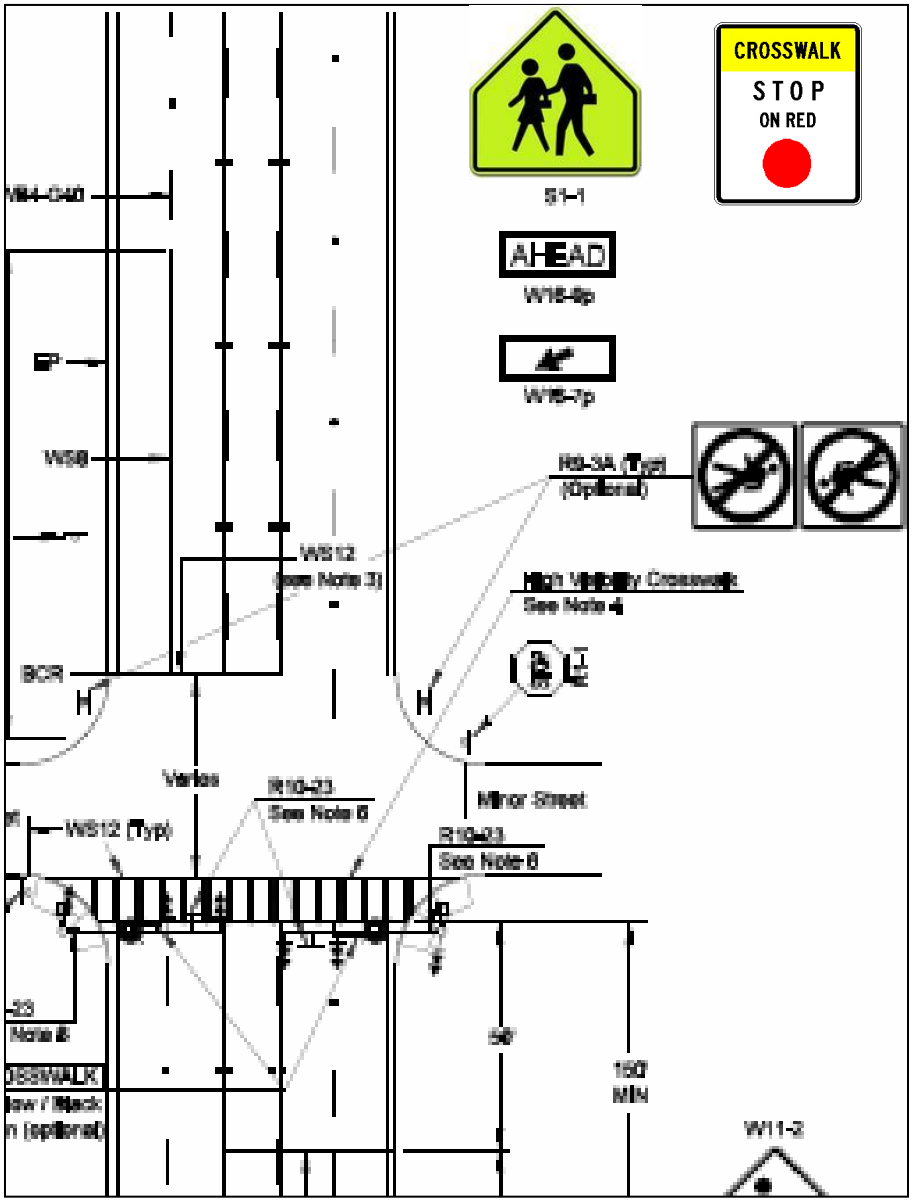
Crosswalk Signing

Mounting Detail

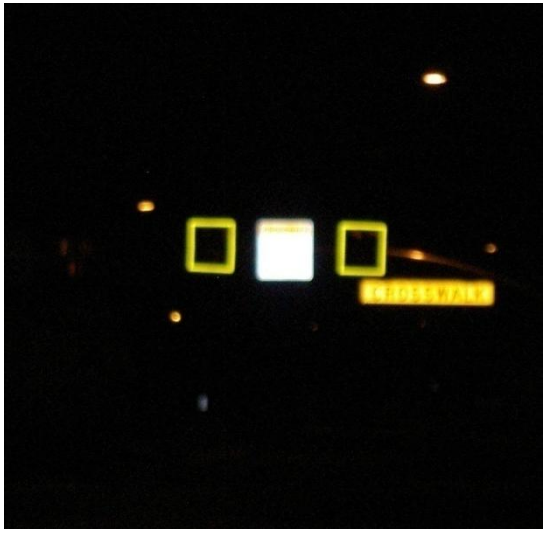
Advance Signing

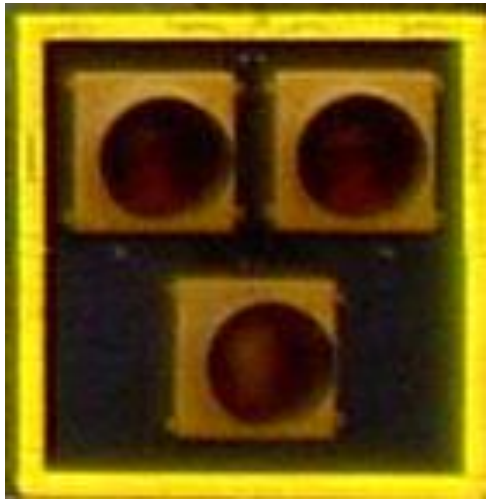
Striping

- High visibility crosswalk
- Stop bar 50 ft back
- Solid white 8-inch lane line between approach travel lanes (distance is a function of posted speed limit)

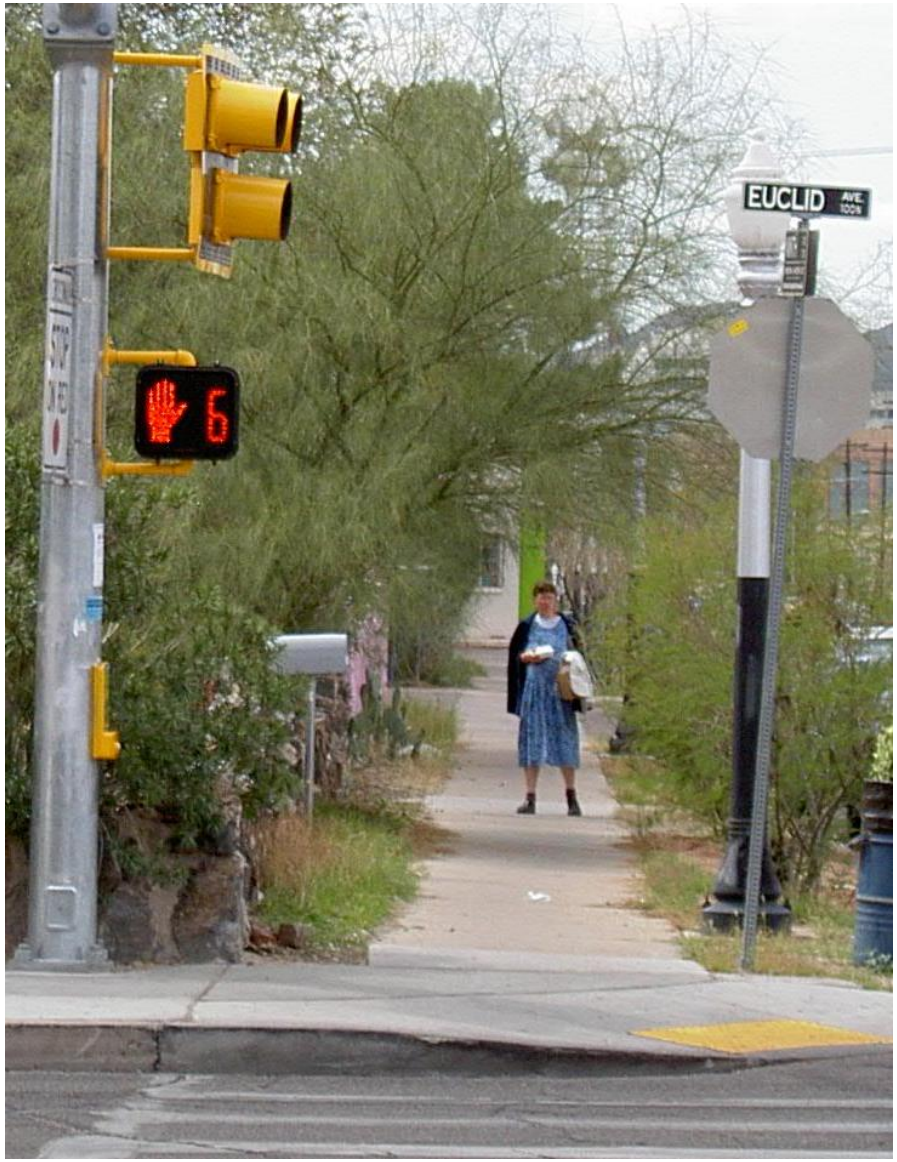


Retroreflective Strip





Countdown Pedestrian Indication



Education

Children's Safety Program

Through TDOT's Traffic Safe Kids Program, the department is teaching children about staying safe on Tucson's streets. A short presentation and magical puppet show is being presented to our young students through the local elementary schools. Whether they're walking or taking the bus to school, riding their bike or scooter, or playing ball in their own neighborhood, we want to help children remember their safety tips when the time comes to act. There is also a safety activity book for children. The book's characters teach life-saving rules in ways that appeal to young children. The messages featured throughout the book are geared for children in elementary school with the hope that the messages learned will be remembered all their lives.

Zack Rabbit, a trusty fellow with a floppy ear, and Lenny Lizard, Zack's mischievous partner, are TDOT's "honorary safety messengers." Some of the safety messages included in the activity book are:

- Look both ways before and while crossing the street and watch for turning cars
- Obey the school crossing guard
- Ask an adult to show you a safe route to walk to school
- Wear safety protective gear when riding your bike or scooter
- Don't play in or near the street
- Buckle up for safety – and remind everyone else to buckle up too!

Special Pedestrian/Bicycle Beacon Signals

Every corner is a crosswalk, marked or not, where the driver must yield. Some have beacon signals for special circumstances. Remember to act responsibly and look out for children.

"If you have people engaging in activities that put lives at risk, engineering countermeasures can only go so far. Convincing people to change their behavior will have the most lasting effects. However, this may be the most difficult thing to do in order to ensure pedestrian safety."

Federal Highway Administration

To learn more about how bicyclists and motorists can **SHARE The ROAD** legally and safely in Pima County, a free guide is available to the public by contacting 791-4372.

You may obtain additional information by calling the

Tucson Department of Transportation
Public Information Officer at
791-4371

Si usted necesita ayuda para entender este folleto, llama a Public Information Officer, 791-4371. Alguien le asistira con sus preguntas.

CITY OF TUCSON

A community service of the
Tucson Department of Transportation
Bringing Life to Transportation

CROSSINGS

Special Pedestrian/Bicycle Beacon Signals

PELICAN Crossing: Pedestrians Activate

The PEdestrian LIght Control ActivatioN crossing is activated by pushing a button. The Pelican then signals pedestrians to cross to the decorative median island and then along the median to the second signalized crossing point a short distance away.

The technique incorporates a standard RED-YELLOW-GREEN signal that rests in main street GREEN for vehicular traffic until a pedestrian wishes to cross. The signal then changes to RED and shows the pedestrian a WALK signal to go to the median.

The pedestrian then activates a second button and crosses the second portion of the main street. This two stage crossing only delays the pedestrian minimally and allows the main street signal operation to maintain the signal synchronization system. The system provides for a safe pedestrian crossing and minimizes the potential for stops, delays, accidents, neighborhood and environmental issues.

Pelicans are quite effective in providing a safe crossing of major streets for pedestrians mid-block. An extension of the **PELICAN** system is the **TOCAN** signal system for both bicycles and pedestrian crossings.

TOCAN Crossing: "TwO groups CAN cross," Bicycle and Pedestrian

The TwO groups CAN cross signaling system was designed to provide a safer crossing for "two" groups – PEDESTRIANS and BICYCLISTS. A traditional signal crossing system would normally be inappropriate at locations where both pedestrian and bicycle crossing is needed. In many cases the bike route is along a residential street where the crossing of the major street is at an irregular spacing creating serious signal synchronization and potential safety problems. A traditional signal would encourage additional vehicle traffic to cut through on the residential street, negatively impacting the "livability" of the neighborhood. The **TOCAN** crossing signal may be activated by either riding up to the stop bar or pressing the button. Please do not ride across the street when the RED bicycle symbol is lit. These signal units, along with the **HAWK** unit help find a community transportation balance for mobility and safety and encourage citizens to 'share the road.'

HAWK Crossing: "Watching over the Pedestrian like a Hawk"

The High intensity Activated crossWalK is one of the newest crossing systems in use. It's based on a European design and is similar to the current American school bus warning flasher system.

The **HAWK** consists of a standard traffic signal RED-YELLOW-RED format. The unit is off until activated by a pedestrian. When a pedestrian wishes to cross the street, they press a button which activates a warning FLASHING YELLOW light on the main street. The indication then changes to a SOLID YELLOW advising drivers to prepare to stop. The signal then displays a SOLID RED and shows the pedestrian a WALK symbol. The beacon then displays an ALTERNATING FLASHING RED and the pedestrian is shown a FLASHING DON'T WALK with a "countdown" signal advising them of the time left to cross. **Drivers are allowed to proceed during the flashing red after coming to a full stop and making sure there is no danger to a pedestrian.** At school crossings, drivers must wait until the children and crossing guard are completely out of the crossing.

Split-Phase

Split-Phase

Split-Phase


RED
CROSSWALK
ADAIR Funeral Home
NO TRUCKS OVER 3 TONS
The Bashful Barn

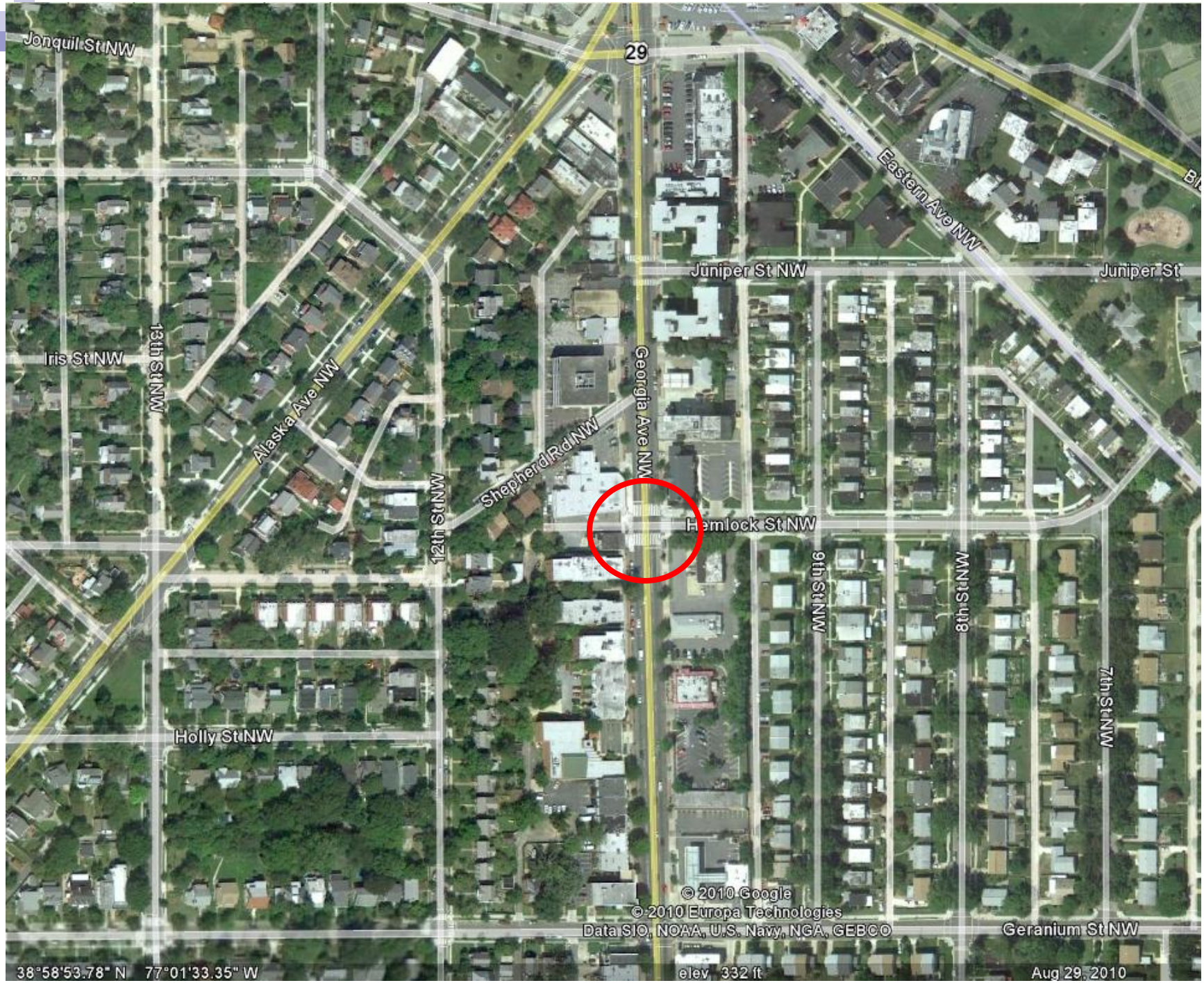
School

EXPERIENCES IN WASHINGTON DC

DC Pedestrian Hybrid Beacon

Background:

- In August 2009 DDOT installed a Pedestrian Hybrid Beacon at a T" intersection at Georgia Ave. NW, a major arterial street (27,000 ADT), and Hemlock St. a local residential street.
- Land use context: mixed use commercial/residential node along commercial corridor
- Intersection is approximately 750 ft from adjacent signalized intersections
- Community members, especially the elderly, had complained for years that it was difficult and unsafe to cross Georgia Ave at this location
- Submitted a request for experimentation to FHWA in April 2009

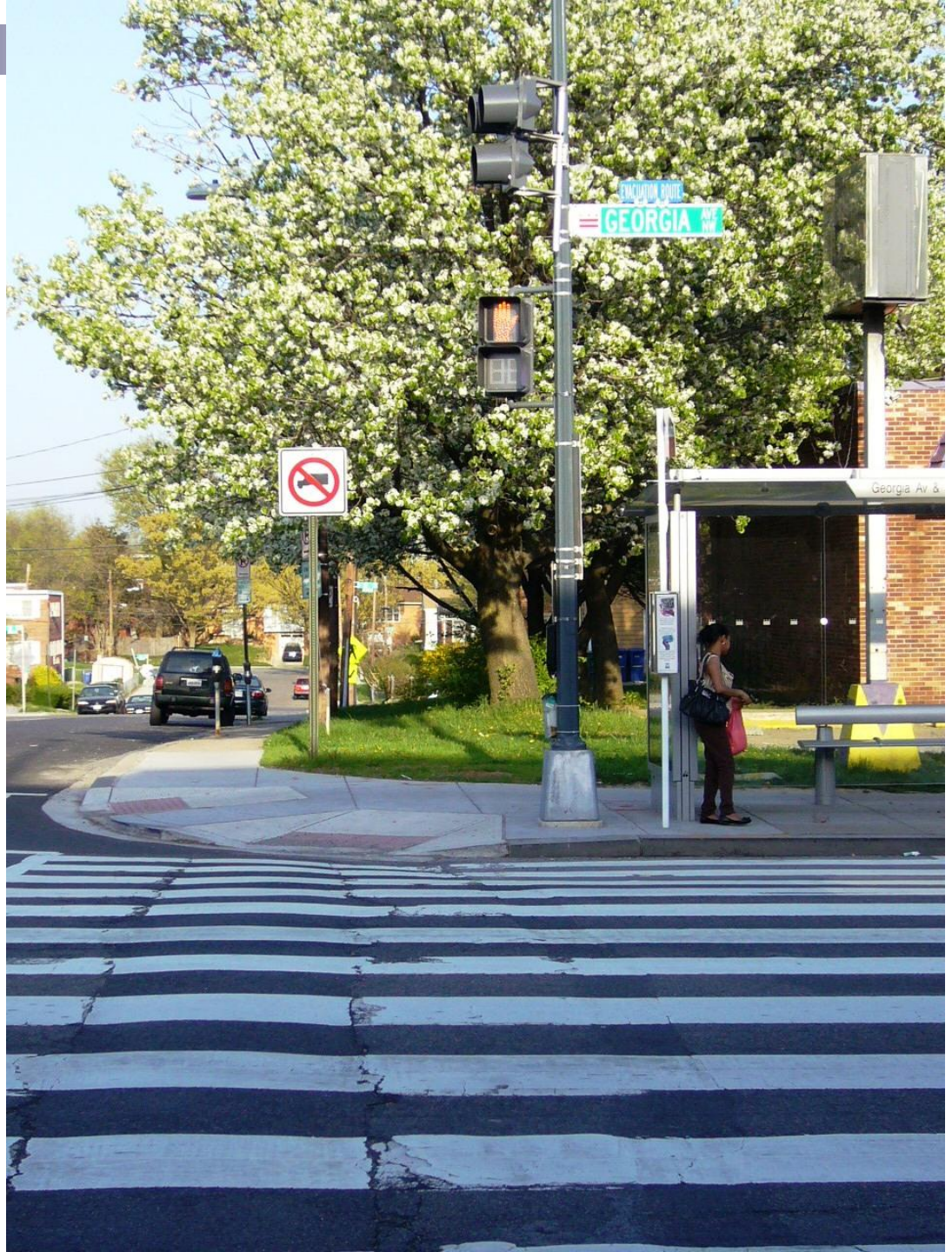

Jonquil St NW
29
Eastern Ave NW
Juniper St NW
Juniper St
Iris St NW
13th St NW
Alaska Ave NW
Georgia Ave NW
Shepherd Rd NW
12th St NW
Hemlock St NW
9th St NW
8th St NW
7th St NW
Holly St NW
© 2010 Google
© 2010 Europa Technologies
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Geranium St NW
38°58'53.78" N 77°01'33.35" W
elev 332 ft
Aug 29, 2010

Location: Georgia Ave. & Hemlock St NW, Washington, DC


CROSSWALK
STOP
ON RED


CROSSWALK
STOP
ON RED


PEDESTRIAN
YOU MUST
PUSH BUTTON
TO
CALL FOR
WALK SIGNAL


EVACUATION ROUTE
GEORGIA

DC PHB Evaluation Findings:

- Pedestrian Hybrid Beacon evaluated by conducting series of 3 field observations of driver compliance and pedestrian behavior
- Main measure of effectiveness:
  - Proportion of drivers stopping/yielding to pedestrians when device showed red indication
- Evaluation showed an average of 97% motorist compliance with the signal
- Overall, 42% of pedestrians who crossed at the intersection did so without activating the signal

Table 1: Analysis of Field Data Collection – 1 (July 7th, 2010)

Begin Time	No. of Ped. Crossing Events Using HAWK Signal	No. of Veh. Yielded/ Stopped for Peds.	No. of Veh. That did not Yield/Stop for Peds.	No. of Vehicles that should have Stopped
12:30 PM	3	12	-	12
12:45 PM	3	12	-	12
1:00 PM	5	18	1	19
1:15 PM	3	12	-	12
1:30 PM	4	9	-	9
1:45 PM	4	11	-	11
2:00 PM	4	14	3	17
2:15 PM	3	12	-	12
2:30 PM	3	4	-	4
BREAK	**BREAK**	**BREAK**	**BREAK**	**BREAK**
4:45 PM	7	27	5	32
5:00 PM	4	15	-	15
5:15 PM	4	16	5	21
5:30 PM	6	24	-	24
5:45 PM	3	12	2	14
6:00 PM	3	15	1	16
6:15 PM	1	4	-	4
6:30 PM	4	13	-	13
4-Hr Period	**64**	**230**	**17**	**247**

P = number of vehicles that yielded or stopped for pedestrians = (230)/number of vehicles that should have stopped (247) = 93.1%

DC General Field Observations:

- Some drivers exhibited aggressive driving characteristics:
  - Hesitating or slowing down briefly for crossing pedestrians to clear the driver's travel path, and then proceeding to drive across the intersection on the flashing red without stopping
- While waiting to turn onto Georgia Avenue, motorists from Hemlock Street generally yielded to pedestrians using the crosswalk

General Field Observations (cont)

- On occasions, pedestrians did not wait before crossing the intersection after activation and instead used gap in vehicular traffic to cross
- During instances where pedestrians attempted to cross the intersection without activating:
  - Some drivers acknowledged and yielded to the pedestrians
  - Other drivers evaded pedestrians and continued through the intersection

DC Findings

- Crossing without activating the PHB led to substantially more ped-veh conflicts than crossing with the device activated

Table 6: Qualitative Analysis of Pedestrian – Vehicle Conflicts

BEGIN TIME	PEDESTRIAN – VEHICLE CONFLICTS		
	No. of Conflicts upon Activating HAWK Signal	No. of Conflicts Without Activating HAWK Signal	Total No. of Pedestrian – Vehicle Conflicts
7:00 AM	1	-	1
7:15 AM	-	-	-
7:30 AM	-	-	-
7:45 AM	-	-	-
8:00 AM	-	-	-
8:15 AM	-	-	-
8:30 AM	-	-	-
8:45 AM	-	-	-
9:00 AM	-	1	1
9:15 AM	-	-	-
9:30 AM	-	-	-
9:45 AM	-	1	1
10:00 AM	-	2	2
10:15 AM	-	3	3
10:30 AM	-	1	1
10:45 AM	-	-	-
AM TOTALS	**1**	**8**	**9**
2:00 PM	1	-	1
2:15 PM	1	-	1
2:30 PM	-	-	-
2:45 PM	-	-	-
3:00 PM	-	-	-
3:15 PM	-	-	-
3:30 PM	-	-	-
3:45 PM	-	-	-
4:00 PM	-	1	1
4:15 PM	-	-	-
4:30 PM	1	3	4
4:45 PM	-	2	2
5:00 PM	-	-	-
5:15 PM	-	-	-
5:30 PM	1	-	1
5:45 PM	-	-	-
PM TOTALS	**4**	**6**	**10**

Operations and Modifications

- The signal functions in a “hot response” mode and is activated immediately upon button call
- The signal is not coordinated with adjacent signals on the corridor. Software is not capable of coordination but should be in the future
- In response to complaints from elderly users, the solid red phase was lengthened from 7 seconds to 17 seconds
- Initially the signal was installed with two signal heads on the right side approach. An additional signal head was later added on the left side
- The red signals flash simultaneously, not wig-wag, because of software limitations

DC Conclusions

- PHB was effective in getting drivers to stop for pedestrians
  - This favorable result could be due to the strong regulatory message that the solid red ball sends to motorists
- PHB did not appear to cause any adverse effects on pedestrian crossing behaviors at the intersection during the field observations

DC Conclusions (cont)

- Minimal traffic operational issues were observed
- Low pedestrian compliance (activation) rate could be attributed to
  - Lack of understanding of the operation of the PHB or the perception of delay
  - Existence of sufficient number of gaps in vehicular traffic for pedestrian crossing without activating the PHB

DC Conclusions (cont)

- Implementation of a public awareness campaign on the PHB could help improve pedestrian understanding and thereby improve the compliance rate (brochures were distributed in the area and were available on the poles)

Final DC Conclusions

- Based on the motorist compliance rate, the use of Pedestrian Hybrid Beacon as a device for improving pedestrian crossing safety at selected intersections is recommended
- The PHB would be especially useful at intersections on high-volume major arterials which do not satisfy any of the warrants for standard signalization

QUESTIONS?


CROSSWALK
STOP
ON
RED
PEDESTRIAN CROSSING
STOP
ON
RED
STOP
ON
RED