Strategies to Improve Pedestrian Safety at Signalized Intersections

Stephen Hanuscin, P.E.

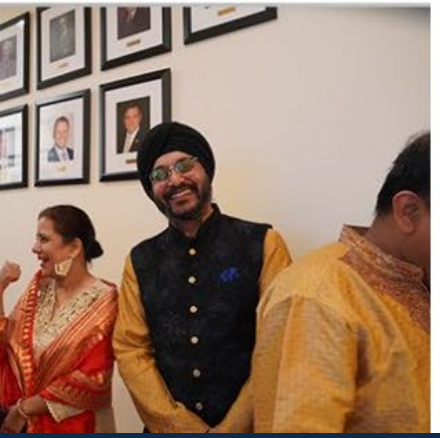
Assistant Director of Public Works

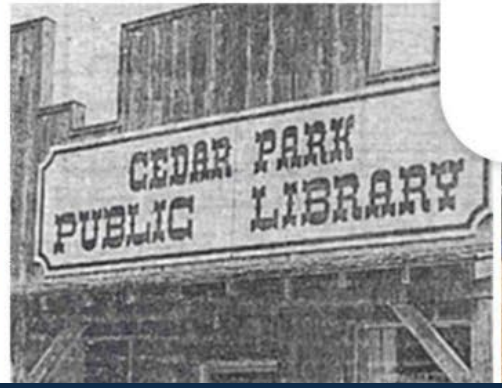
City of Cedar Park

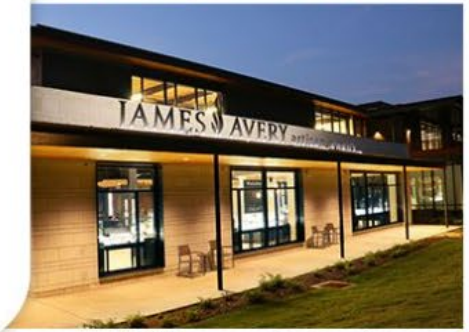
CEDAR PARK TEXAS

2023: A Milestone Year for Cedar Park

CELEBRATING
CEDAR PARK 50
FIFTY YEARS



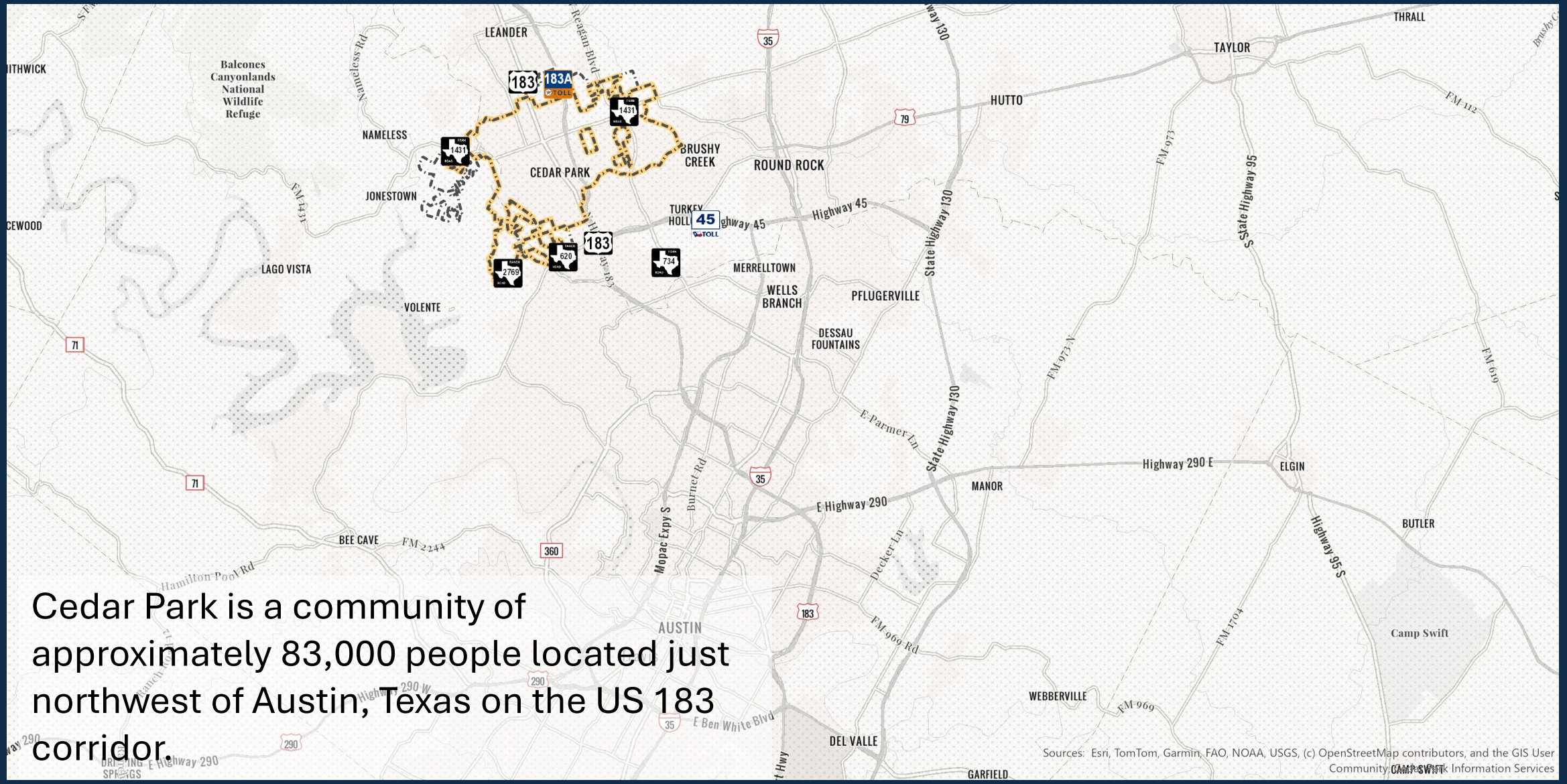




2023: A Milestone Year for Cedar Park

- Cedar Park's first comprehensive mobility master plan (MMP) outlined the City's plan to develop a connected multimodal transportation network with an emphasis on safety, including key action items.
- Prior to the MMP, safety concerns were primarily addressed on an ad-hoc basis, and to some extent still are (in other words, if somebody brings a concern to our attention, we take it seriously and address it).
- The story behind this presentation began with one such request.

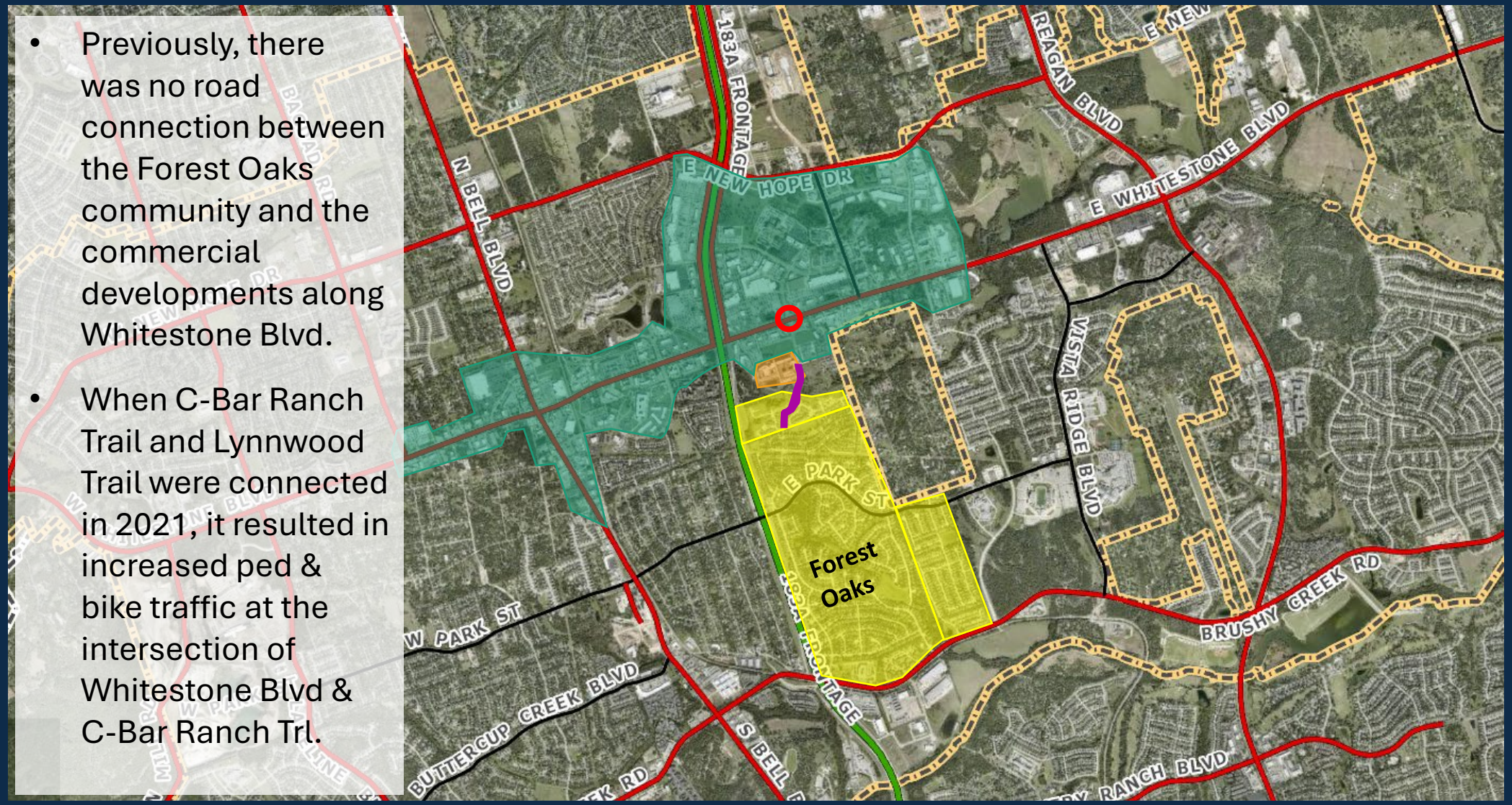
Where is Cedar Park?



Cedar Park is a community of approximately 83,000 people located just northwest of Austin, Texas on the US 183 corridor.

Study Location

- Previously, there was no road connection between the Forest Oaks community and the commercial developments along Whitestone Blvd.
- When C-Bar Ranch Trail and Lynnwood Trail were connected in 2021, it resulted in increased ped & bike traffic at the intersection of Whitestone Blvd & C-Bar Ranch Trl.



LEGEND

- Commercial (retail, office, medical)
- Single Family Residential
- Multi-Family Residential
- C-Bar Ranch Trl & Lynnwood Trl connection (2021)
- Subject Intersection (Whitestone Blvd & C-Bar Ranch Trl)

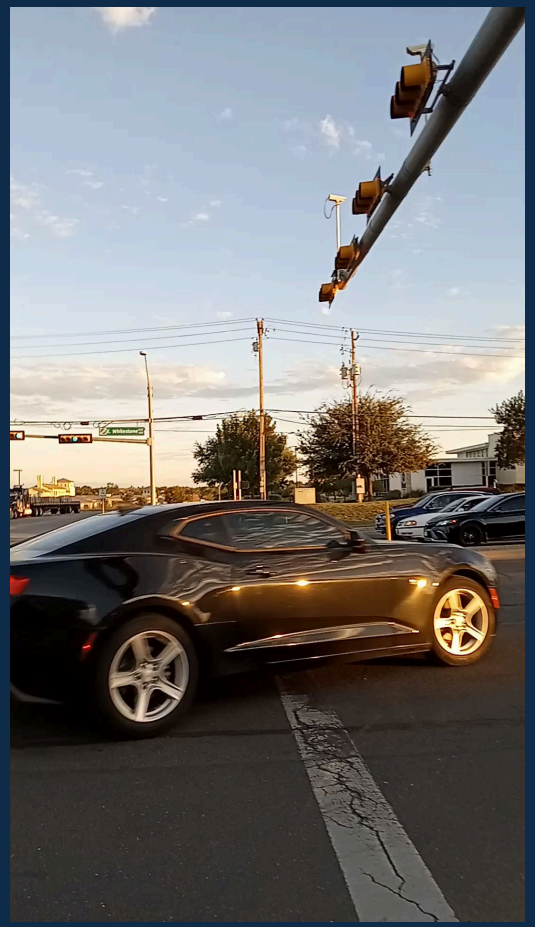
The Problem: Right Turns Not Stopping for Pedestrians in Crosswalk

From: [redacted]
Sent: Thursday, September 19, 2024 7:05 AM
To: Stephen Hanuscin <Stephen.Hanuscin@cedarparktexas.gov>
Subject: Re: Crosswalk improvement needed at Whitestone and C-Bar Ranch

I am writing to request a crosswalk signal improvement at the crosswalk over Whitestone Blvd. at C-Bar Ranch Trail. I cross at this crosswalk daily, morning and evening.

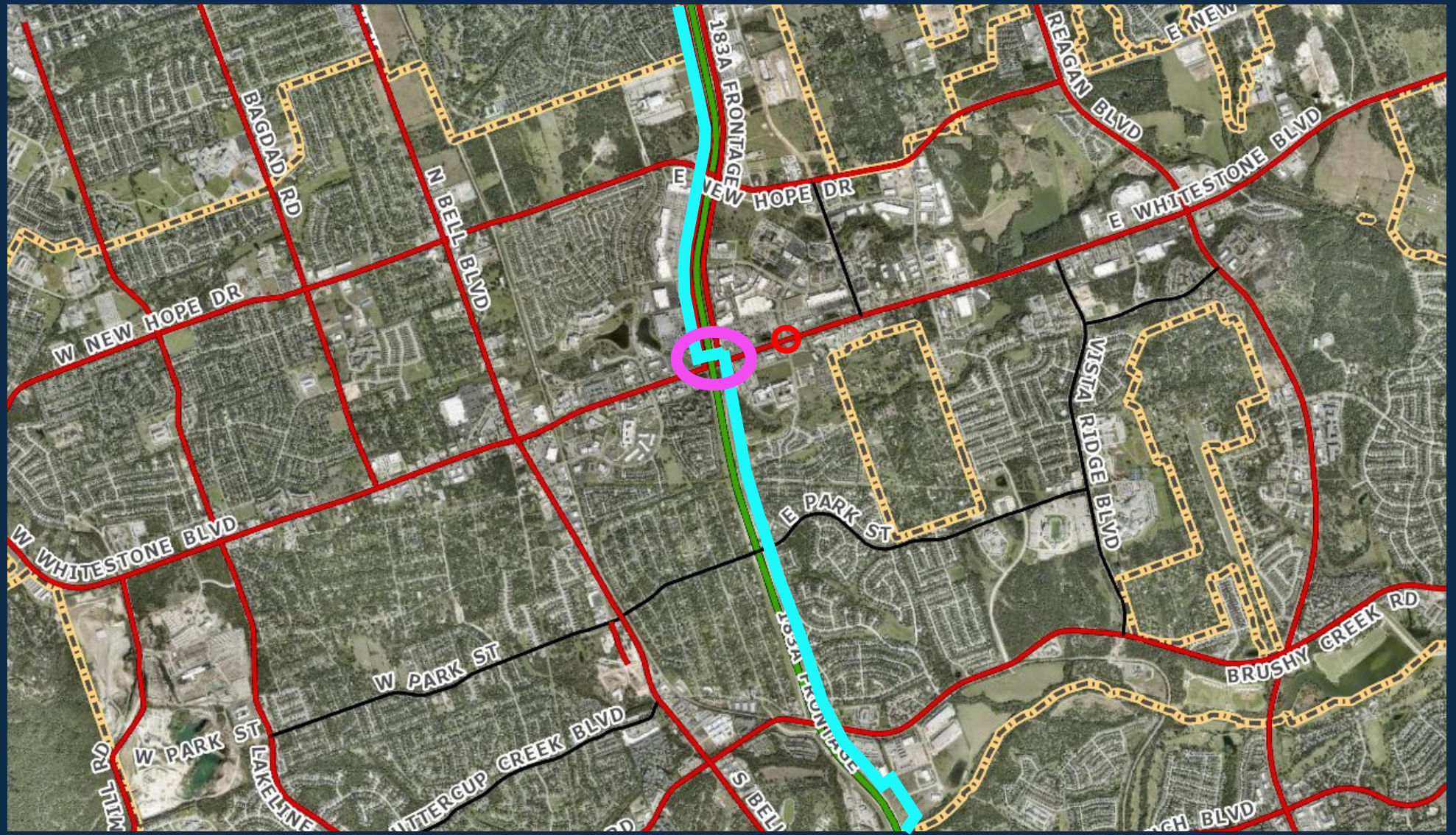
I chose my neighborhood in Cedar Park mainly so I could walk to work, but I am finding that my daily walking commute is extremely hazardous. On multiple occasions I have watched cars blow through a red light without slowing, while I had a walk signal, particularly early in the morning on my way to work. Crossing Whitestone is even more dangerous in the evening, on my way south on C-Bar Ranch Trail, as the southbound drivers making a right turn onto Whitestone from C-Bar Ranch Trail do not look for pedestrians nor the pedestrian walk signal at all. I wear reflective gear and carry an air horn and a red traffic signaling flashlight due to my apprehension over the many near-misses I've had as a pedestrian. I am frustrated that it seems it would be safer to buy a car to drive the mile from my home to my workplace than it is to continue walking to work.

I know that an enhanced crosswalk will not prevent all careless driving, but I feel it would be a real help at this apparently invisible crosswalk.



The initially proposed solution to this request was a tool that we first deployed in 2018, approximately ¼ mile west of C-Bar Ranch Trail at the intersection of Whitestone Blvd and the 183A Toll NB frontage road.

Pilot Site: Whitestone Blvd at 183A NB Frontage Road



LEGEND

- Subject Intersection (Whitestone Blvd & C-Bar Ranch Trl)
- Pilot Intersection (Whitestone Blvd & 183A NB Frontage Road)
- 183A Shared Use Path

Pilot Site Problem Statement (2017)

- Trail users crossing the NB 183A frontage road indicated westbound right turn traffic often does not stop for pedestrians in the crosswalk.

Pilot Site Strategy 1: Installation of R10-15 Signs

Google, "Street View image of 1037 RM 1431, Cedar Park, Texas," Google Maps, accessed March 20, 2025

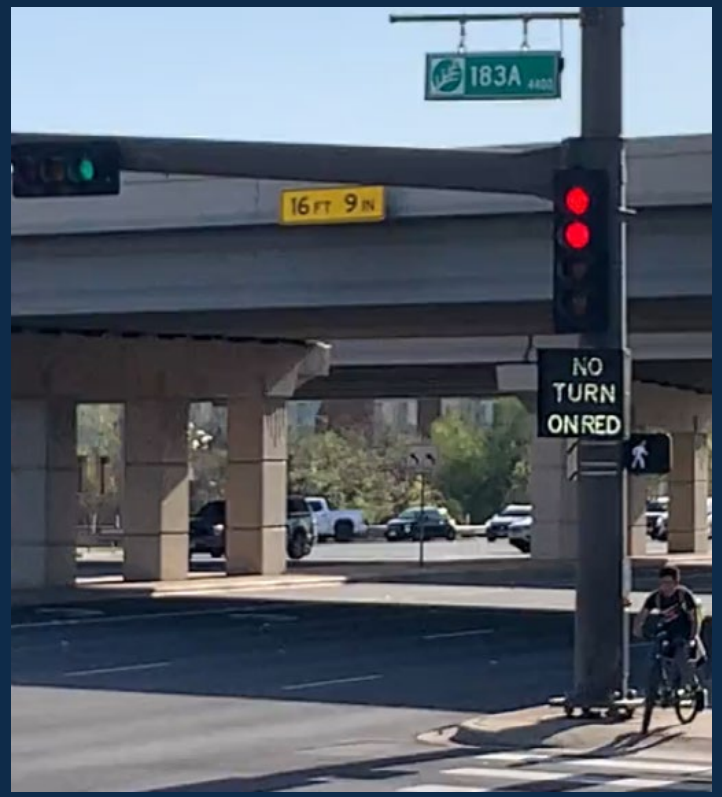
We began by installing static signs in 2017, which proved to be largely ineffective.

Pilot Site Strategy 2: Right Turn Overlap with Leading Ped Interval

Next a right-turn overlap signal was installed for the dedicated right-turn lane, which operates with a leading pedestrian interval just for the right-turn lane, followed by a flashing yellow right-turn arrow during the pedestrian clearance interval.

While we did observe more drivers stopping for pedestrians, we were still receiving complaints and felt like more could be done.

Pilot Site Strategy 3: Replacement of R10-15 w/ Blank-Out Sign



Finally, in 2018, a dual message blank out sign was added.

The use of blank out signs had previously been observed in other municipalities as a tool to improve pedestrian safety, but Cedar Park's engineers wanted to take it a step further by displaying two messages on a dynamic demand-based basis after observing the ineffectiveness of static signs at this location:

- NO TURN ON RED displayed with the WALK interval, and
- TURNING TRAFFIC YIELD TO PEDESTRIANS during the pedestrian clearance (flashing DON'T WALK) interval.

Yes, we are now installing R10-15a blank-out signs

This change was implemented following the Lisa Torrey Smith Act in 2021 (Senate Bill 1055)

Pilot Site Verdict: SUCCESS! Until…

This use of the blank-out sign was perceived to be extremely effective because staff engineers observed a significant increase in driver yielding behavior, and the phone calls and emails about that intersection completely stopped… until 5 years later in 2023, when the email below was received requesting the first message be turned on *before* the WB light turns green and the WALK signal turns on.

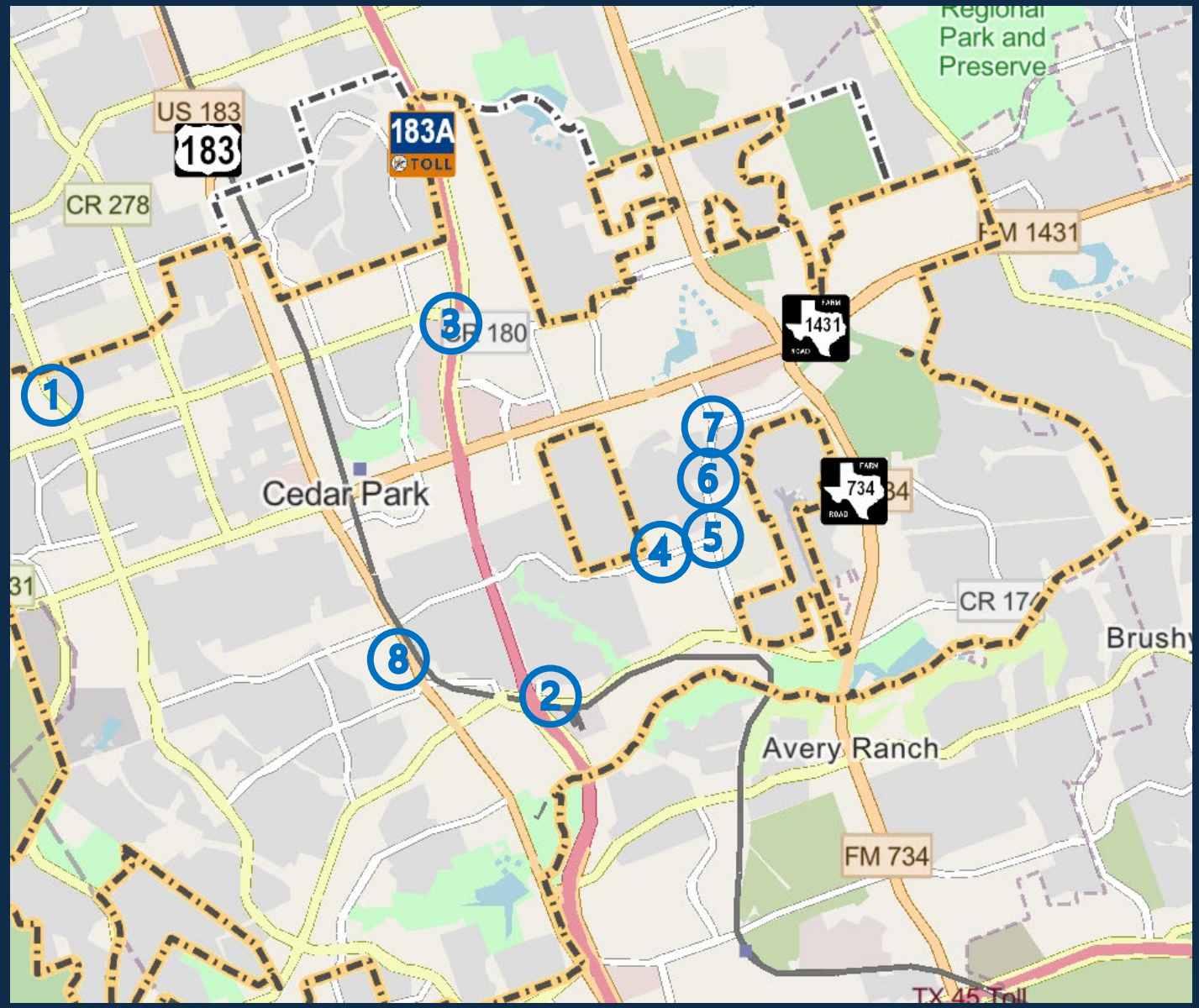
Staff engineers had a solution for this, integrating the signal controller's "phase next" status to turn on the NO TURN ON RED message when the preceding phase enters the yellow interval.

Name: [redacted]
Email [redacted]
Phone:

Category: SeeClickFix
Problem: Signal Timing Change
Address:
General Location: RM-1431 W & TX-183A
Comments: Hi Stephen, just wanted to be sure to record the issues we discussed about the ped crossings at 1431 and 183A.
For the crosswalk across the NB frontage road, can there be a leading "No Right On Red". Currently this only turns on when the west bound traffic light on 1431 turns green so you get people creeping around the corner trying to turn north who anticipate the green light and drive through the crosswalk at the same time pedestrians are crossing.

Subsequent Implementations

1. Lakeline Blvd & Cougar Country Dr (2018)
2. Bushy Creek Rd & Darkwoods Dr (2018)
3. New Hope Dr & 183A (2021)
4. Park St & Gupton Way (2024)
5. Park St & Vista Ridge Blvd (2024)
6. Vista Ridge Blvd & Golden Arrow Ave (2024)
7. Vista Ridge Blvd & Colonial Pkwy (2024)
8. Bell Blvd & Aster St (2024)



New Challenge in 2024: Variable WALK durations

A 2024 installation near at a middle school driveway presented a new challenge:

- Previously, the second message (TURNING TRAFFIC STOP FOR PEDESTRIANS) was driven by the fixed durations of the WALK and Ped Clearance intervals.
- At this intersection, due to the volume of pedestrians during school egress, it was not practical to utilize fixed pedestrian intervals all day.
- To accommodate variable pedestrian intervals, staff engineers discovered a way to dynamically tie the display of the second message to the display of the flashing don't walk interval:
  - During the Ped Clearance interval, the ped signal output channel alternates between Channel Red and Dark.
  - Using logic programming, the second message displays when the ped signal channel is dark, with an extended output so the sign continues to display as the DON'T WALK signal flashes on.

Back to the C-Bar Request…

- Before installing blank-out sign, needed real data to support installation. Prior evidence of its effectiveness was anecdotal in nature (ie: people stopped complaining)
- Developed study to analyze right-turn crosswalk interactions for 4 scenarios:
  - Baseline condition
  - Leading Pedestrian Interval
  - Right-turn Overlap with Leading Pedestrian Interval
  - Blank-out Sign with Right-turn Overlap and Leading Pedestrian Interval
- Observed 100 southbound pedestrian crossings for each scenario and tabulated whether SB drivers stopped for pedestrians in crosswalk

Driver Behavior Analysis

Did the first driver behind the SB stop bar at the beginning of the WALK interval stay stopped and wait for the pedestrian?

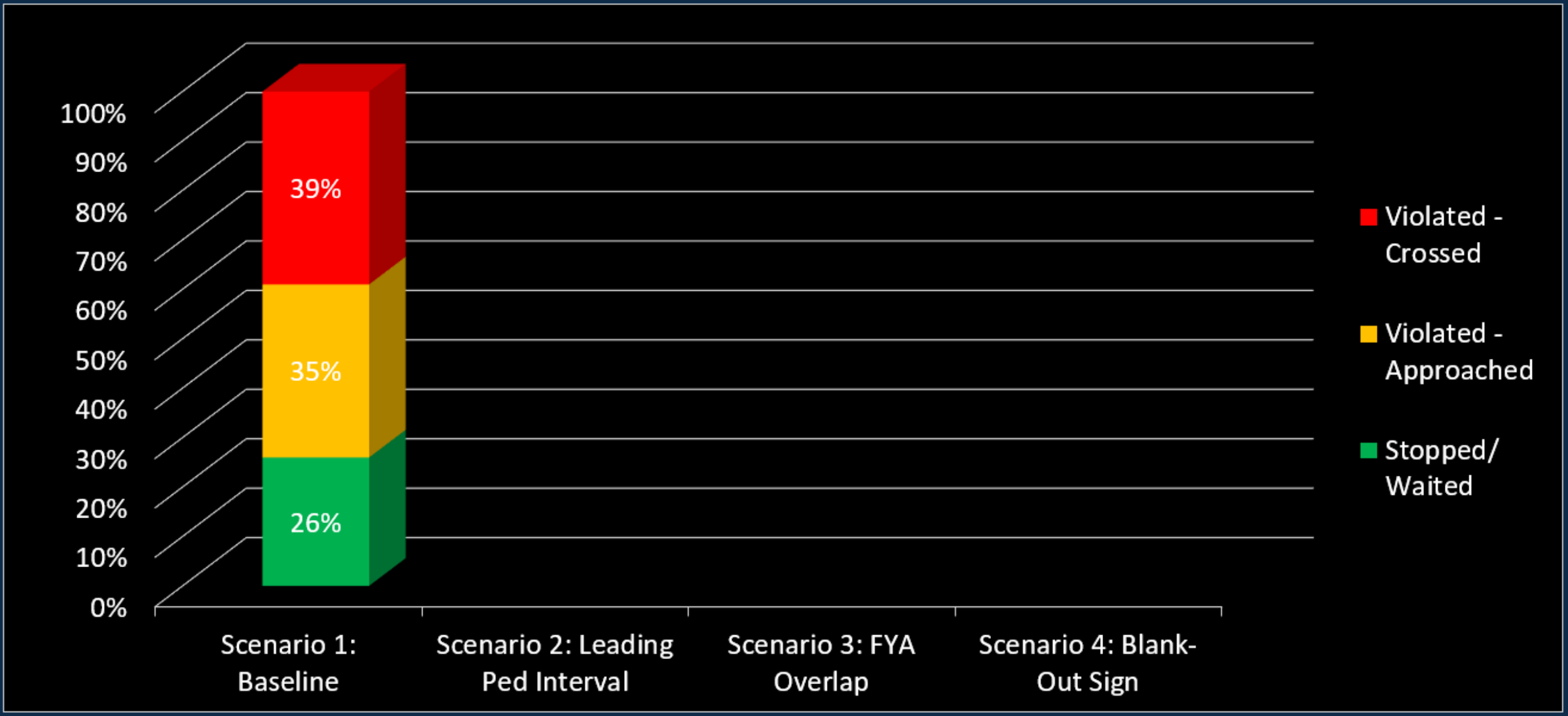
Or, if the ped signal was violated, did the driver approach the crosswalk?

Or, did the driver proceed to drive all the way across the crosswalk despite the pedestrian's presence?

Scenario 1: Baseline

Southbound walk signal turns on at the same time as the southbound green signal.

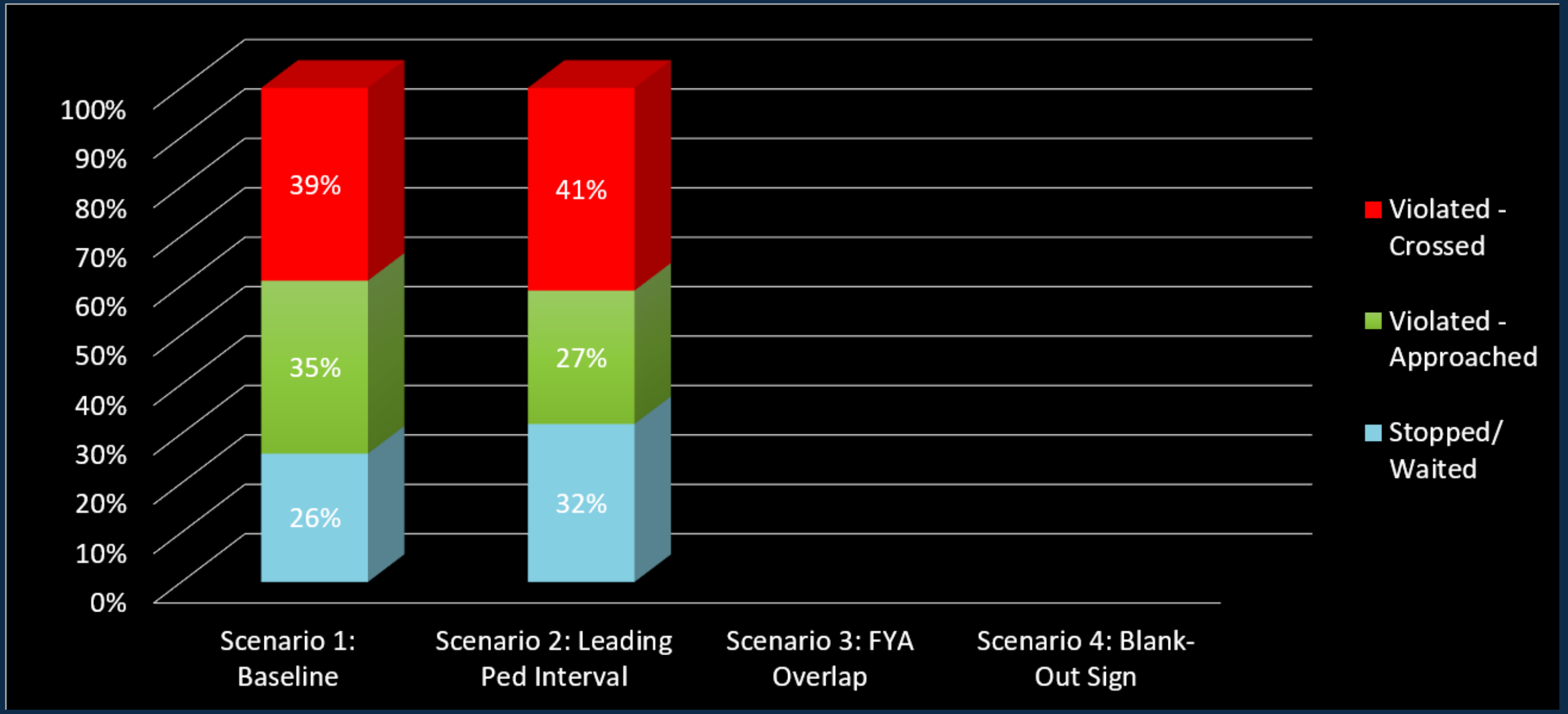
Scenario 1 Results: First Vehicle at Stop Bar on WALK



Scenario 2: Leading Pedestrian Interval (LPI)

Southbound vehicular signals remain red when southbound ped signal displays WALK.

Scenario 2 Results: First Vehicle at Stop Bar on WALK



Scenario 2 Results: A few takeaways

- Only saw a 6% improvement in driver stopping behavior.
- Hypothesis: Intersection geometry matters!
  - LPI is not very effective when there is a dedicated right-turn lane because most drivers don't know what it is; they still see it as an opportunity to turn right on red.
  - LPI is probably highly effective when there is a shared through/right-turn lane. In that case, if the first driver in the queue is going straight, subsequent drivers waiting to turn right cannot turn on red.
- Bottom line: Even if you have a dedicated right-turn lane, if your only tool is a LPI, use it! A 6% improvement is still an improvement!

Scenario 3: Flashing Yellow Arrow Right-Turn Overlap w/ LPI

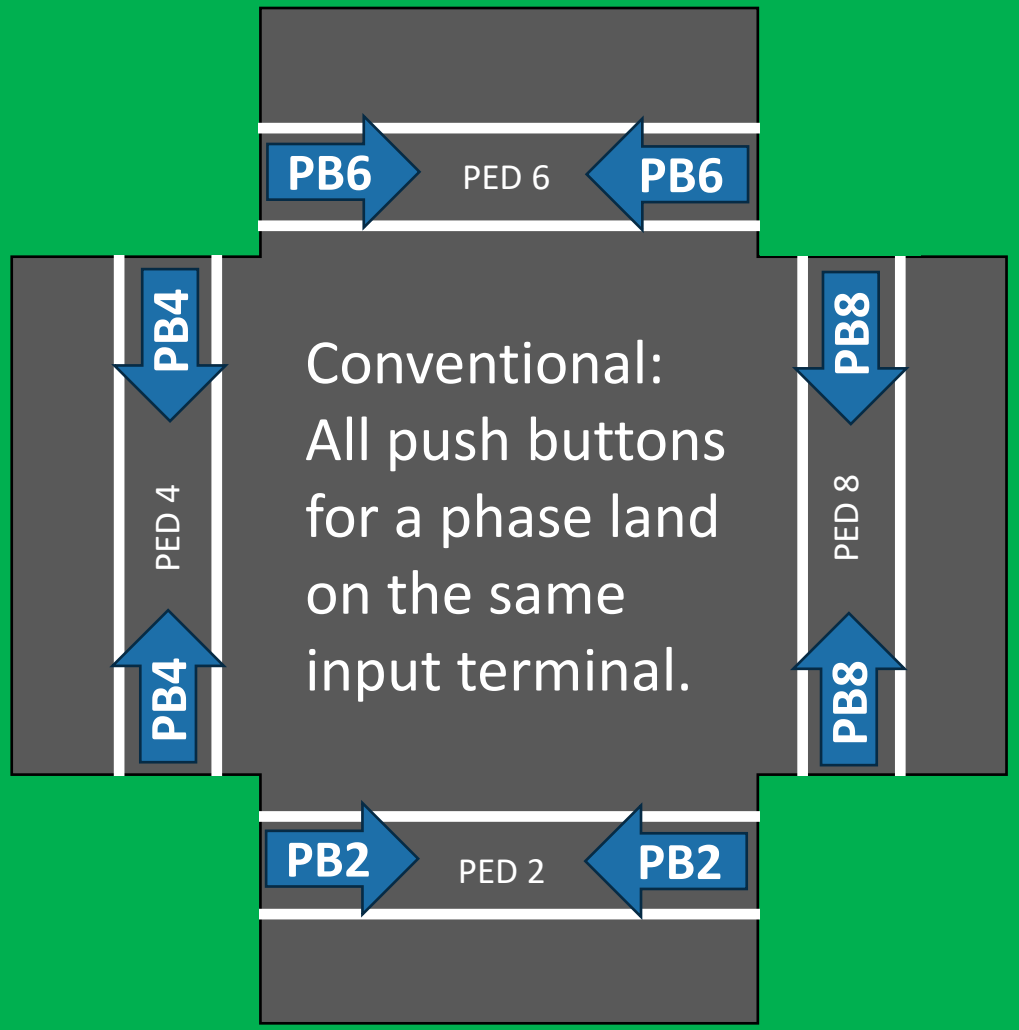
Southbound right-turn signal remains red during WALK .

Southbound right-turn signal flashes yellow arrow during pedestrian clearance (Flashing DON’T WALK).

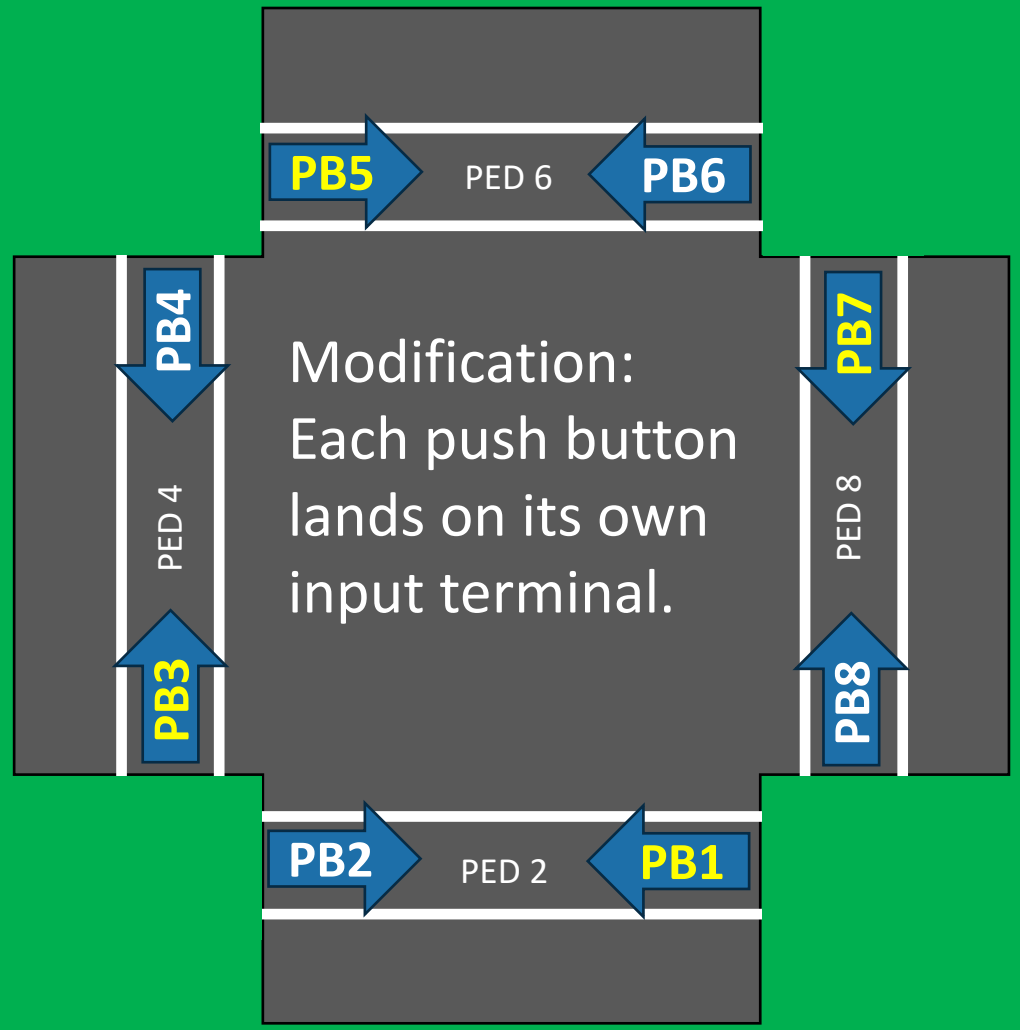
Scenario 3: A new challenge

- Desired to only utilize LPI for when near-side push button was activated.
- 140’ crosswalk
- Concern was that if there was only a pedestrian crossing from the far side, especially in Scenario 4 when the NO TURN ON RED sign is displayed, a driver waiting to turn right could grow frustrated at being prohibited from turning when there is not a pedestrian crossing from the near side. That driver might then turn in front of the pedestrian at the end of the LPI around the same time the pedestrian is passing the median.
- Staff engineers determined a solution: Decouple the push buttons so that the LPI (and later the NO TURN ON RED sign) is only activated when there is a pedestrian crossing SB from the NW corner.

Scenario 3: Separating Push Button Inputs

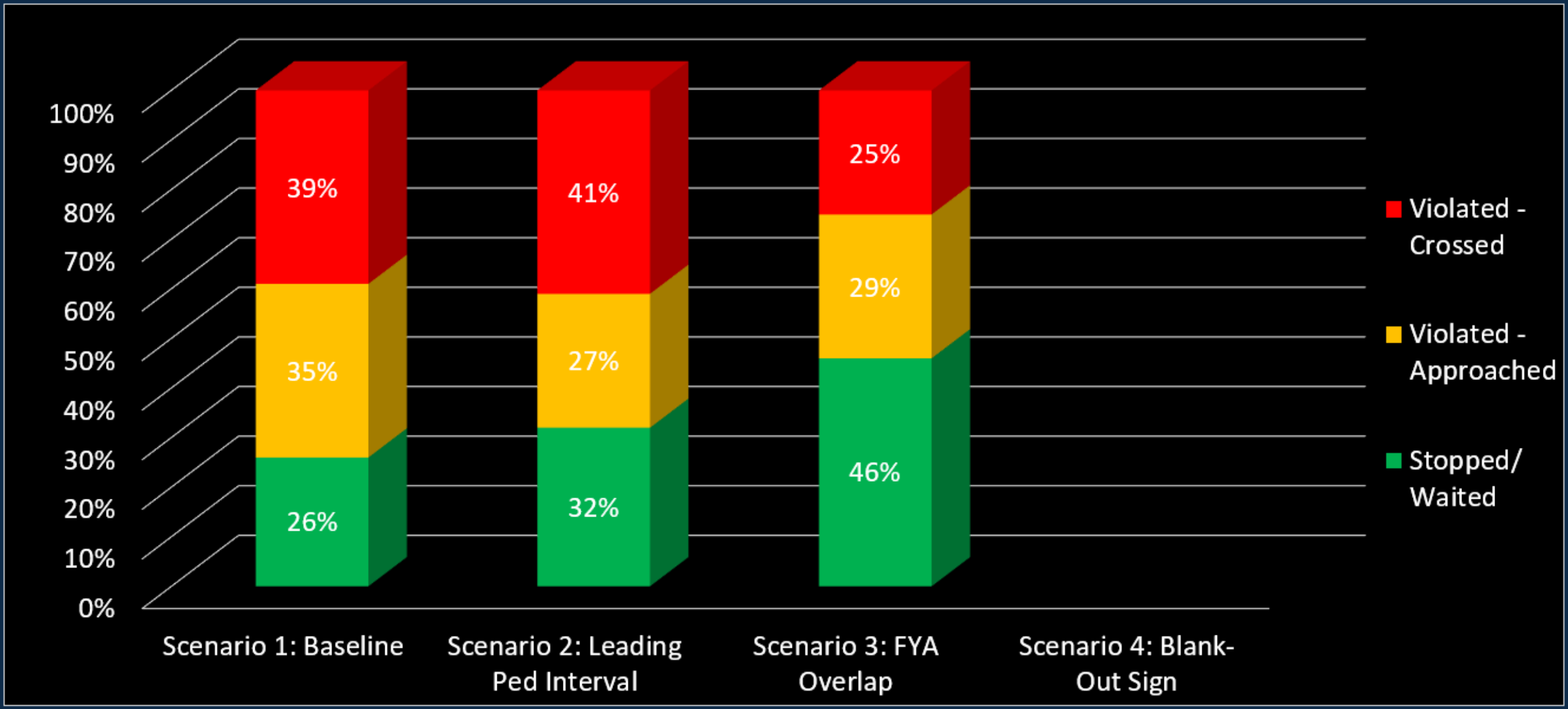


Conventional:
All push buttons for a phase land on the same input terminal.



Modification:
Each push button lands on its own input terminal.

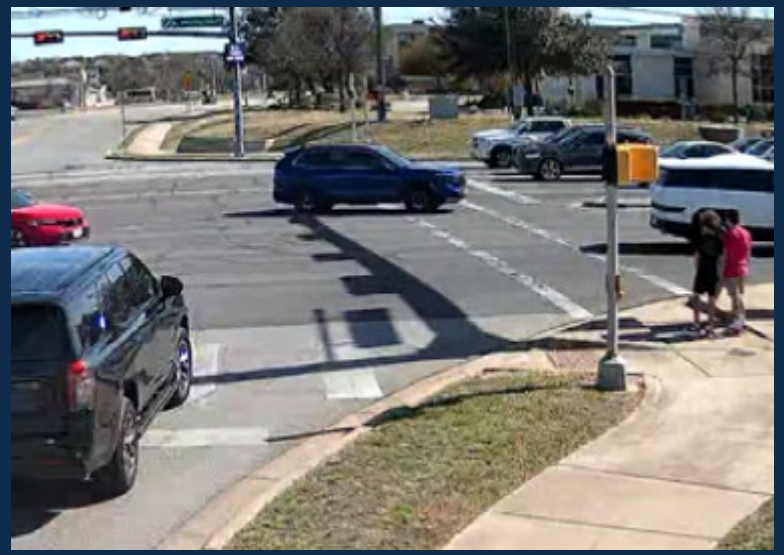
Scenario 3 Results: First Vehicle at Stop Bar on WALK



Scenario 3 Results: A few takeaways

- There was a larger increase to 46% compliance with the crosswalk.
- Although this still technically operates as a LPI, staff engineers believe that the improved compliance compared to the traditional LPI is related to the display of a red right turn arrow when the adjacent through signals turn green.
    - The hypothesis is that this leads drivers to pause and observe the cause of the right-turn arrow to still be red, allowing the pedestrian to enter the crosswalk.
- It is notable that nearly all of the improvement in stopping behavior came from a decrease in the percentage of drivers who previously drove all the way across the crosswalk in the baseline scenario.

Scenario 4: Blank-Out Sign w/ FYA Overlap and LPI

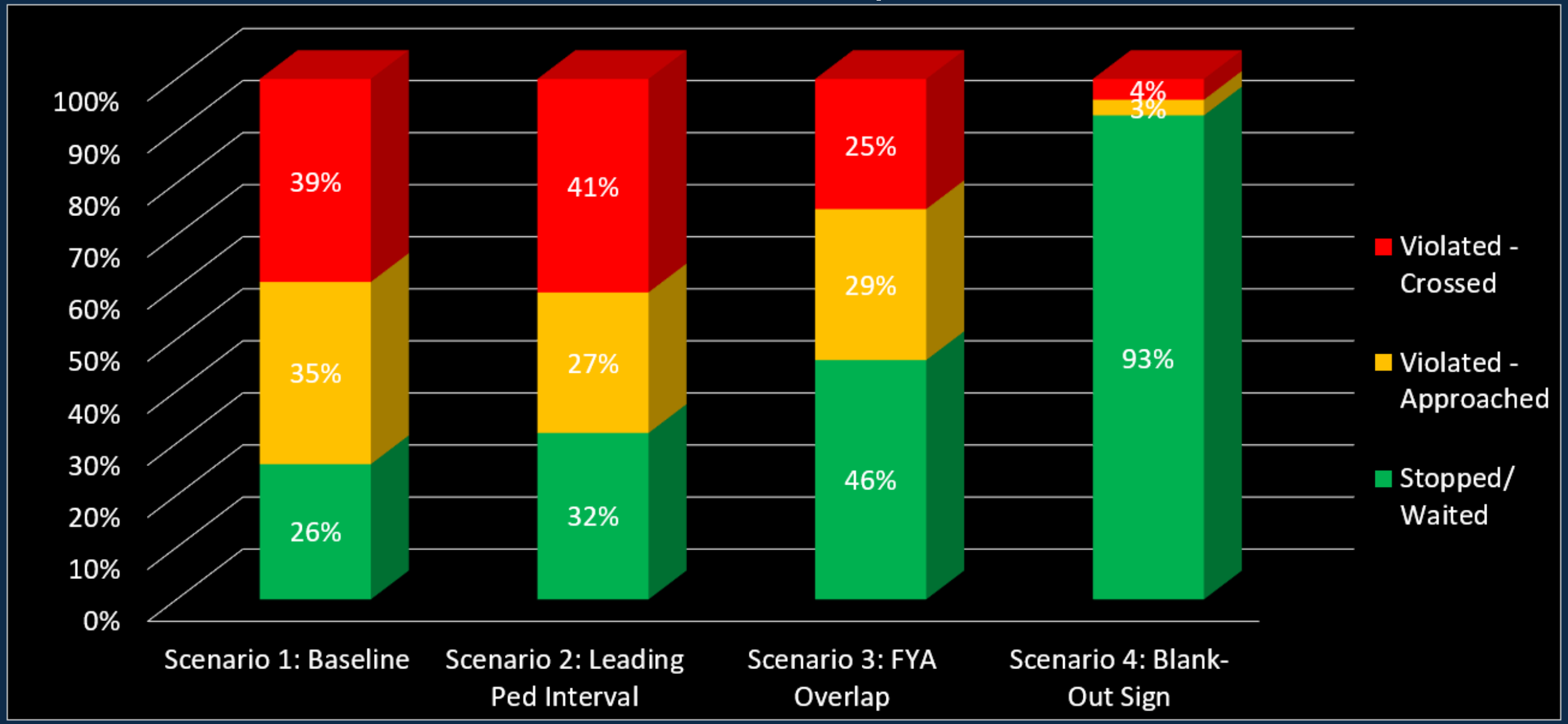


NO TURN ON RED displays during Phase 4 Next status (opposing direction, phase 3, is in yellow and red clearance).

NO TURN ON RED and SB right-turn red arrow continue to display during SB (Phase 4) LPI.

TURNING TRAFFIC STOP FOR PEDESTRIANS and SB right-turn flashing yellow arrow display during SB (Phase 4) pedestrian clearance interval.

Scenario 4 Results: First Vehicle at Stop Bar on WALK

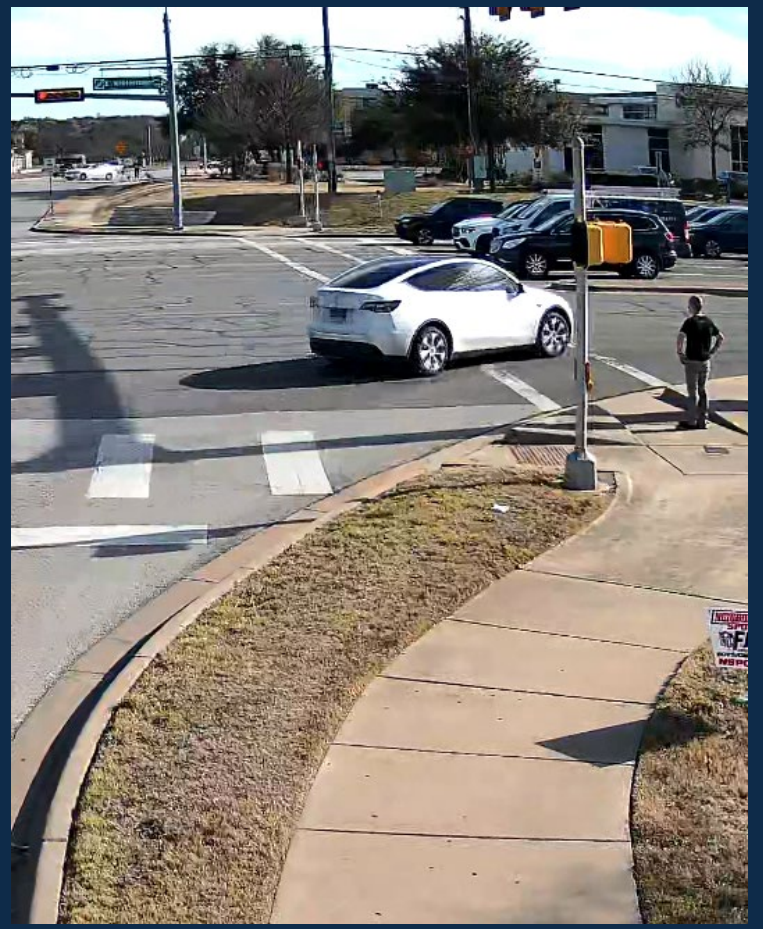


Scenario 4 Results: A few takeaways

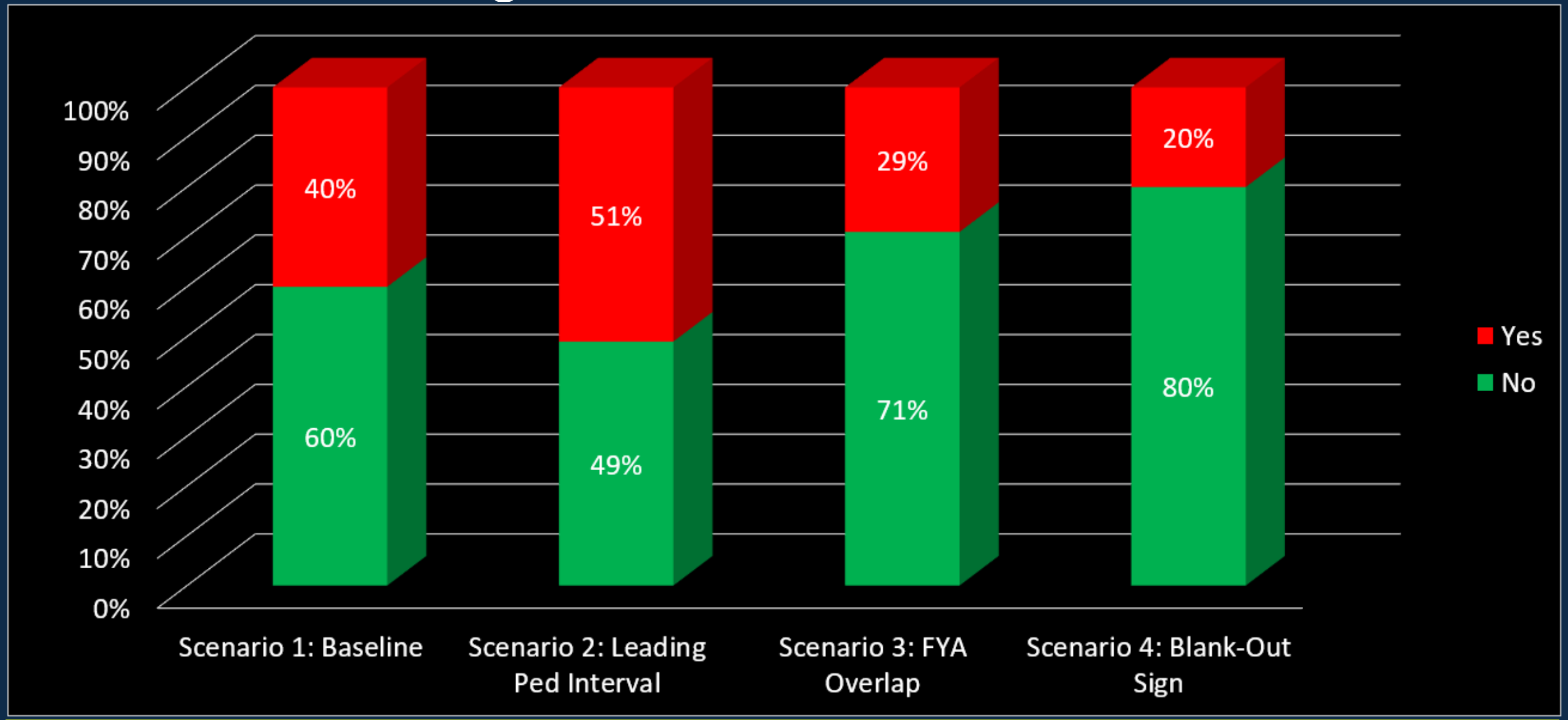
- This was a huge success, with 93% compliance!
- Note that results may vary depending on each intersection's characteristics and the technology available to the agency. The 93% compliance here is believed to be a result of:
  - Intersection geometry (dedicated right-turn lane)
  - Staff engineers deploying every tool available to them here (dual message blank-out sign, phase next logic, decoupling of push buttons, etc.)
- While it's not feasible to deploy this solution on every approach of every intersection, in Cedar Park's experience it has proven to be highly effective in locations where drivers often fail to stop for pedestrians in a signalized crosswalk.

Other Conditions Evaluated: Right turns on red

Staff also considered the effect of the blank-out sign in the situation where a driver makes a legal right turn on red, but ends up in the crosswalk when the WALK signal turns on. This is problematic because in many cases subsequent drivers have been observed to follow the first driver without regard for the presence of a pedestrian, making it difficult for the pedestrian to enter the crosswalk.



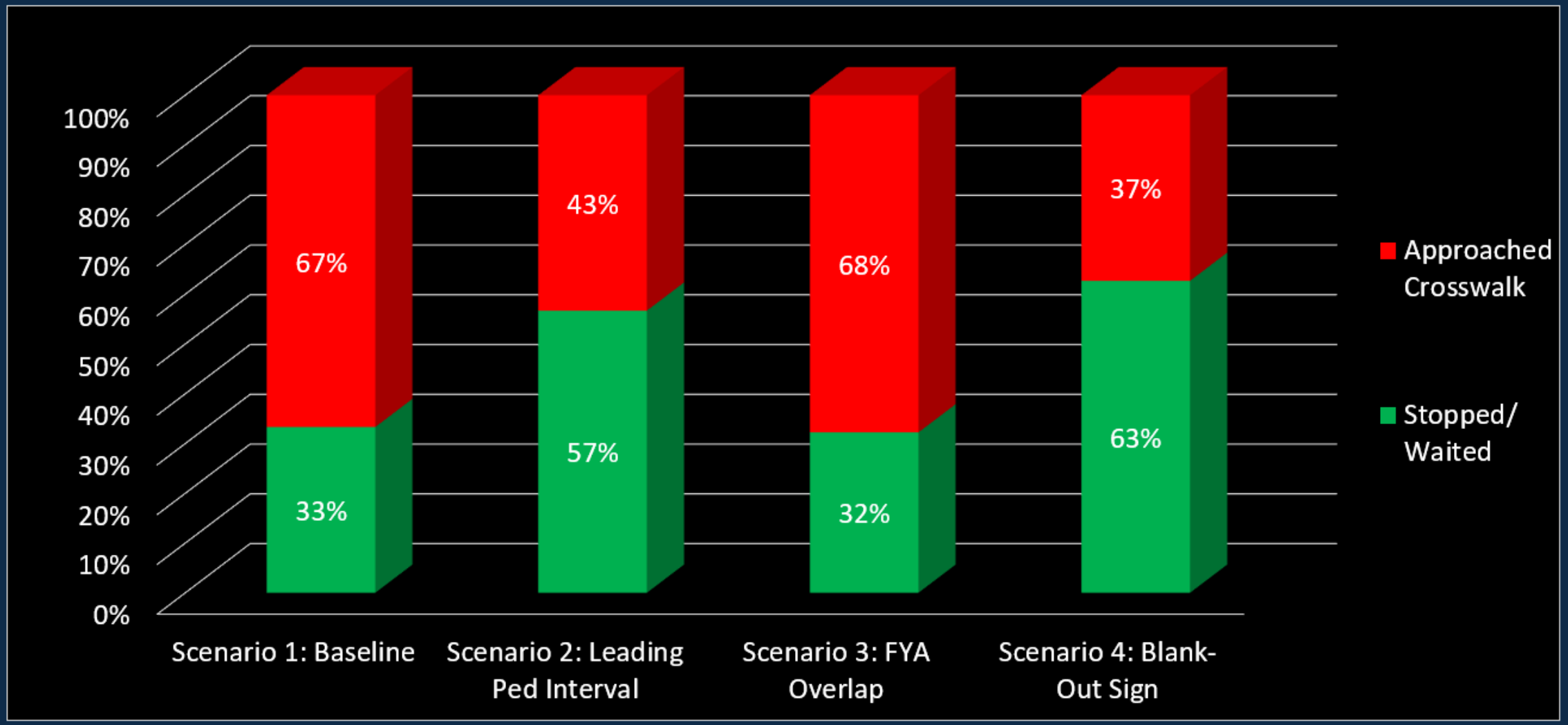
Additional Results: Right-On-Red Vehicle in Intersection on WALK



Right-on-Red: A few takeaways

- The dual message blank-out sign decreased the occurrence of drivers who legally turned right on red and subsequently ended up blocking the crosswalk when the WALK signal turned on.
- This improvement is believed to be a direct result of using the controller's "Phase Next" status to display the NO TURN ON RED message in advance of the WALK signal, which gives drivers plenty of time to observe and react to the sign.

Additional Results: SB Driver Stopping Behavior for NB Pedestrians Crossing from Opposite Corner



Crossings from Opposite Corner: A few takeaways

- There was an improvement in the percentage of drivers who stopped and waited for pedestrians crossing from the opposite corner when comparing the baseline and blank-out sign scenarios.
- This improvement is believed to be a direct result of displaying the TURNING TRAFFIC STOP FOR PEDESTRIANS message dynamically rather than statically.

Some Constraints to Consider

- Does your controller allow logic programming?
  - Probably not necessary if only displaying NO TURN ON RED concurrent with WALK (just run as an overlap or out of same channel)
  - Logic programming is essential for more advanced functions (displaying multiple messages, decoupling push buttons, utilizing Phase Next status, etc.)

Logic Gates (paraphrased)

LOGIC ARGUMENT 1:
- IF Ped Detector 4 actuated (somebody pushed the SB Ø4 push button)
- THEN latch Logic Input 1 until Channel 11 Green (latches push button)

LOGIC ARGUMENT 2:
- IF Logic Input 1 (SB Ø4 push button latched)
- AND Phase 6 Next (previous phase is in yellow & red interval)
- THEN Logic Input 2

LOGIC ARGUMENT 3:
- IF Logic Input 2 (SB Ø4 push button latched & Ø4 is next)
- OR Channel 11 Green (Ø4 WALK signal on)
- OR Channel 12 Green (Ø6 WALK signal on)
- OR Channel 5 Green (WB Left/u-turn on)
- THEN Logic Output 1 (displays NO TURN ON RED)

Logic Gates (paraphrased)

- IF Channel 11 NOT Green (if WALK signal off)
- AND Channel 11 NOT Red (if DON'T WALK signal off)
- THEN Logic Output 2 (displays STOP FOR PED)
  - Extend output 2 seconds (continues display when DON'T WALK flashes on)

Some Constraints to Consider

- Does your controller allow logic programming?

- Document, document, document!
  - Do not make your staff and/or predecessors reverse engineer your work logic programming!
  - It is highly recommended to create a plain language narrative describing the purpose and function of each logic statement.

1.3.8 LOGIC GATE #8 (WB Blank Out NTOR) (NB Blank Out NTOR)

	FUNCTION	INDEX	INVERT?	
IF	Logic Input	4		*If the Ø3 push button is latched in the active state (Logic Input 4) and the controller status is Phase 3 Next, this turns on Logic Input 8, which is used in Logic Gate 13 to drive the WB NTOR blankout message and Logic Gate 13 to drive the SB NTOR blank out message. The Channel 6 Red modifier prevents the sign from turning on if the SB vehicle signal is yellow or green to prevent driver confusion.*
AND	Phase Next	3		
AND	Channel Red	6		
THEN	Logic Input	8		

1.3.9 LOGIC GATE #9 (NB Blank Out NTOR)

	FUNCTION	INDEX	INVERT?	
IF	Channel Green	19		*This logic gate turns on the NB NTOR blank out mesage if any of the following is true:* *• the Ø2 pedestrian signal is displaying WALK; or* *• the Ø4 pedestrian signal is displaying WALK; or* *• there is a latched Ø2 pedestrian call (gate #1) and Ø2 is next (gate #5); or* *• there is a latched Ø4 pedestrian call (gate #2) and Ø4 is next (gate #6).*
OR	Channel Green	20		
OR	Logic Input	5		
OR	Logic Input	6		
THEN	Logic Output	1		

1.3.10 LOGIC GATE #10 (NB Blank Out STOP FOR PED)

	FUNCTION	INDEX	INVERT?	
IF	Channel Green	19	Y	*This logic gate detects when the Ø2 pedestrian signal indication is dark, which indicates that the flashing don't walk interval is active (or in rare cases when the signal is in flash) and subsequently turns on the NB TURNING VEHICLES STOP FOR PEDESTRIANS blank out message. The 2 second extension is necessary to prevent the message from flashing along with the FDW indication.*
AND	Channel Red	19	Y	
THEN	Logic Output	2		
Extend	seconds	2		

1.3.11 LOGIC GATE #11 (EB Blank Out NTOR)

	FUNCTION	INDEX	INVERT?	
IF	Channel Green	20		*This logic gate turns on the EB NTOR blank out mesage if any of the following is true:* *• the Ø4 pedestrian signal is displaying WALK; or* *• the Ø6 pedestrian signal is displaying WALK; or* *• there is a latched Ø4 pedestrian call (gate #2) and Ø4 is next (gate #6); or* *• there is a latched Ø6 pedestrian call (gate #3) and Ø6 is next (gate #7).*
OR	Channel Green	21		
OR	Logic Input	6		
OR	Logic Input	7		
THEN	Logic Output	3		

Some Constraints to Consider

- Does your controller allow logic programming?
- Document, document, document!
- Does your cabinet have enough output channels?
  - If not, is there an available auxiliary I/O module?
  - Consider 32-channel cabinet.
  - For this reason, Cedar Park is exclusively installing 32-channel ATC cabinets with auxiliary I/O modules at all new installations.

Some Constraints to Consider

- Does your controller allow logic programming?
- Document, document, document!
- Does your cabinet have enough output channels?
  - If not, is there an available auxiliary I/O module?
  - Consider 32-channel cabinet.
- Ensure MUTCD compliance with new signal heads.

Left-Turn Strategies to Improve Pedestrian Safety

- Cedar Park omits flashing yellow left-turn arrows during conflicting WALK and Ped Clearance intervals.
- This is highly recommended for all FYA left-turn overlaps with conflicting crosswalks.
- This may be a basic function in your controller's overlap setup (for example, it is standard in SWARCO|McCAIN's Omni eX software).

What's Next for Cedar Park?

Signal/ITS Related:

- APS deployment (In Progress)
- C-V2X & AI-based detection deployment at all signals (In Progress)
- C-V2X deployment at unsignalized crosswalks (Evaluating)
- C-V2X deployment in school zones (Evaluating)

Non-Signal Related Other Pedestrian Safety

- High Visibility Crosswalk program (In Progress)
- Sidewalk Gap Closure program (In Progress)
- New shared use paths (In Progress)

A final thought…

- My 7-year old gave this keychain to me last year for Christmas. He picked it out all by himself at his school's holiday shop, and he could barely contain his excitement when he gave it to me.
- This might have only cost $1, but it is perhaps the most valuable gift I've received. It is my constant reminder, every time I get behind the wheel, that nothing is more important than making sure I get home to the beautiful wife and four kids waiting there for me.
- I offer the same to everyone here: whether you're walking, biking, or driving, and whether it's family, friends, or co-workers, somebody is waiting for you on the other end of your trip. And the same is true for the person in the crosswalk in front of you or next to you: somebody is waiting for that person, too. Let's all work together to make sure we get where we're going safely.

Stephen Hanuscin, P.E.
Assistant Director of Public Works
City of Cedar Park
stephen.hanuscin@cedarparktexas.gov