ISOAP – Intersection Safety and Operational Assessment Process

A Safe System Approach to Identify the Best Access Solution

December 17, 2024

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ISOAP and Safe System Intersections

A proven approach and solutions that can prevent pedestrian, cyclist, and motorist deaths and incapacitating injuries resulting from severe broadside and left-turn crashes

Rachel Carpenter

Caltrans Chief Safety Officer

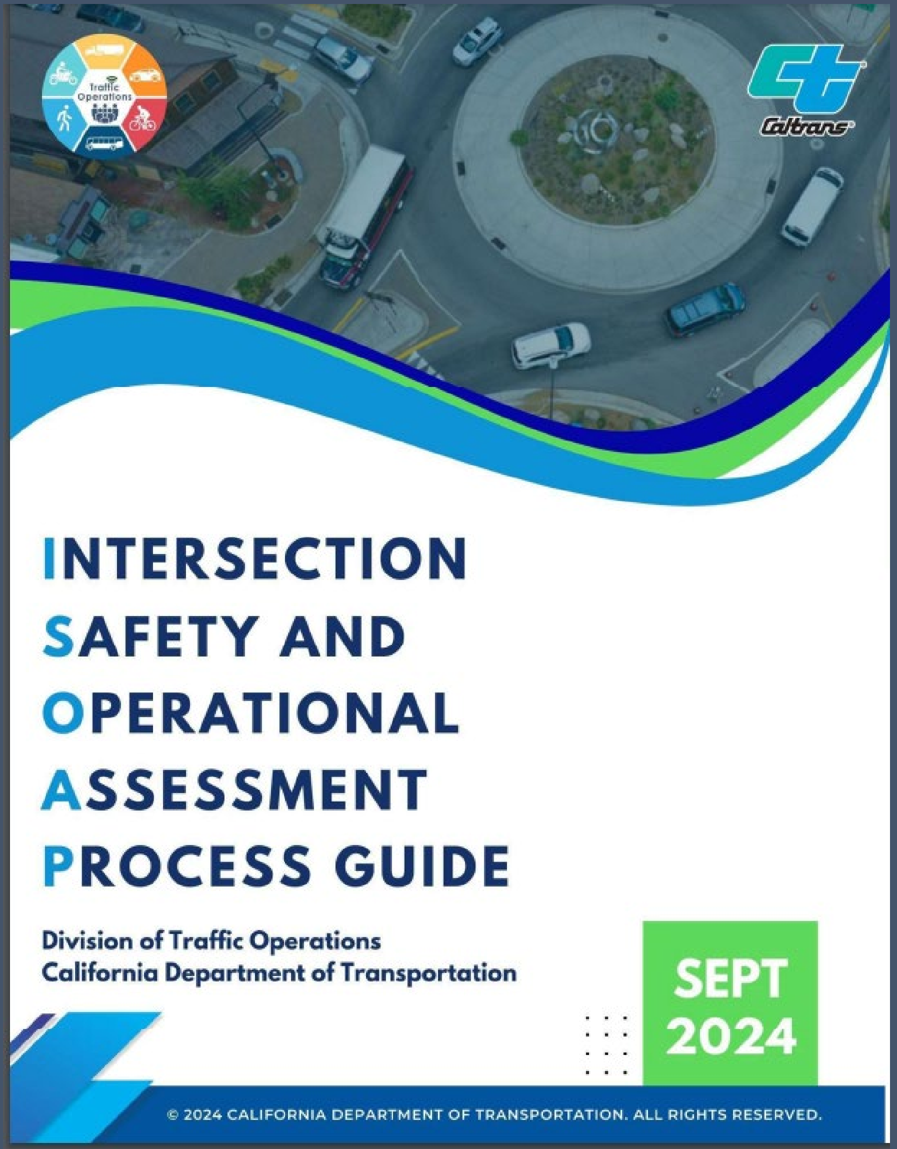
Presentation

1. Background
2. Key changes from ICE to ISOAP
3. Safe System Approach/Safe System Intersections
4. Types of intersection control and intersection forms
5. Applicability and timing of ISOAP
6. Roles and responsibilities
7. Analysis tools
8. Steps of ISOAP
9. Case studies
10. Questions and answers

1. Background

Background

- Intersection Control Evaluation (ICE) was established in a Traffic Operations Policy Directive (TOPD) in 2013
- Began update process in late 2021 with FHWA and VHB
- ICE rebranded to ISOAP, and memo signed on September 10, 2024



Intersection Control Evaluation (ICE)

- Decision-making process and framework for access strategies and control of intersections
- Emphasized context and performance rather than relying on warrants
- Not meant to create a new process, promote innovation
- 2-step process
  - Step 1: Assessment/screening
  - Step 2: Detailed analysis

Need to Update ICE

- ICE has not been updated since 2013
- New strategic direction of Caltrans
  - Complete streets
  - Director's Policy 36 on Road Safety (vision of zero road fatalities and serious injuries by 2050, adoption of Safe System Approach)
  - SB-743
  - Climate Action Plan for Transportation Infrastructure (CAPTI)
  - Caltrans System Investment Strategy (CSIS)
- 25% of fatal and serious injuries statewide at intersections

Intended ISOAP Outcomes

- Improved safety for motorists, bicyclists, and pedestrians
- More implementation of cost-effective and timely intersection improvements
- More consistent application across districts
- Improved utilization of support resources

2. Key Changes from ICE to ISOAP

Key Changes from ICE to ISOAP

- More guidance as to what to include in the analysis, including bikes, peds, transit, and freight
- Standardized forms
- Required use of Highway Safety Manual (HSM) in Stage 2 if applicable
- If short of funding for the recommended strategy, need to consider phased or interim improvements or finding additional funding

Key Changes from ICE to ISOAP

- Recommended strategy needs to support the Safe System Approach (may or may not have the highest B/C)
- District Traffic Safety Engineer concurrence for recommended strategy
- New streamlined processes for certain conditions

Streamlined Processes

1. Stop sign at new low-volume public road connection where signal warrants are not expected to be met within 20 years
2. Single lane roundabout where:
   - ADT of all approaches is less than 25,000, and
   - Signal warrants are projected to be met within 10 years or there is a high number of broadside crashes, and
   - Cost of a roundabout is comparable to signalization
   - If public concern is anticipated, evaluating alternative strategies may be required for the environmental process

3. Safe System Approach

Safe System *Intersections*

Safe System Approach

PRINCIPLES

- Death/serious injury is unacceptable
- Humans make mistakes
- Humans are vulnerable
- Responsibility is shared
- Safety is reactive & *proactive*
- Redundancy is crucial

Intersection Control Evaluation Webinar

HUMANS MAKE MISTAKES

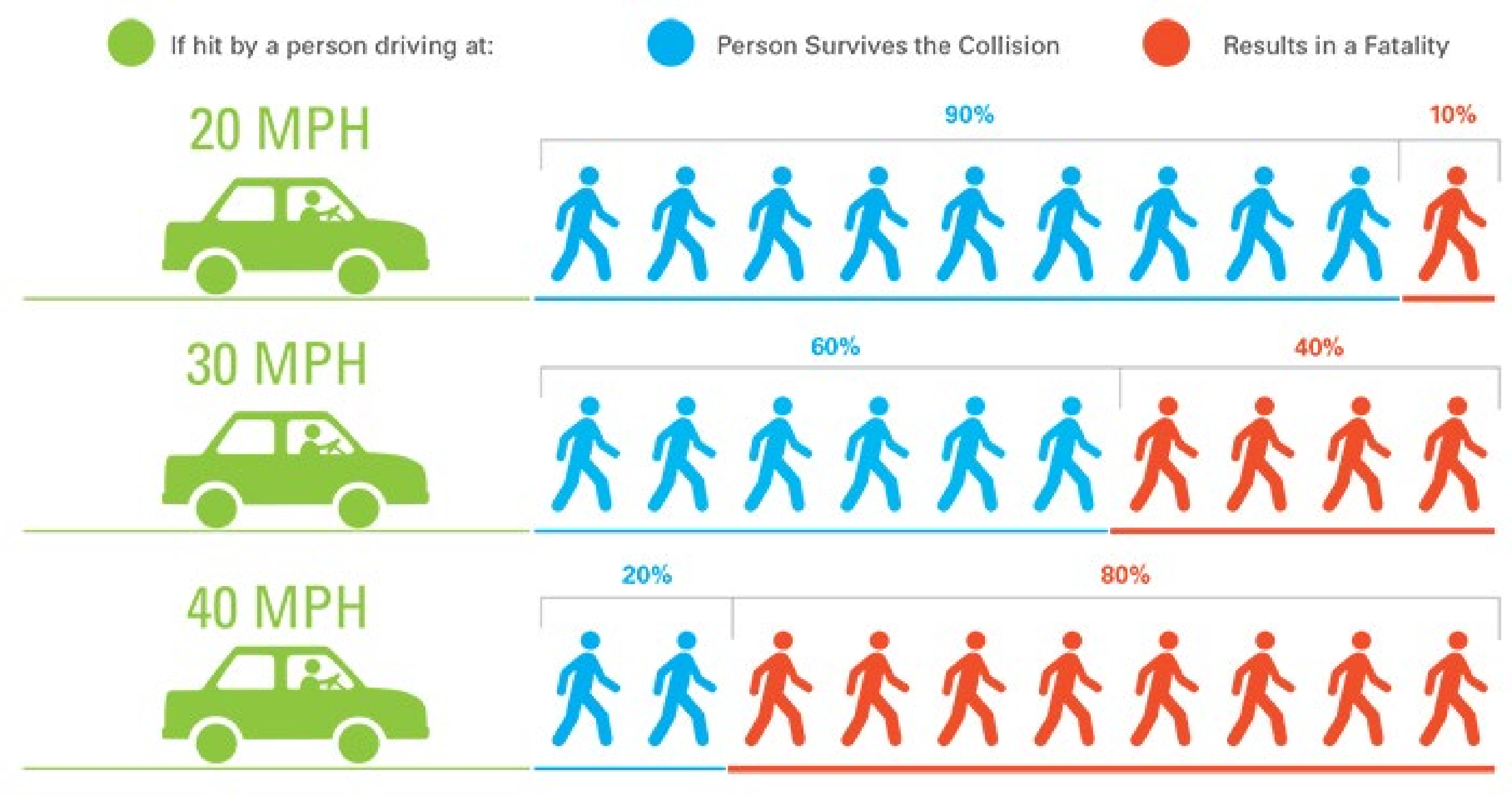
Safe System Approach

ELEMENTS

- Safe road users
- Safe vehicles
- Safe roads …
- (produce) Safe speeds
- Post-crash care

Safe System Intersections

- Reducing speeds



Source: ITE

Key to Safe Roadways: <u>Safe Speeds at Conflict Points</u>

"Speed is at the heart of a forgiving road transport system. It transcends all aspects of safety: without speed there can be no movement, but with speed comes kinetic energy and with kinetic energy and human error come crashes, injuries, and even deaths."

Organisation for Economic Co-operation and Development

Do all intersections and control strategies produce the same speed environment and other high-risk conditions?

3. Safe System Approach

3.A Safe System *Intersections*

ISOAP IS A PROACTIVE SAFE SYSTEM APPROACH

when applied to Capital Projects which include proposals to

- **Add a <u>new</u> access point** (intersection or interchange)
- **<u>Expand</u> or reconfigure existing access points**

These Capital projects are investment opportunities
for implementation of a *Safe System Intersection*
where severe crashes have and high-risk factors continue to prevail

Proposals to Add New or Expand existing Access Points

How do you identify the optimal solution or control strategy (Investment)?

TRADITIONAL APPROACH	SAFE SYSTEM APPROACH
Nominal Safety [1] →	Data-driven safety analysis
Reduce crashes →	**Prevent Death & Severe Injury**
Improve Human Behavior →	**Design for Human Mistakes**
Traffic Calming / Speed Enforcement →	**Reduce System Kinetic Energy**
Design for Peak Conditions →	Design for Peak, non-peak [2] and "dark"
Perform *Signal Warrant* Study →	**First, consider RAB** [3] & other alts
If met, then "size" & pursue project $ →	**ISOAP Step 1 to identify optimal geometry and traffic control**

[1] If *non-safety* capital project alternatives meet design standards, traffic & safety warrants - then the Alts are equally safe.

[2] Speeds are typically higher and 60% of fatal crashes occur during darkness, dawn and dusk

[3] Roundabouts do not create undesirable side-effects or traffic impacts, so their use is not governed by *warrants*. Roundabouts are also known to handle traffic volumes more efficiently, and are a *less restrictive* form of intersection traffic control (All-way Yield vs. AWSC and the required stopping at signals.

SAFE SYSTEM ALIGNMENT

Safe System Principles & Elements
Eliminate death and incapacitating injury
Humans make mistakes
Reduce impact of mistakes
Reduce Kinetic Energy Manage **Vehicle Speed** Manage **Crash Angles**
Increase Attentiveness & Awareness

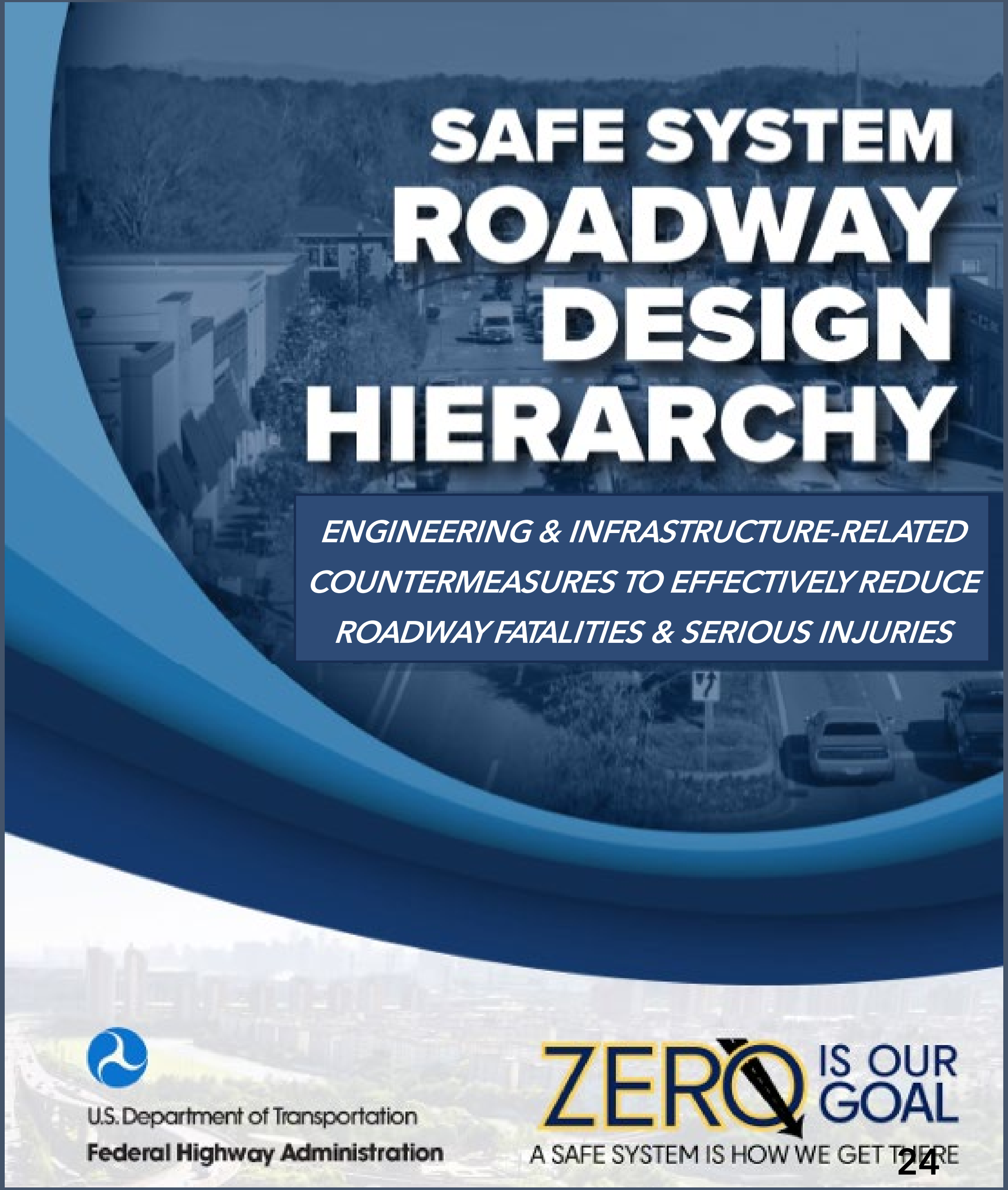
SAFE SYSTEM ***ALIGNMENT***

Safe System Principles & Elements	Signal	Roundabout
Eliminate death and incapacitating injury	**Some**	**> 90%**
Humans make mistakes	**HIGH** Potential	**LOW** Potential
Reduce impact of mistakes	✗	✓
Reduce Kinetic Energy	✗	✓
Manage Vehicle Speed	✗	✓
Manage Crash Angles	✗	✓

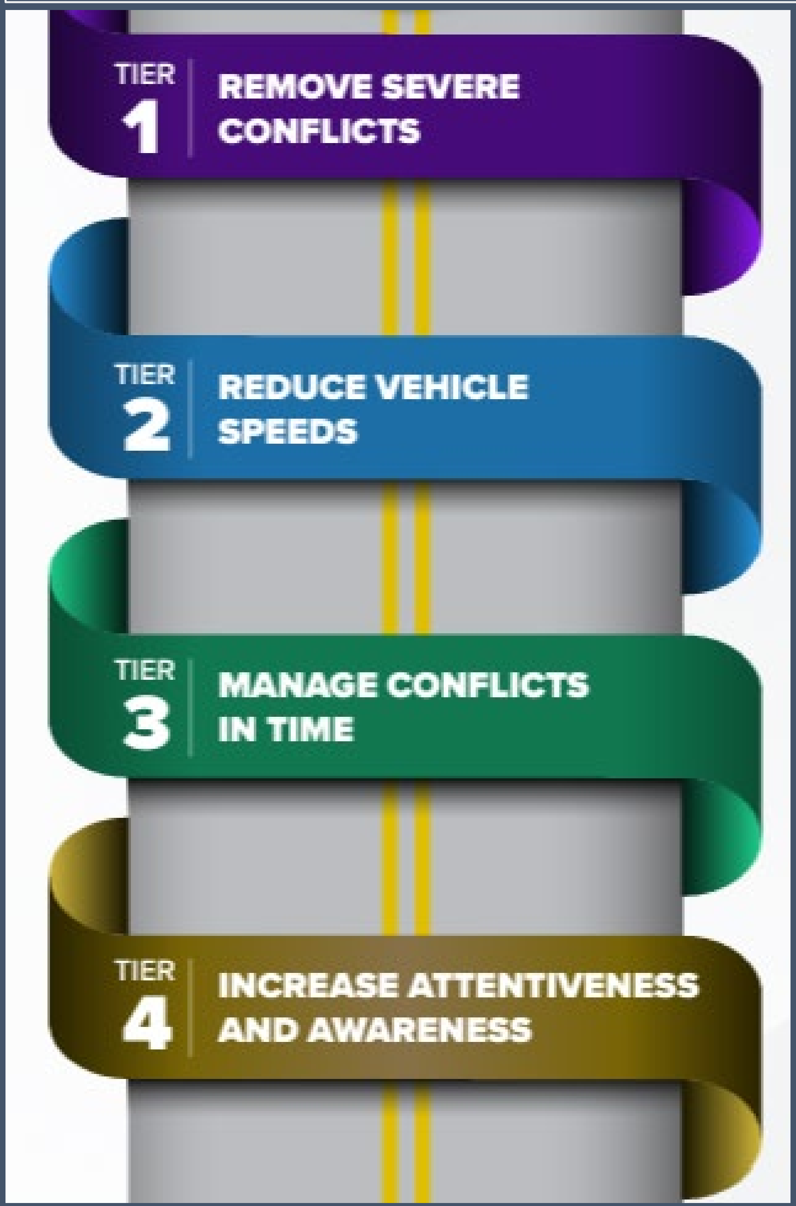
A data-based comparison of select Intersection Control Strategies

Safe System Hierarchy

- *TOOL for project site assessments*
- PURPOSE:
  - *help agencies & practitioners to identify and prioritize strategies when developing transportation projects*
- *TIERS (4)*
  - *arranged from most to least aligned with Safe System Principles*



SAFE SYSTEM ROADWAY DESIGN HIERARCHY



Removing severe conflicts involves the elimination of specific high-risk conditions, and separating road users moving at different speeds or different directions. Solutions within this tier include the elimination of at-grade RR and highway crossings, and *roundabouts* which convert vehicle angle crashes into merging and diverging crashes at low speeds

Installing design features, traffic control and speed management strategies to reduce vehicle speeds effectively reduces the kinetic energy involved in a crash (should it occur).

Managing conflicts in time creates a safer environment by separating the users in time using intersection traffic control strategies such as hybrid beacons, yield-controlled roundabouts and traffic signals

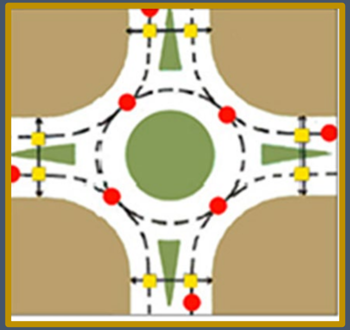
Alerting roadway users about certain conflicts is consistent with the SSA. Tier 4 strategies and countermeasures provide critical information so roadway users can take appropriate action.

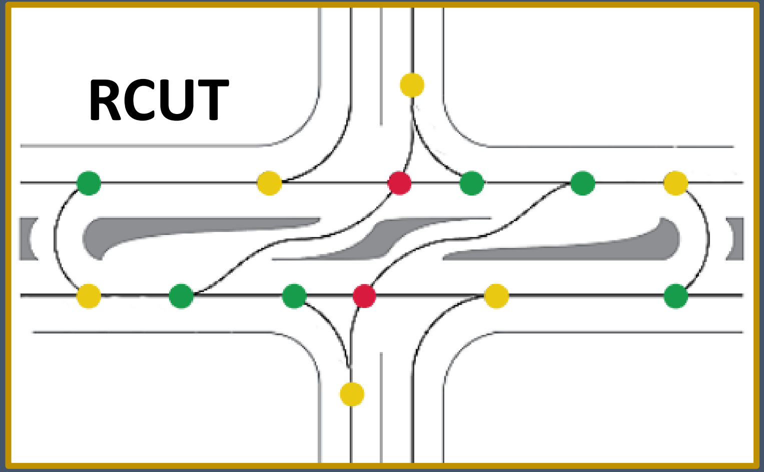
SAFE SYSTEM ROADWAY DESIGN HIERARCHY

Tier 1 Intersection Strategies & Countermeasures (Solutions)

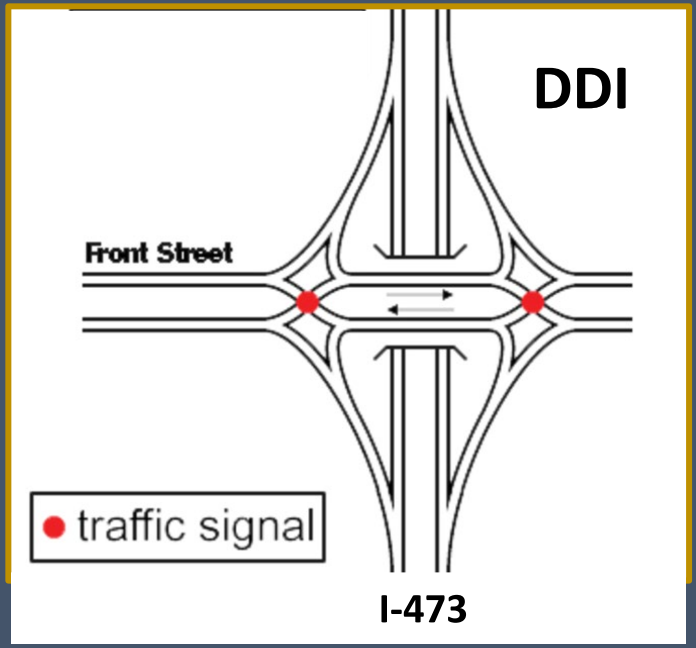
Median & Ped Refuge Islands

"When applying the hierarchy, agencies should consider countermeasures and strategies under Tier 1 *first* …"





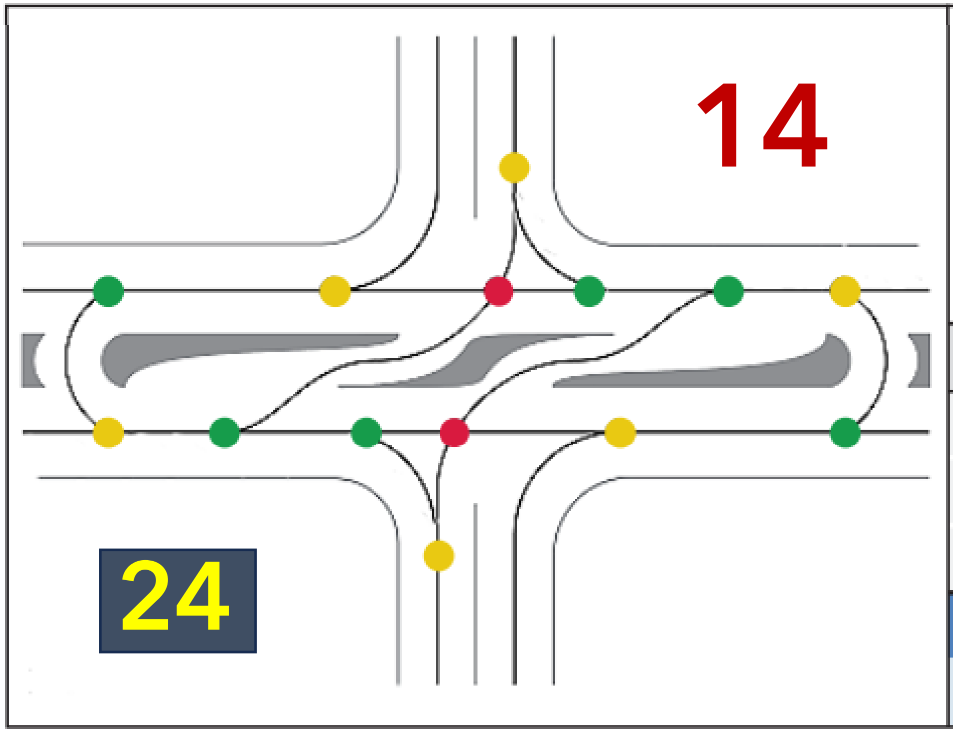
Reduced Left Turn Intersection



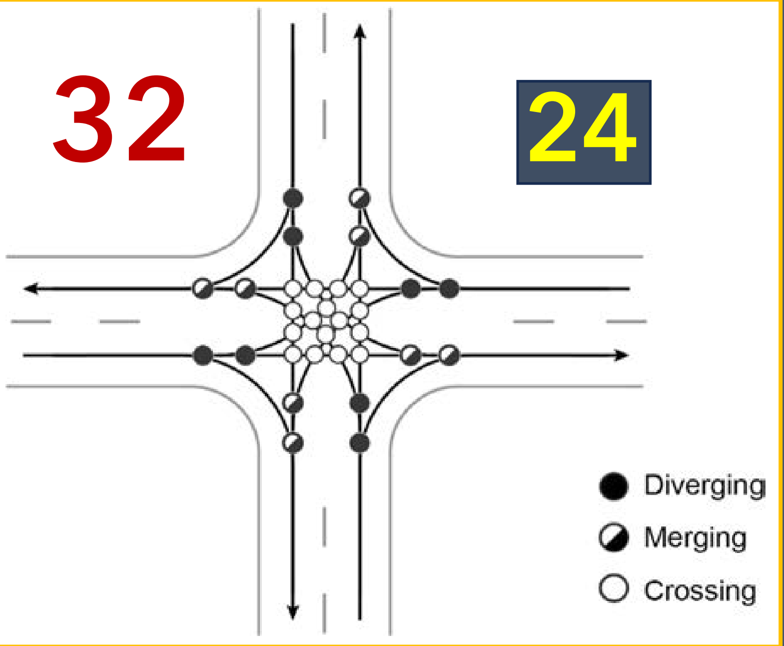
Diverging Diamond Interchange

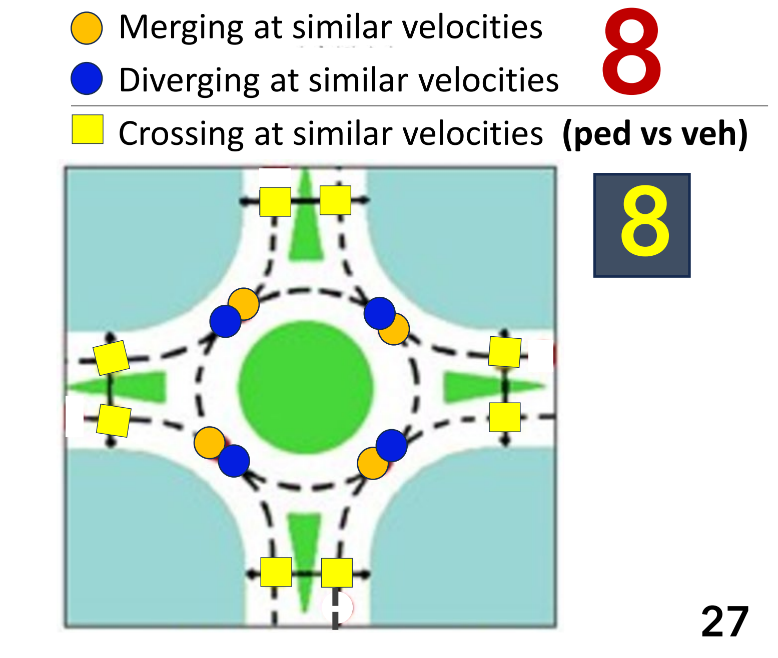
Safe System Intersections

Conflict Point Analysis (Source: FHWA)



Conflict Type	Count
Crossing	2
Merging	6
Diverging	6
Total:	
14 Conflicts	





INTERSECTIONS AS A SAFE SYSTEM STARTING POINT

- United States is only at the beginning of our Safe System journey.
- Road infrastructure characteristics (e.g., geometrics, traffic operations & control) can be assessed from a ***kinetic energy management*** perspective.
- Need to "start somewhere", so why not intersection projects?

4. Types of Intersection Control and Intersection Forms

Intersection Control Strategies

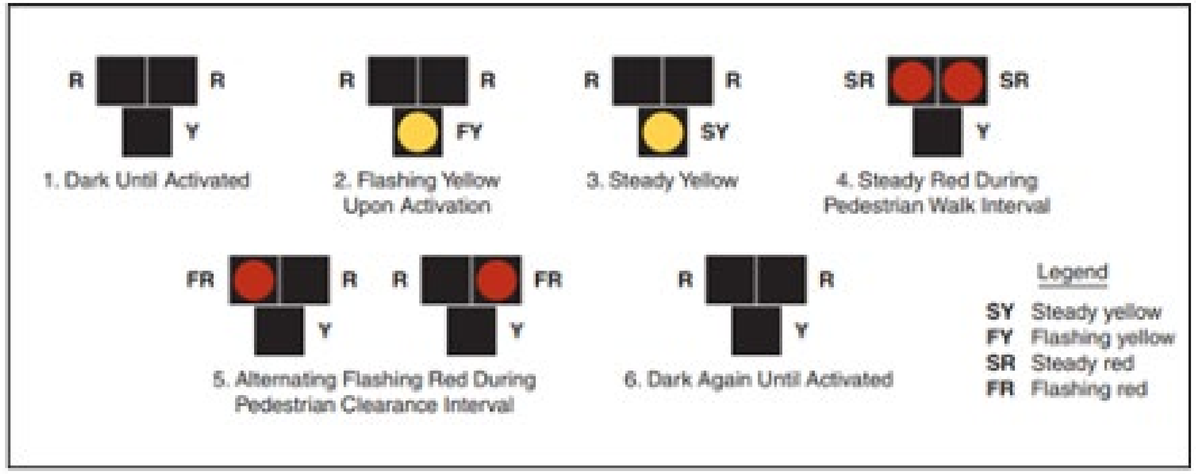
- At-grade intersections
  - Minor road stop
  - Right in/right out
  - ¾ Movements
  - All-way stop
  - Traffic signal
  - Continuous Tee signal
  - Pedestrian hybrid beacon
  - Roundabout
  - Displaced left-turn
  - Median U-turn (MUT)
  - Restricted crossing U-turn (RCUT)
  - Jughandle
  - Quadrant Roadway
  - Thru-Cut
- Grade separation (non-freeway)
  - Echelon
  - Center Turn Overpass
- Freeway interchange
  - Diverging Diamond Interchange
  - Single point
  - Diamond, partial cloverleaf

Proven safety countermeasures are shown highlighted

OFFICE OF SAFETY
Proven Safety Countermeasures

Pedestrian Hybrid Beacons

The pedestrian hybrid beacon (PHB) is a traffic control device designed to help pedestrians safely cross higher-speed roadways at midblock crossings and uncontrolled intersections. The beacon head consists of two red lenses above a single yellow lens. The lenses remain "dark" until a pedestrian desiring to cross the street pushes the call button to activate the beacon, which then initiates a yellow to red lighting sequence consisting of flashing and steady lights that directs motorists to slow and come to a stop, and provides the right-of-way to the pedestrian to safely cross the roadway before going dark again.



"Nearly 74% of pedestrian fatalities occur at non-intersection locations."

Safety Benefits:

55% reduction in pedestrian crashes.[2]

29% reduction in total crashes.[3]

15% reduction in fatal and serious injury crashes.[3]

U.S. Department of Transportation
Federal Highway Administration

OFFICE OF SAFETY
Proven Safety Countermeasures

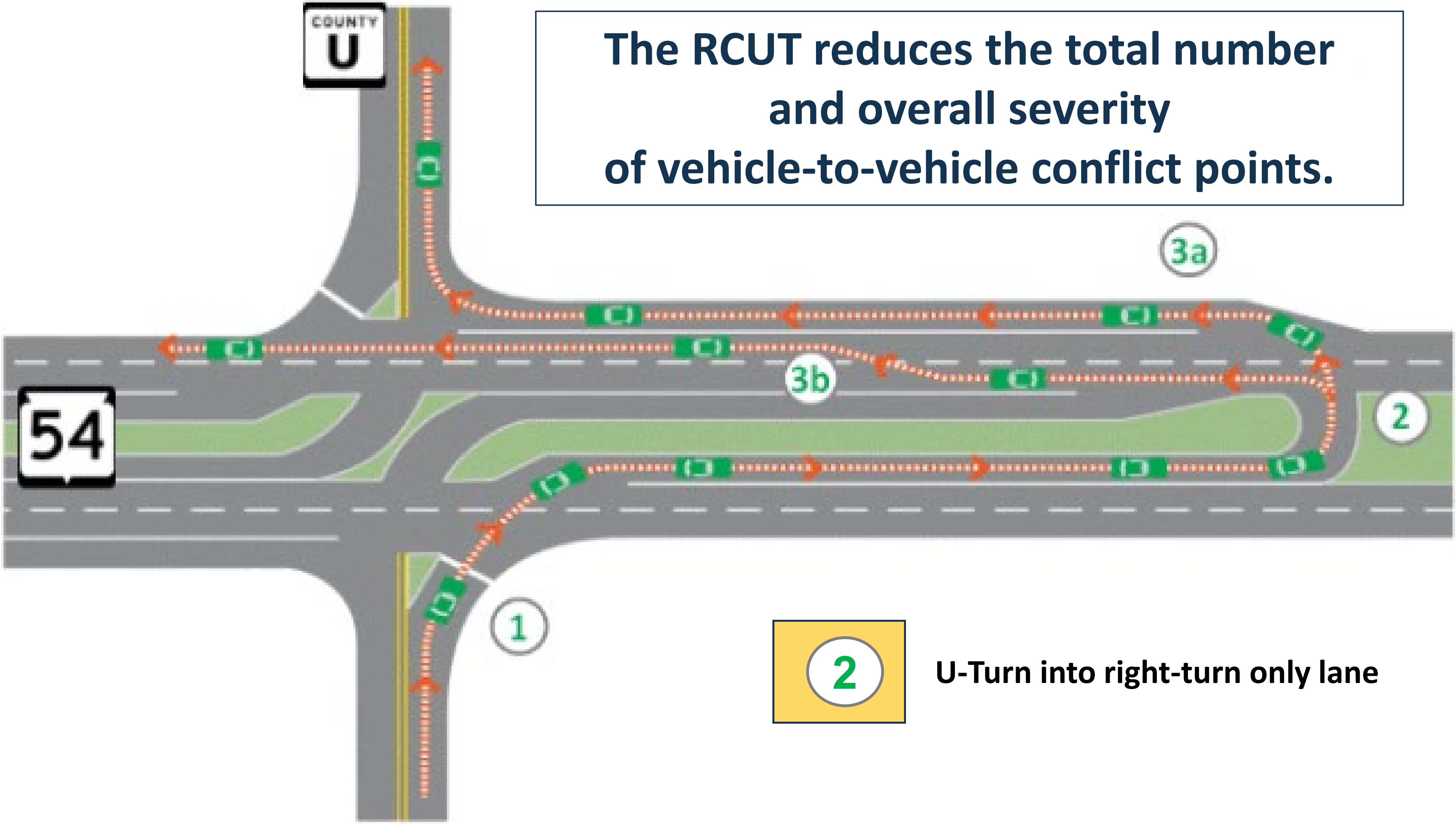
Reduced Left-Turn Conflict Intersections

Reduced left-turn conflict intersections are geometric designs that alter how left-turn movements occur. These intersections simplify decision-making for drivers and minimize the potential for higher severity crash types, such as head-on and angle. Two highly effective designs that rely on U-turns to complete certain left-turn movements are known as the Restricted Crossing U-turn (RCUT) and the Median U-turn (MUT).

Two Basic Types:
- **Restricted Crossing U-Turn (RCUT)**
- **Median U-Turn (MUT)**

Restricted Crossing U-Turn (RCUT) Intersections

The RCUT reduces the total number and overall severity of vehicle-to-vehicle conflict points.



2 U-Turn into right-turn only lane


Sheraton

SAFETY BENEFITS Restricted Crossing U-Turn (RCUT)

RCUT

Two-Way Stop-Controlled to RCUT:

54%

reduction in fatal and injury crashes.[2]

Signalized Intersection to Signalized RCUT:

22%

reduction in fatal and injury crashes.[3]

Unsignalized Intersection to Unsignalized RCUT:

63%

reduction in fatal and injury crashes.[4]

Roundabouts
virtual tour

What and *WHY* Roundabouts?

Roundabouts are a Proven Safety Countermeasure because they can substantially reduce crashes that result in serious injury or death. Roundabouts can:

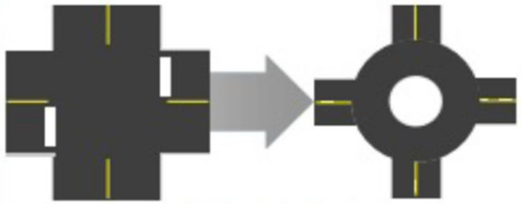
- Improve safety
- Promote lower speeds and traffic calming
- Reduce conflict points
- Lead to improved operational performance
- Meet a wide range of traffic conditions because they are versatile in size, shape, and design

What else are they?

Source:JamesBrey,E+,Getty Images

Are Roundabouts Safer than Conventional Intersections?

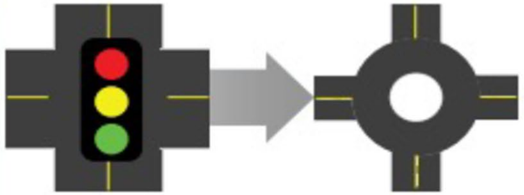
Convert TWO-WAY STOP to Roundabout Intersection



82%

Before-After Project Study RESULTS

Convert SIGNALIZED intersection to Roundabout



78%

% Reduction in Fatal and Injury Crashes [1]

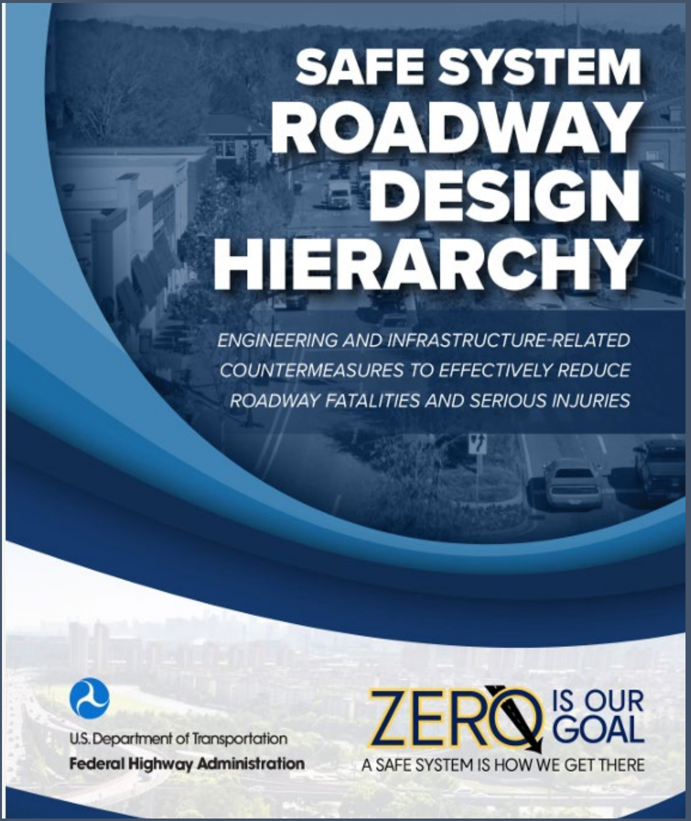
And, ***90% decrease*** **in fatal & incapacitating injury crashes**

[1] SOURCE: *Making our Roads Safer, One Countermeasure at a Time; see page 18, FHWA Publication*

- https://safety.fhwa.dot.gov/provencountermeasures/pdf/FHWA-SA-21-071_PSC%20Booklet_508.pdf

ROUNDABOUTS: SUMMARY

- **Tier 1 *SAFE SYSTEM* Intersection & *Interchange***
  - ***Proven Safety Countermeasure***



- **Remove severe conflicts from intersections**
- **Reduce number of intersection crossing conflict points**
- **Reduce vehicle speeds at conflict points (Tier 2)**
- **Create self-enforcing roads when installed in series**
- **Reduce kinetic energy** involved in a vehicle crash
- **limit pedestrian exposure** to oncoming traffic by allowing peds to cross one direction of traffic at a time with median refuge areas **(Tier 2)**

The *best* but under-utilized solution for access problems and new access proposals

… and increasingly under-utilized as costs increase

Roundabouts and Road Diets

College Street in Ashville, NC

AFFORDABLE ROUNDABOUTS
come in many shapes, sizes & materials

And can now be installed for a fraction of the funding & time required for traditional construction methods & materials

Quick Build

Temporary or Interim Installation

Cost: $10k – 100k
Time: 1 to 3 days

Mini

Diameter: 48-90'

Cost: $1M - $2M
Time: 6 to 9 mos.

MODULAR

pre-fabricated components

Cost: $100k - $200k
Time: 3 to 6 days

Affordable & Quick Build Roundabouts (Alternatives)

MODULAR: Recycled plastic components for *curbed islands*

Components shipped to, and assembled at the project site

Manufactured by ***VORTEX*** https://vortexroundaboutscom.wordpress.com

City of Cleveland, Ohio
West Franklin Blvd Mini-Roundabout Corridor Project

City of Cleveland
Franklin Blvd Mini-Roundabout Corridor Project

Finished Product

Observations and Evaluation: Large Vehicles

Observations and Evaluation: Traffic Calming Impacts and Safety

Pre-Project

Location	Direction	85th Percentile Speed (mph)
8205 Franklin Blvd.	Eastbound	32
	Westbound	36
6016 Franklin Blvd.	Eastbound	34
	Westbound	34
4610 Franklin Blvd.	Eastbound	34
	Westbound	32
3600 Franklin Blvd.	Eastbound	34
	Westbound	34
Corridor Average		34

Table 4: Measured Speeds, 2016 Speed Study

Post-Project

- Volumes dropped—from ~3900 ADT to ~1400 ADT
- Speeds slowed: 50th percentile ~22.5 mph; 85th percentile ~27
- Speed limit signage changed to 25 mph
- Crash records: too soon to say, but only 1 recorded roundabout-involved crash (PDO)

< https://www.facebook.com/watch/?v=418253114024960 >

facebook

Video Home Live Reels Shows Explore

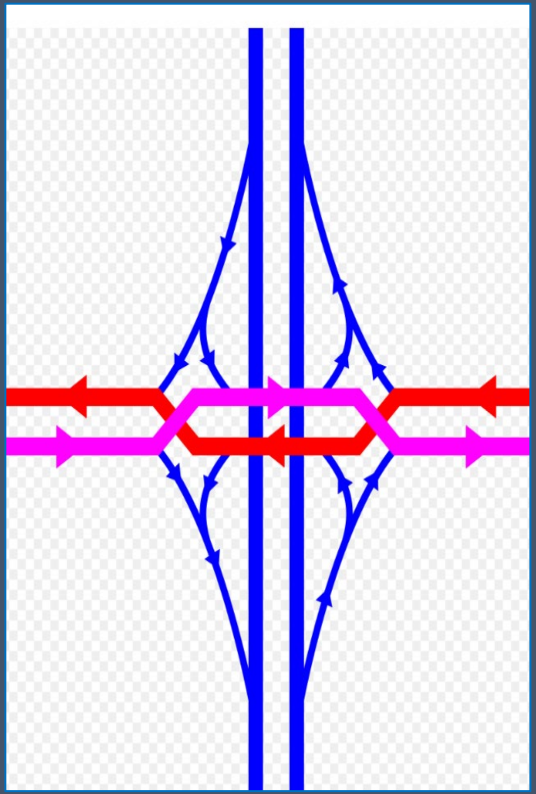
In a truly collaborative effort to calm traffic on Franklin Blvd., ODOT installed 7 mini roundabouts to encourage lower speeds. Construction...

Do Turbo Roundabout intersections produce the same kind of safety benefits as conventional roundabouts?

Potential Benefits of Turbo Roundabouts

An international crash-based safety evaluation suggests conversion of an intersection from yield-control, signalized, or old-style rotary to a turbo roundabout is associated with a 76% reduction in injury crash frequency

Diverging Diamond Interchange (DDI)



aka *Double Crossover* interchange featuring signals to control only through traffic along the local street or highway

Diverging Diamond Interchange (DDI)

aka *Double Crossover* interchange featuring signals to control only through traffic along the local street or highway

A Tier 1 *SAFE SYSTEM*
Interchange Configuration

Looks can be deceiving …

Diverging Diamond Interchange (DDI)

WHAT ARE THE BENEFITS OF DIVERGING DIAMOND INTERCHANGES?

Compared to the conventional diamond interchange, which is the most common form in the United States, the DDI reduces vehicle-to-vehicle conflict points by nearly 50 percent and eliminates most severe crash types.[9] Converting traditional diamond interchanges to DDIs at 80 locations in 24 States resulted in a 44 percent reduction in fatal and serious injury crashes when applied in urban or suburban areas with a minimum of 1,295 AADT and maximum of 76,100 AADT on arterial roadways.[10]

- **50% reduction in conflict points** (vehicle-vehicle)
- **Eliminates most severe crash types**

SAFETY BENEFITS

Convert Traditional Diamond to DDI

44% reduction

in fatal and severe injury crashes

5. Applicability and Timing of ISOAP

Applicability

ISOAP is required for the following:

- New public road, private road, or high-volume (1,000 ADT) driveway
- New freeway interchange
- Change in type of traffic control (stop, yield, signal)
- Pedestrian hybrid beacon (PHB) at an intersection
- Major physical changes to intersection approaches, such as adding a leg to an intersection or widening to provide an additional through or turn lane

Applicability

ISOAP is not required for the following:

- Changing lane configurations without pavement widening
- Minor modifications to existing traffic signals (adding or removing signal heads, modifying detection, etc.)
- Changing signal software, phasing, or timing
- Restricting movements at an existing intersection, such as prohibiting left turns or through movements

Stages of ISOAP

Stage	Typical Tools	Project Phase
Stage 1: Screening and Initial Assessment	CAP-X, SPICE	Pre-PID or PID
Stage 2: Detailed Analysis	Synchro, SIDRA, VISSIM, HSM	PA&ED

Stage 1 Screening and Initial Assessment

- Step 1.1 – Is ISOAP required?
- Step 1.2 – Determine intended project outcome, place type, design vehicle, and gather data
- Step 1.3 – Ped and bike planning and feasibility assessment
- Step 1.4 – General R/W and operational feasibility assessment
- Step 1.5 – Transit and freight assessment
- Step 1.6 – Initial safety assessment
- Step 1.7 – Eliminate infeasible strategies
- Step 1.8 – Findings and recommendations

Stage 2 Detailed Analysis

- Step 2.1 – Detailed safety analysis using Highway Safety Manual (HSM) if applicable
- Step 2.2 – Detailed operational analysis
- Step 2.3 – Functional sketches and performance checks
- Step 2.4 – Cost estimate, life-cycle costs
- Step 2.5 – Performance-based analysis matrix
- Step 2.6 – Findings and recommendation

When to Conduct ISOAP

1. Capital project
   - If a SHOPP, STIP, or locally funded projects proposes intersection changes meeting applicability criteria, Stage 1 of ISOAP would typically be done during PID development
   - Stage 2, if needed, would be done during PA&ED

When to Conduct ISOAP

2. Traffic Investigation
   - If a Traffic Investigation Report (TIR) recommends an intersection improvement meeting the ISOAP applicability criteria and a project will be initiated, then Stage 1 of ISOAP may be conducted in conjunction with the TIR and preparation of the pre-PID document (conceptual report or equivalent) <u>or</u> can be done during PID development
   - If a TIR recommends a change in intersection traffic control that would result in an installation order to be completed by Maintenance forces (for example changing a two-way stop to an all-way stop) with no additional improvements, then ISOAP should be completed in conjunction with the TIR.

When to Conduct ISOAP

3. Local Development Review (LDR)
    - If a local agency or developer proposes an intersection improvement meeting the ISOAP applicability criteria, the Traffic functional review unit should make an initial cursory assessment as to the potential viability of the proposal
    - If the proposed improvement is potentially viable, the project proponent is requested to conduct ISOAP during LDR if the QMAP (Quality Management Assessment Process) is expected to be followed for constructing the improvement
    - If a PID is to be prepared, then ISOAP may be conducted during PID development

6. Roles and Responsibilities

Roles and Responsibilities

- **Preparing (Caltrans staff or external)**
  - **ISOAP Engineer**
    - Performs the ISOAP, engages with functional units as needed, and submits completed ISOAP documents to the District ISOAP Coordinator
    - Within Caltrans, will typically be in a Traffic Operations functional unit
    - Does not need to be an engineer, but if not, should be under the guidance of an engineer
  - **Traffic Operations Engineer**
    - Performs the operational analysis

Roles and Responsibilities

- **Preparing (Caltrans staff or external)**
  - **Traffic Safety Engineer**
    - Performs the safety analysis
  - **Project Engineer**
    - Develops geometrics for alternative strategies and cost estimates for construction and right-of-way working with other functional units as needed

Roles and Responsibilities

- **Reviewing and supporting (Caltrans staff)**
  - **District ISOAP Coordinator**
    - Reviews ISOAP documents
    - Provides technical support
    - Gets concurrence by District Traffic Safety Engineer
    - Approves ISOAP submittals
    - May be the ISOAP Engineer, but an additional reviewer is recommended in such cases

District ISOAP Coordinators

District/HQ	Coordinator
1 – Eureka	Paul Hailey
2 – Redding	Frank Rivas
3 – Marysville	Scott Waksdal
4 – Oakland	Whitney Lawrence
5 – San Luis Obispo	Bing Yu
6 – Fresno	Caleb Wu
7 – Los Angeles	Wilfred Domingo
8 – San Bernardino	Siva Sivakkolunthar
9 – Bishop	Lianne Talbot
10 – Stockton	Jaime Quesada
11 – San Diego	Safwat Ibrahim
12 – Orange County	Jose Hernandez
HQ Traffic Operations	Zifeng "Lilian" Wu

Roles and Responsibilities

- **Reviewing and supporting (Caltrans staff)**
  - **District Traffic Operations Engineer**
    - Reviews traffic operational analyses
    - Provides guidance for operational analyses performed by consulting engineers or other agencies
  - **District Traffic Safety Engineer**
    - Provides guidance as needed for calculating the safety benefit
    - Reviews and concurs with the recommendations in ISOAP Stages 1 and 2

Roles and Responsibilities

- **Additional involved staff**
  - **Project Development Team (PDT)**
    - Selects the type of control and intersection configuration for STIP and SHOPP projects for project approval
    - Decisions are documented in the Project Report or other approval document

Roles and Responsibilities

- **Additional involved staff**
  - **LDR Planner**
    - Coordinates reviews of local development proposals for impacts to the operation of state highways as well as reviews of local and regional transportation plans
    - Serve as primary point of contact to local agencies for future intersection configurations, types of traffic control, and ISOAP with respect to potential improvements on state highways, in coordination with the district Traffic Operations unit responsible for LDR

Roles and Responsibilities

- **Additional involved staff**
  - **Technical Planner**
    - Projects future traffic volumes based on regional models for analyzing intersection configurations
  - **Complete Streets Coordinator**
    - Compiles complete streets needs for highways within their districts and provides recommendations for projects
  - **Permits Engineer**
    - For permit submittals through the Encroachment Permit Office Process (EPOP), Encroachment Permits staff verify that ISOAP has been completed for any applicable changes to traffic control and that a Permit Engineering Evaluation Report (PEER) is completed

7. Analysis Tools

Screening Tools

Stage 1

- Safe System for Intersections (SSI) Score Calculator
- FHWA ICE Tool
- VJuST – VDOT Junction Screening Tool

Safety Analysis Tools

<u>Stage 1</u>

- Safety Performance for Intersection Control Evaluation (SPICE)

<u>Stage 2</u>

- Highway Safety Manual (HSM)
- Caltrans Safety Index
- Caltrans ICE Collision Cost Analysis (CCA) Tool

Operational Analysis Tools

Stage 1

- Capacity Analysis for Planning of Junctions (CAP-X) Tool

Stage 2

- Highway Capacity Software (HCS)
- Synchro
- VISSIM
- SIDRA
- Rodel

Pedestrian and Bicyclist Analysis Tools

<u>Stage 2</u>

- HCM Pedestrian Level of Service (PLOS), Bicycle Level of Service (BLOS)
- Bicycle Level of Traffic Stress (LTS)
- Design Flags Calculator Tool – NCHRP Report 948, Guide for Pedestrians and Bicyclist Safety at Alternative and Other Intersections and Interchanges
  - Red flags – safety concern
  - Yellow flags – user comfort

20 Design Flags

1. Motor Vehicle Right Turn
2. Uncomfortable/ Tight Walking Environment
3. Non-Intuitive Motor Vehicle Movement
4. Crossing Yield or Uncontrolled Vehicle Paths
5. Indirect Paths
6. Executing Unusual Movements
7. Multilane Crossing
8. Long Red Times
9. Undefined Crossing at Intersections
10. Motor Vehicle Left Turn
11. Intersecting Driveways and Side Streets
12. Sight Distance for Gap Acceptance
13. Grade Change
14. Riding in Mixed Traffic
15. Bicycle Clearance Times
16. Lane Change Across Motor Vehicle Lanes
17. Channelized Lanes
18. Turning Motorists Crossing Bicycle Path
19. Riding Between Travel Lanes
20. Off-Tracking Trucks in Multi-Lane Curves

8. Steps of ISOAP

Step 1.1 Is ISOAP Required?

- Use applicability criteria
- Exceptions from conducting ISOAP for a proposed new or modified intersection meeting the applicability criteria
  - Requires approval from the Divisions of Traffic Operations and Safety Programs
  - District ISOAP Coordinator will process any exceptions

Step 1.2 Determine Intended Project Outcome, Place Type, Design Vehicle, and Gather Data

<u>Determine desired result of project</u>

- Collaborate with functional units and stakeholders
- Examples
  - Address collision pattern
  - Address excessive queuing
  - Calm traffic
  - Improve walkability

Step 1.2 Determine Intended Project Outcome, Place Type, Design Vehicle, and Gather Data

Gather available existing traffic data

- Traffic counts (ADT, peak hour, turning movement, truck, bicycle, pedestrian, etc.), roadway geometrics
- Collision data

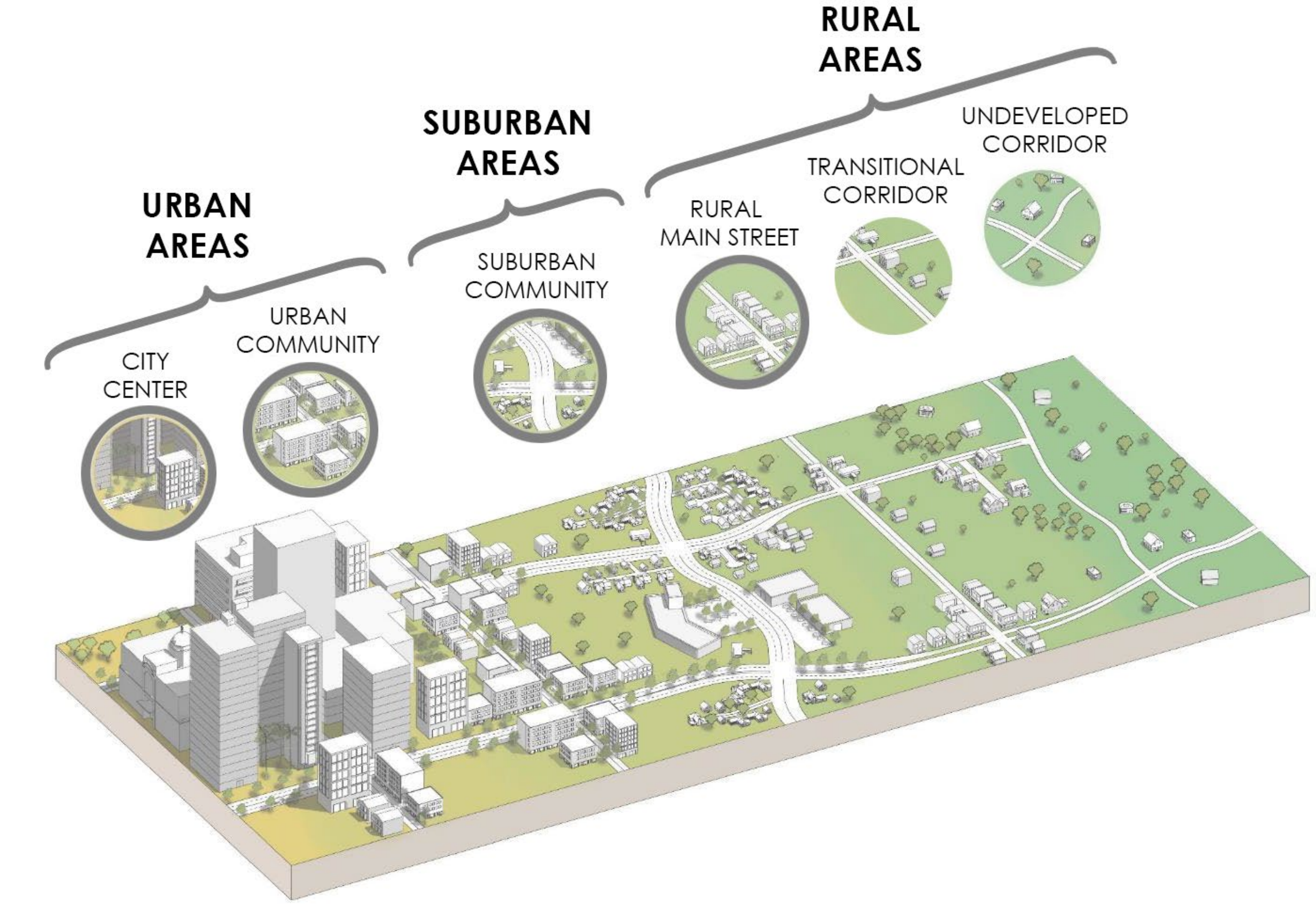
Gather planning information

- Route Concept Report, Transportation Concept Report, or Multimodal Corridor Plan
- Active Transportation Plan
- General Plan or Specific Plan

Step 1.2 Determine Intended Project Outcome, Place Type, Design Vehicle and Gather Data

<u>Determine place type</u>

- Urban areas
  - Center cities
  - Urban communities
- Suburban areas
- Rural areas
  - Rural main streets
  - Transitional corridors
  - Undeveloped corridors
- Special use areas and protected lands



Step 1.2 Determine Intended Project Outcome, Place Type, Design Vehicle, and Gather Data

Determine design vehicle

- Truck network – STAA, Terminal Access
- Consult with District Truck Access Manager (DTAM) if lesser than STAA trucks may be accommodated

Step 1.3 Ped and Bike Planning and Feasibility Assessment

- Qualitative assessment for the needs of bicyclists and peds
- Consider land use and connectivity
- Take note of schools and senior centers or housing
- Determine appropriate type of bicycle facility

Step 1.4 General R/W and Operational Feasibility Assessment

- Consider appropriate strategies to analyze
- Right of way
  - Footprint based on typical designs
  - Use Highway Design Manual (HDM) or DIB 94
  - Look for constraints
- Operational assessment
  - Use CAP-X or rules of thumb for lane configurations
  - Use more advanced tools (Synchro, Sidra) if turning movement counts are available

Optional Control Strategy Worksheet

Stage 1 Control Strategy Worksheet (Optional)					
Prepared by:				Date	
Cty-Rte-PM				Project EA	
Major Street		Existing AADT		Speed Limit	
Minor Street		Existing AADT		Speed Limit	

Control Strategy	**Is it a viable strategy? (Y/N)**	Meets intended project outcomes (Y/N)	Warrants met (if applicable) (Y/N)	Performs acceptably (Y/N)	Addresses peds and bikes (Y/N)	Acceptable impacts to R/W and env. (Y/N)
Minor Road Stop						
Right In/Right Out						
3/4 Movements						
All-Way Stop						
Traffic Signal						
Continuous Tee Signal						
PHB						
Roundabout						
Displaced Left-Turn						
Median U-Turn						
RCUT						
Jughandle						
Quadrant Roadway						
Thru-Cut						
Echelon						

Step 1.5 Transit and Freight Assessment

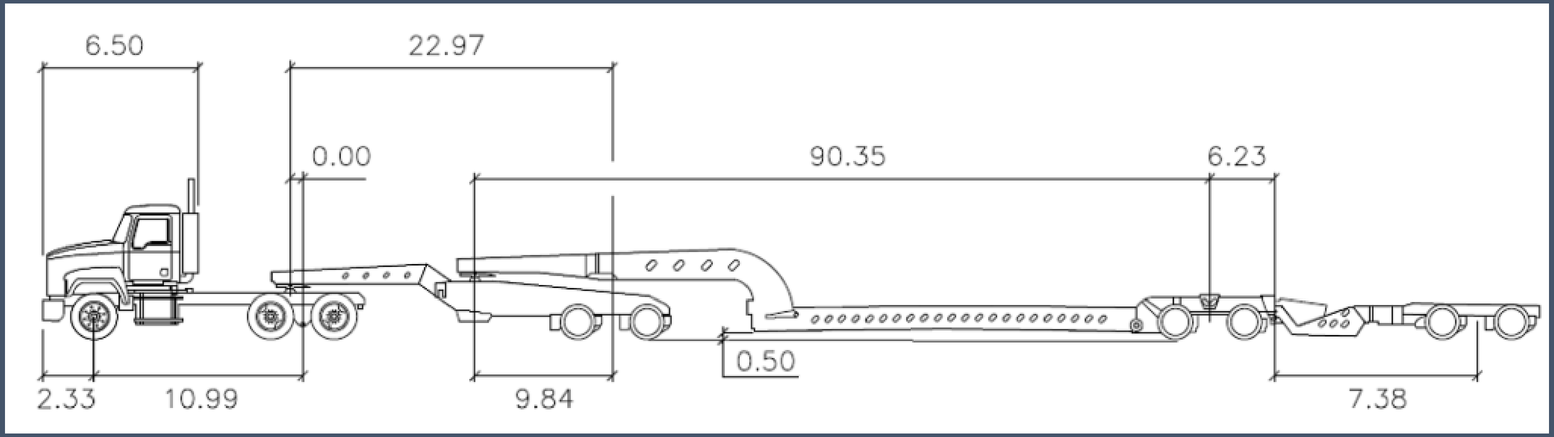
<u>Transit considerations</u>

- Existing and potential future transit needs
- Shelters and passenger queuing
- Bus bays, far side/near side, vehicle queuing

Step 1.5 Transit and Freight Assessment

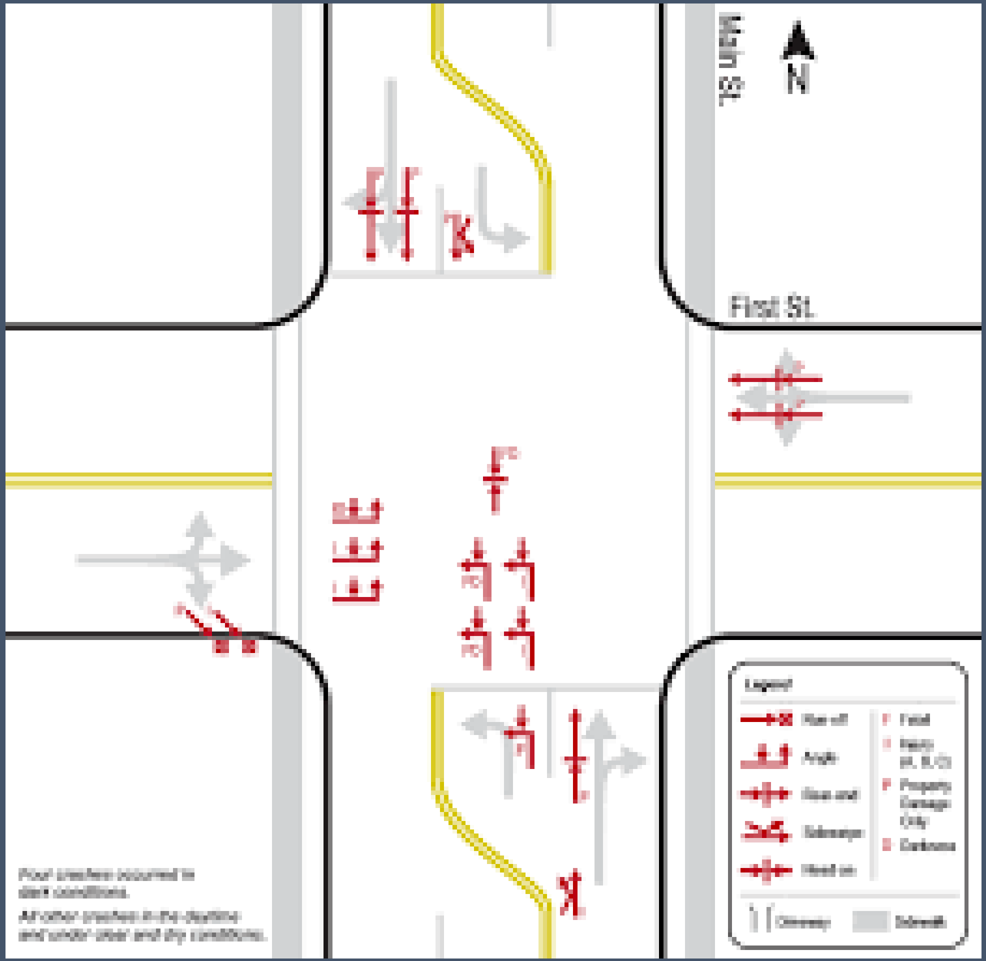
<u>Freight considerations</u>

- Design vehicle determined in Step 1.2
- Consider oversize vehicles
- Determine which movements trucks make, any potential alternate routes



Step 1.6 Initial Safety Assessment

- Consider relative safety among strategies
- Analyze existing collision history
- Can use SPICE tool, SSI methodology



Step 1.7 Eliminate Infeasible Strategies

Eliminate strategies that:

- Do not satisfy the need
- Have unmitigable environmental impacts
- Inadequately address safety
- Exceed available and potentially available funding

Step 1.8 Findings and Recommendations

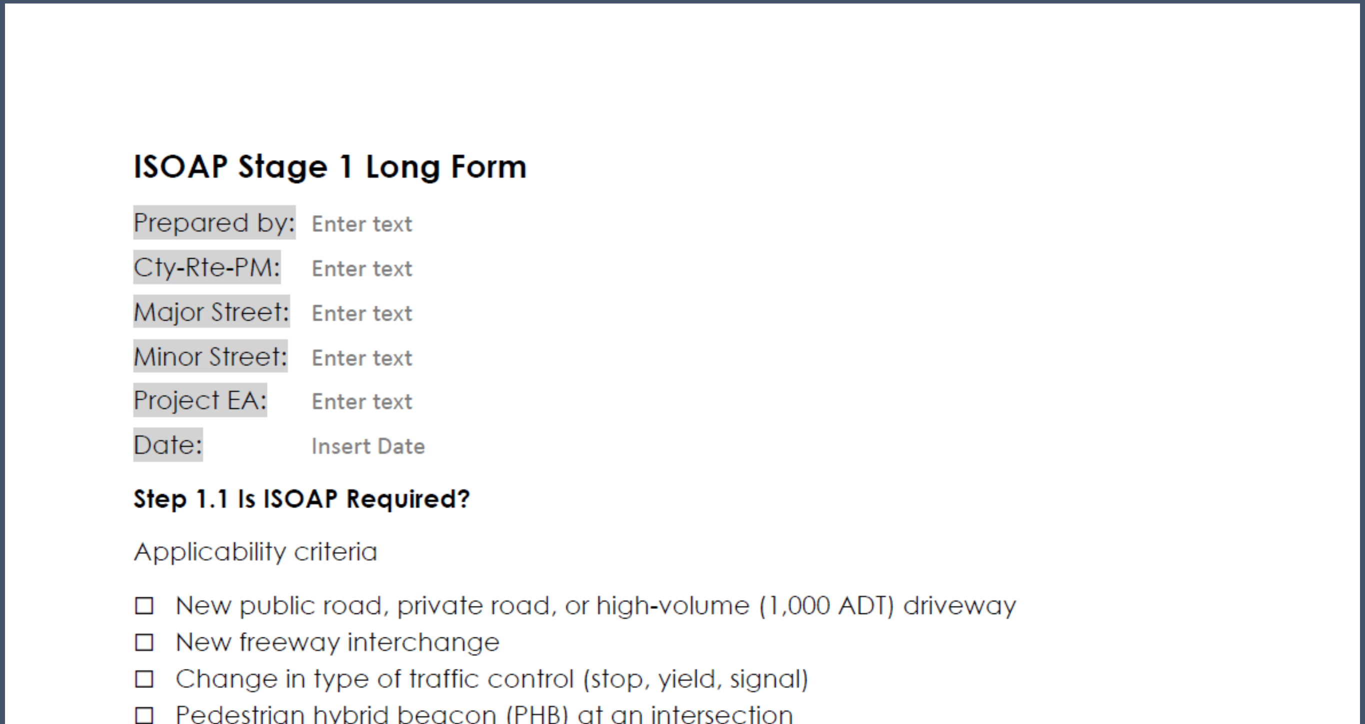
- Document findings on Stage 1 ISOAP form and submit to District ISOAP Coordinator for review
- If there is only one viable strategy but funding is insufficient, consider:
  - Other potential funding sources (SHOPP, CMAQ, Minor, ATP, measure, developer fees)
  - Phased implementation
  - Interim improvements

Step 1.8 Findings and Recommendations

- District ISOAP Coordinator and designated Traffic Operations functional manager, if applicable, reviews ISOAP forms
- If ISOAP form is satisfactory and there is only one viable strategy, ISOAP form is submitted to the District Traffic Safety Engineer for review and concurrence of recommendation
- District ISOAP Coordinator responds with comments or approval memo
- If there is more than one viable strategy, proceed to Stage 2; otherwise ISOAP concludes

Stage 1 Forms

- Fillable Microsoft Word Forms
  - Long Form with step-by-step instructions
  - Short Form for use with streamlined processes or multiple locations on a corridor



ISOAP Stage 1 Long Form

Prepared by: Enter text
Cty-Rte-PM: Enter text
Major Street: Enter text
Minor Street: Enter text
Project EA: Enter text
Date: Insert Date

Step 1.1 Is ISOAP Required?

Applicability criteria

- ☐ New public road, private road, or high-volume (1,000 ADT) driveway
- ☐ New freeway interchange
- ☐ Change in type of traffic control (stop, yield, signal)
- ☐ Pedestrian hybrid beacon (PHB) at an intersection

Step 2.1 Detailed Safety Analysis

- Quantitative safety analysis to show predicted crash frequency and severity for each strategy
- The Highway Safety Manual (HSM) is to be used where applicable
- Use Caltrans crash costs with the predicted crashes and severities to convert to a dollar amount to be used in an economic analysis
- Where the HSM cannot be used, a qualitative safety analysis may be performed by describing the safety benefits rather than doing an economic analysis

Step 2.2 Detailed Operational Analysis

- Use analysis tools such as Synchro/SimTraffic, VISSIM, Highway Capacity Software (HCS), Sidra, and Rodel
- Study area should be large enough to capture all potential impacted facilities
- Data collected during appropriate time periods, days of the week, and time of year, include pedestrians, bicyclists, transit, and freight movements

Step 2.2 Detailed Operational Analysis

- As LOS is no longer the standard performance metric, the measure of effectiveness (MOE) should be documented and may be daily person hour delay (DPHD), volume/capacity ratio, queuing, or other measure as directed by the district Traffic Operations functional manager
- The operational analysis should address accommodating queues

Step 2.3 Functional Sketches and Performance Checks

- Conceptual layout for each feasible strategy showing pedestrian, bicycle, and transit facilities
- Sufficient detail to develop a cost estimate and evaluate right-of-way and potential environmental impacts
- Performance checks for roundabouts and verifying sight distance
- Can use NCHRP 948 Design Flags Tool to evaluate bike and ped facilities

Step 2.4 Cost Estimate and Lifecycle Costs

- Cost estimate for construction and right of way for each viable strategy
- Consider traffic handling and detours
- Life-cycle costs using annual maintenance costs, including for electricity, and other periodic maintenance costs
- Crash costs

Step 2.5 Performance-Based Analysis Matrix

- Matrix showing operational and safety performance, life-cycle cost estimate, and benefit-cost ratio of each viable strategy
- Cost to State, which is the sum of the construction cost and all crashes for 20 years after opening to traffic, may be used as an alternative to the benefit-cost ratio for new construction

Step 2.5 Performance-Based Analysis Matrix

			Performance Metrics					
Improvement Strategy (Alternative)	**Capital Cost** ($)	**Service Life** (years)	***Mobility*** **Delay Benefit ($)**	***Safety*** **Crash Benefit ($)**	***Maint.*** **Cost ($)**	***Life-Cycle*** **Cost ($)**	***Other*** **Cost ($)**	**Benefit / Cost Ratio*** (BCR)
Traffic Signal								
Roundabout								
Mini-Roundabout								
RCUT								
No Build (do nothing Alt.)								

Step 2.6 Findings and Recommendations

- Highest performing strategy supporting the principles of the Safe System Approach becomes the recommended strategy, may or may not be the strategy with the highest benefit-cost ratio
- Bicycle and pedestrian accommodations and description how the Safe System Approach is supported are documented

Step 2.6 Findings and Recommendations

- Cost may exceed the available funding, and additional funding sources and phased implementation or interim improvements should be considered in such cases
- Completed Stage 2 ISOAP form is submitted to the District ISOAP Coordinator for review and approval by the designated Traffic Operations functional manager
- If satisfactory, Stage 2 ISOAP form is submitted to the District Traffic Safety Engineer for review and concurrence

Step 2.6 Findings and Recommendations

- District ISOAP Coordinator responds with comments or approval memo, and ISOAP concludes

Stage 2 Form

- Fillable Microsoft Word Form

ISOAP Stage 2 Form

Prepared by: Enter text

Cty-Rte-PM: Enter text

Major Street: Enter text

Minor Street: Enter text

Project EA: Enter text

Date: Insert date

Step 2.1 Detailed Safety Analysis

Use Highway Safety Manual (HSM) if applicable. Use Caltrans crash costs with the predicted crashes and severities to convert to a dollar amount to be used in an economic analysis. Where the HSM cannot be used, a qualitative safety analysis may be performed by describing the safety benefits rather than doing an economic analysis.

Comments: Enter text

Step 2.2 Detailed Operational Analysis

Public Outreach

- The planning and project delivery processes incorporate public outreach
- Additional public outreach beyond the planning and project deliver activities may be needed
- Education may need to be provided to local officials or the public for novel or unfamiliar forms of intersections

9. Case Studies

Key messages:

- The cost of modular roundabouts makes them easy to support
- Modular removability makes it easy to avoid overbuilding capacity
- Roundabouts embody both safe-systems fundamentals
- Roundabouts are the only intersection control that doesn’t require a safety vs efficiency tradeoff

People support saving $, and 10x-20x your impact

Perimeter-only

Parts are interchangeable

Use today's traffic volumes (easily removed)

- Don't overbuild for the future: 1 lane is smaller/simpler/safer
- Most expandable roundabouts have not needed to expand

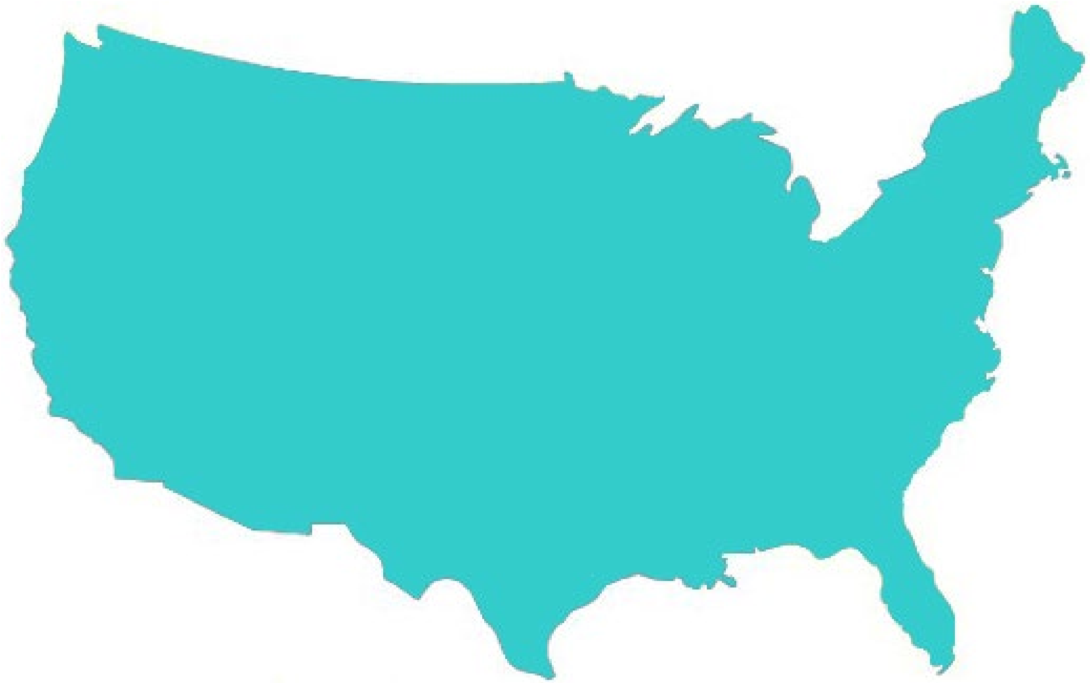
- All-way stop – removed 2 bypass lanes (1st modular)
- All-way stop – removing 2 through lanes (2nd modular)
- With same lanes: roundabouts handle more traffic than signals

- Calibrated capacity https://rosap.ntl.bts.gov/view/dot/27665

Page vii (pdf page 10)

Single-lane: $c = 1440 \cdot \exp(-0.0010 \cdot v_c)$

What is the traffic signal's track record?



10,000+ roundabouts

Many 20+ years old

90%-100% elimination of fatal crashes

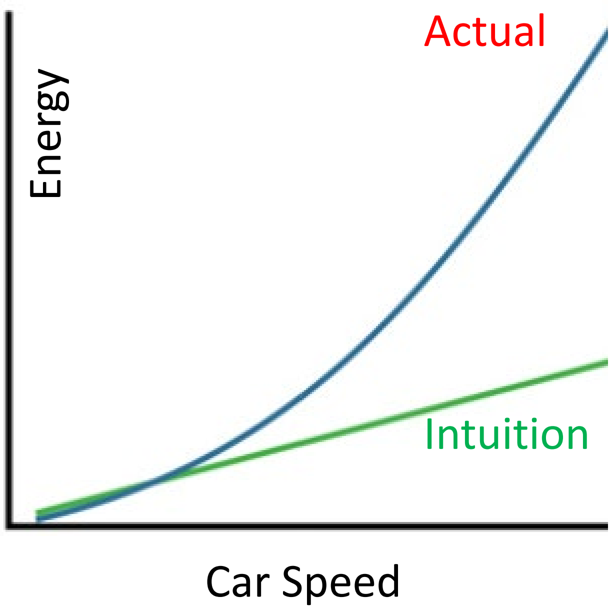
<u>ZERO fatal crashes in crosswalks</u>

https://usa.streetsblog.org/2022/09/21/study-some-roundabout-designs-slash-crash-injuries-up-to-85 KSU listserv

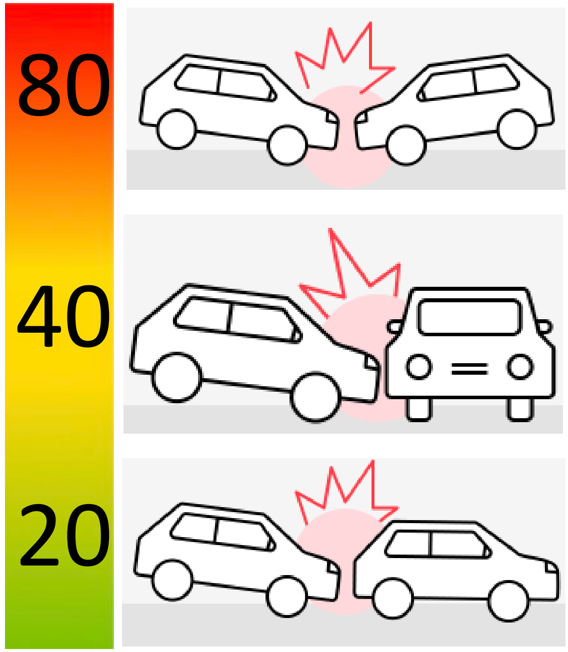
What makes a System Safe? 2 tests.

- **People Make Mistakes.** Is there redundancy?
- **People Are Vulnerable.** Is crash energy low?

Square of speed



Angle



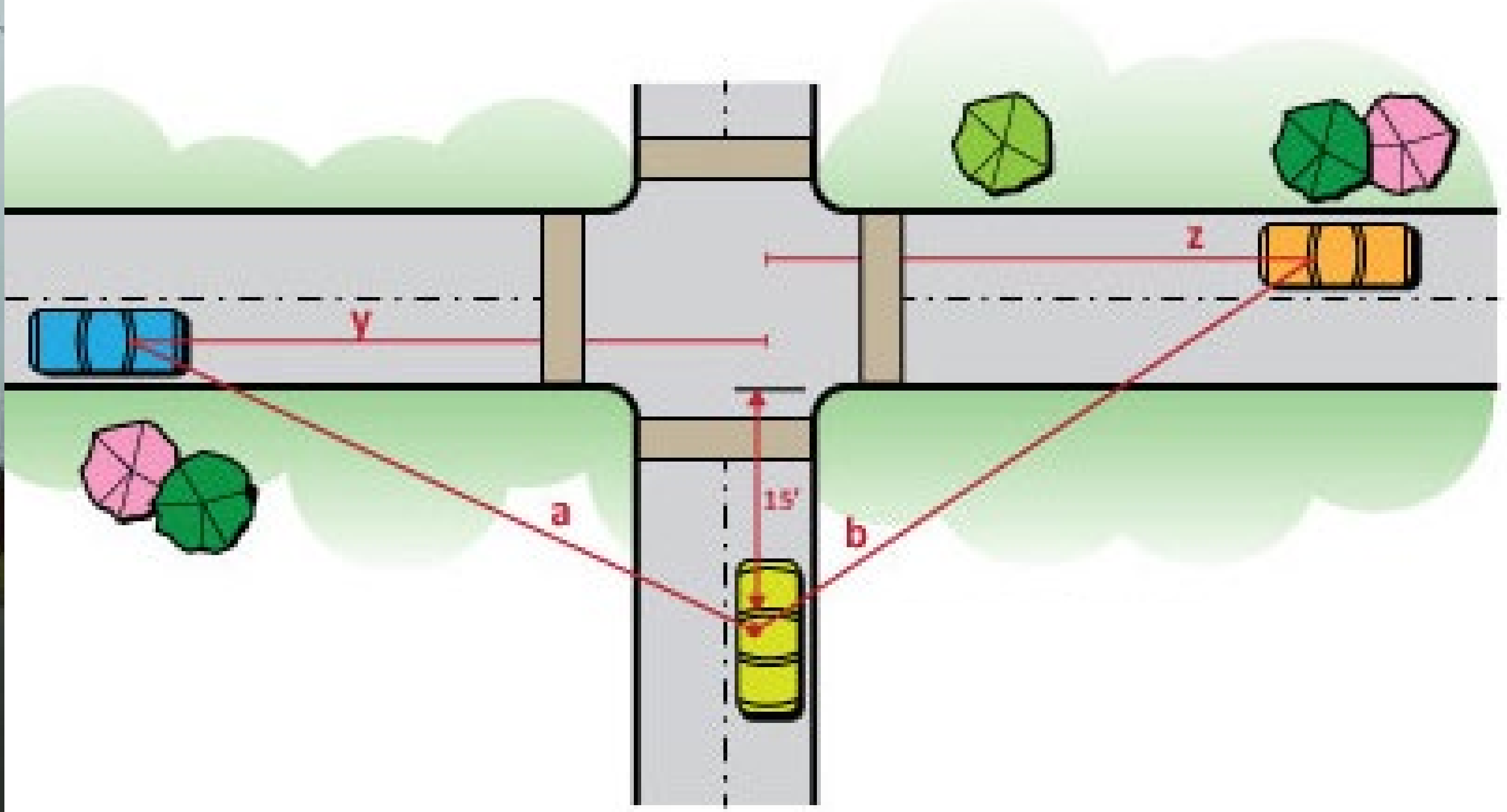
40+40

40+0

40-20

People Make Mistakes. Spot it. Compensate.

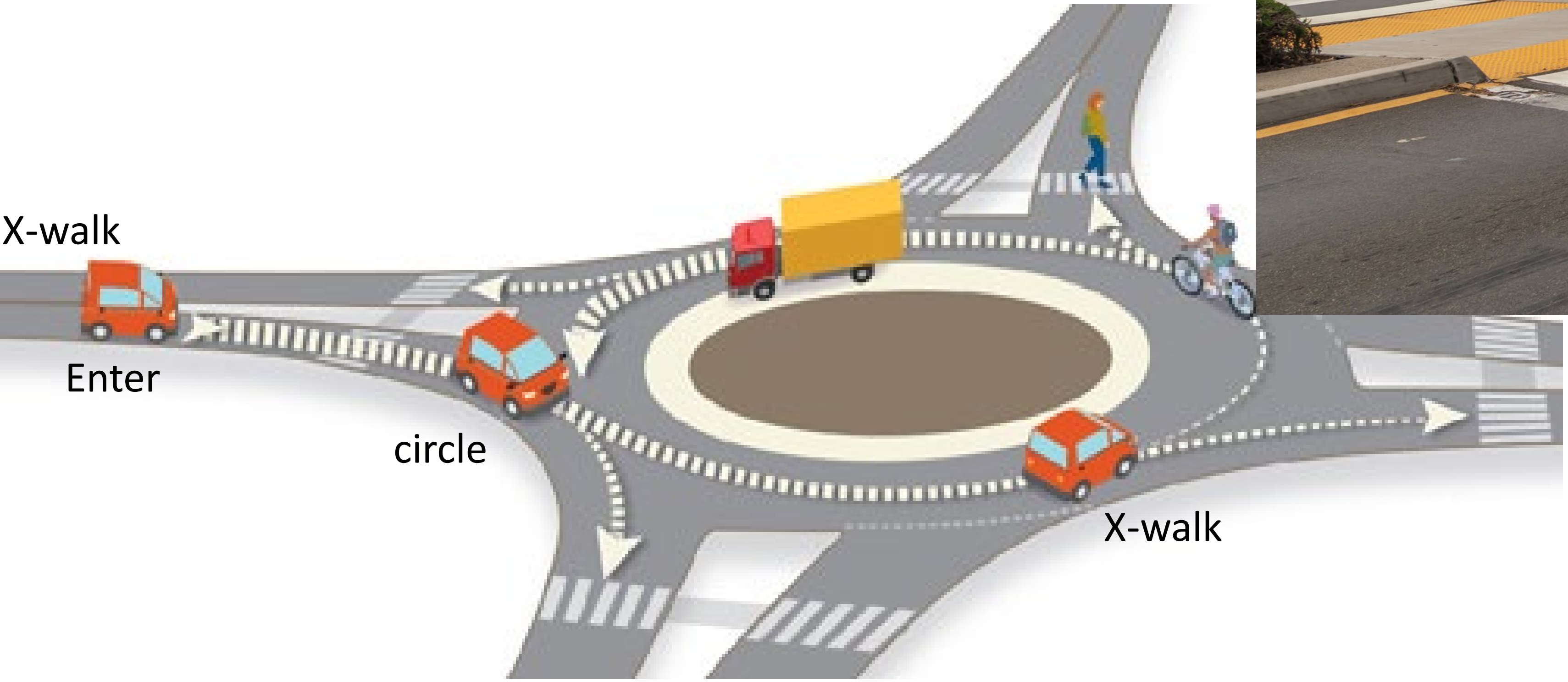
Look both ways at the same time



Add redundancy (no single point of failure).

Direct and in front.

One decision at a time.



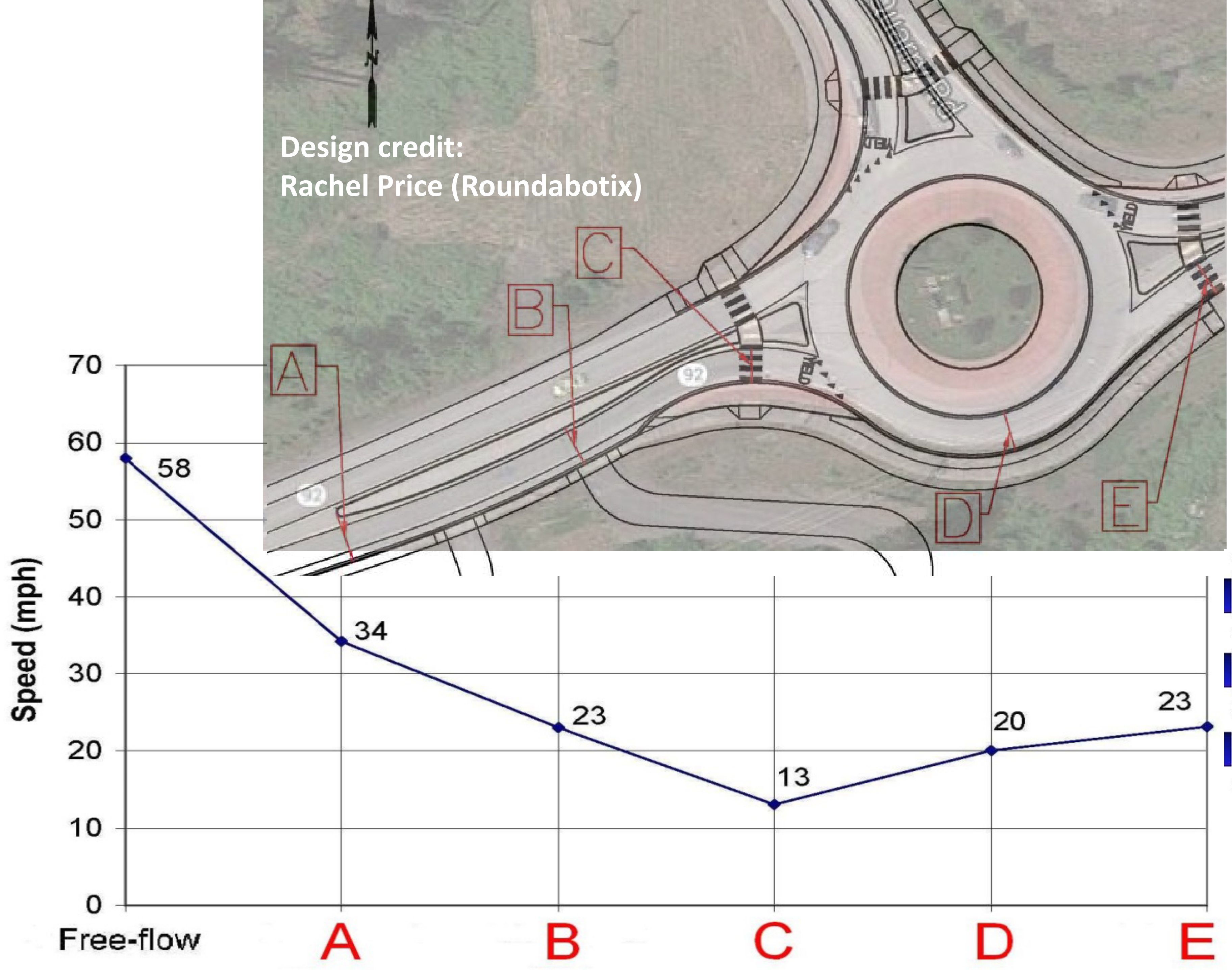
Safe System? (Can I compensate for their mistake?)

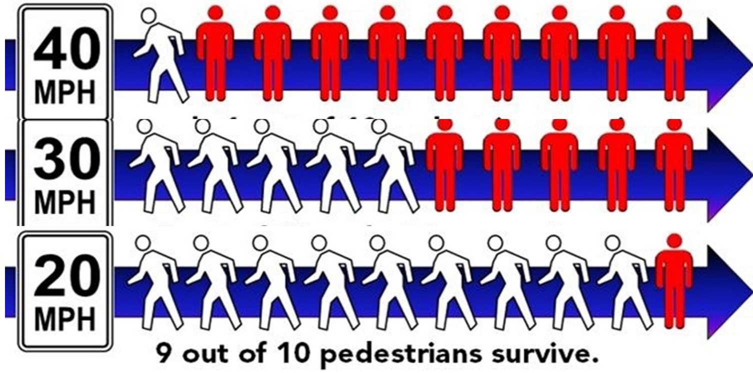
x fail

✓ pass

Photo credit Patrick McGrady

Low speed.


Design credit:
Rachel Price (Roundabotix)
Speed (mph)
70
60
50
40
30
20
10
0
58
34
23
13
20
23
Free-flow
A
B
C
D
E


40 MPH
30 MPH
20 MPH
9 out of 10 pedestrians survive.

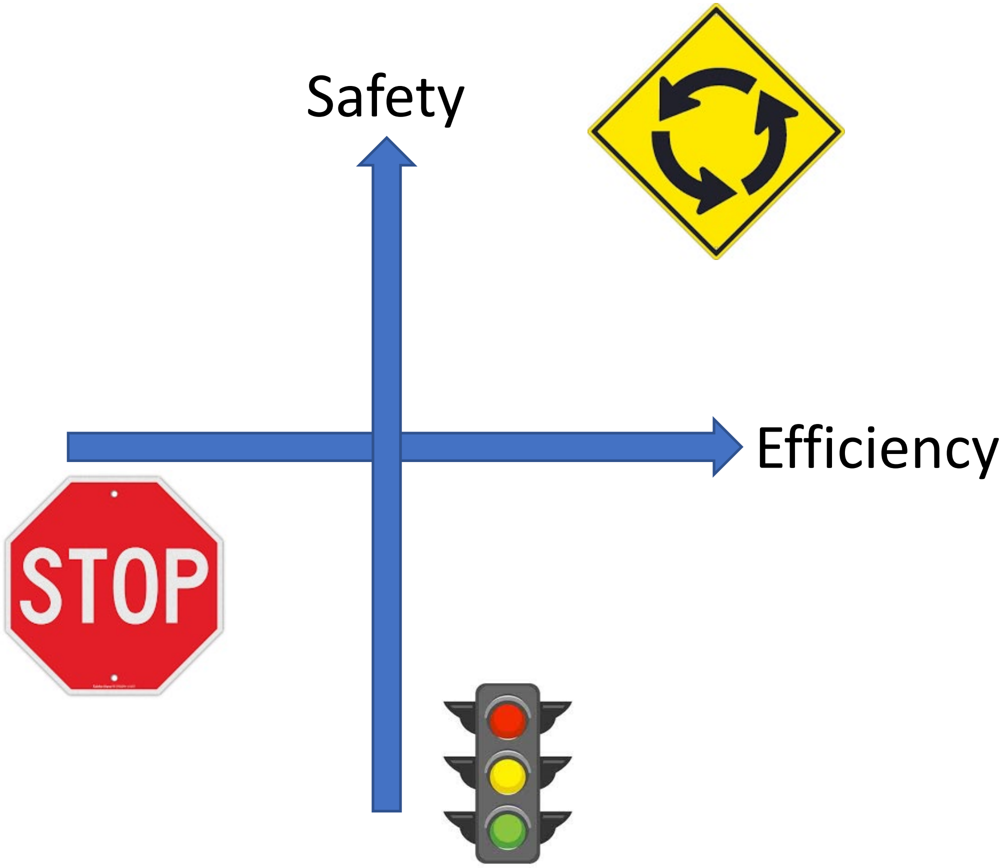
Safe System? (Low energy?)

x fail

✓ pass

Photo credit Patrick McGrady

Roundabouts are unique:
Safety AND delay improve
Slow AND less travel time?



Case Studies

1. **Urban roundabout**
   Fre-33 and Fre-180 in Mendota
2. **Urban roundabout with road diet**
   Mad-145 at C Street in Madera
3. **Suburban PHB**
   Fre-180 at 1st Street in Kerman
4. **Rural RCUT**
   Tul-198 at Road 182 in Tulare County
5. **Suburban diamond interchange with roundabouts**
   Tul-99 at Paige Avenue in Tulare

Case Study 1: Urban Roundabout vs Signal (Jct 33/180 in Mendota)


Route 33
Route 33
Route 180

Stage 1 Screening and Initial Assessment

- **Step 1.1 – Is ISOAP required?**

  Yes, change in traffic control is proposed.

- **Step 1.2 – Determine intended project outcome, place type, design vehicle, and gather data**

  Relieve congestion, particularly for school traffic. Place type is urban community. Design vehicle is STAA truck as Routes 33 and 180 are STAA Terminal Access routes. The 2035 Concept and Ultimate Transportation Corridor (UTC) for Route 33 are both 4-lane conventional highway and for Route 180, 4-lane conventional highway and 4-lane expressway, respectively.

Stage 1 Screening and Initial Assessment

Route 33 AADT: 5,000 (south leg), 13,500 (north leg)
Route 180 AADT: 11,700

- **Step 1.3 – Ped and bike planning and feasibility assessment**
  There is no notable pedestrian or bicycle activity at the intersection. Immediate vicinity is expected to remain agricultural.

- **Step 1.4 - R/W and operational feasibility assessment**
  There is a fire station at the NW corner and school at the SW corner of Route 33 and McCabe Ave.

Stage 1 Screening and Initial Assessment

Signal Warrants 1 (Eight Hour Vehicular Volume), Warrant 2 (Four Hour Vehicular Volume), Warrant 3 (Peak Hour) are satisfied.

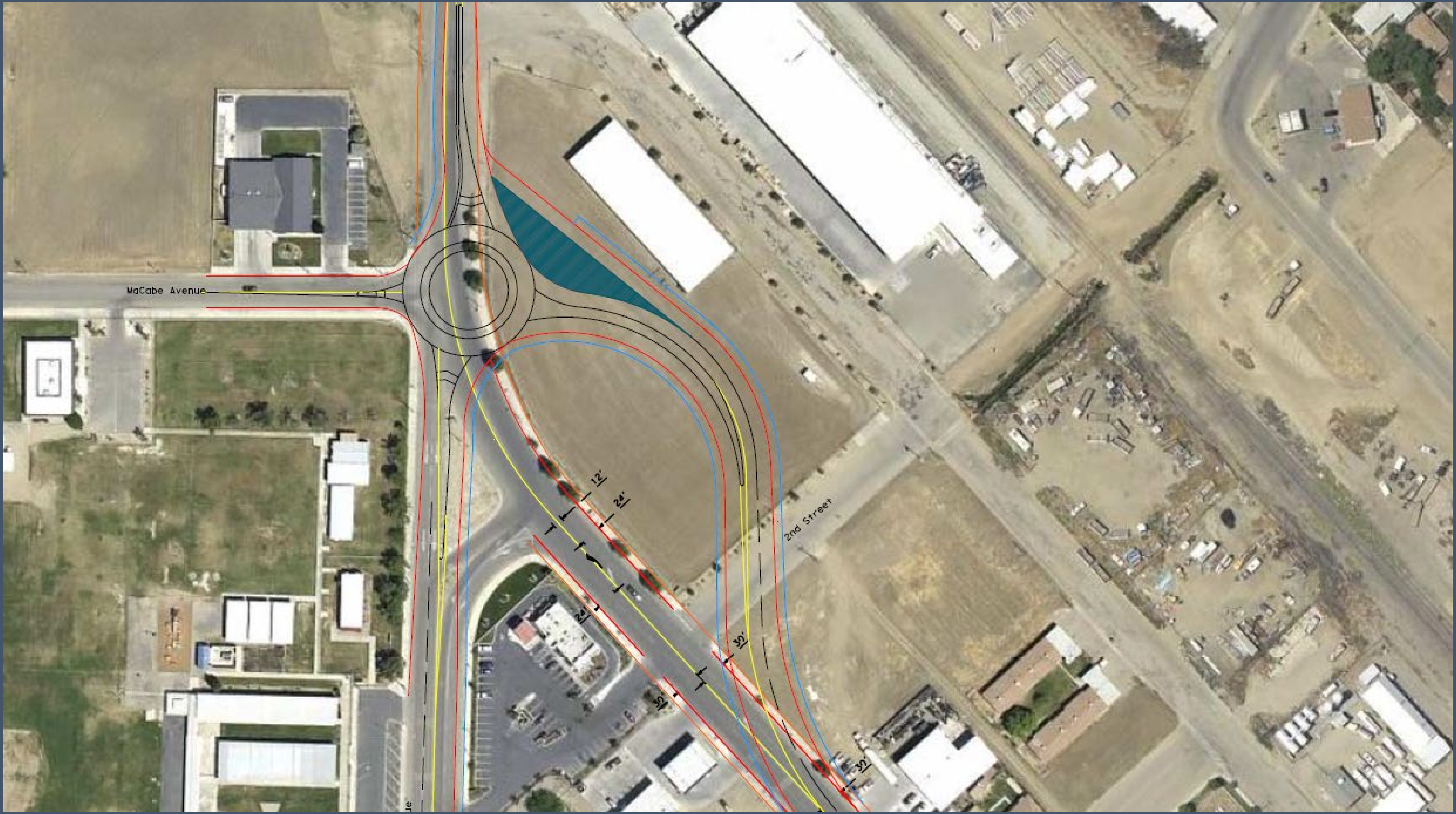
<u>Synchro – Signal – HCM6</u>

2016 AM - LOS D – 45.3 sec
2016 PM - LOS E – 62.4 sec
2036 AM - LOS F – 189.6 sec
2036 PM - LOS F – 276.9 sec

<u>Sidra – Roundabout</u>

2016 AM - LOS A – 7.9 sec
2016 PM - LOS A – 9.2 sec
2036 AM - LOS D – 33.9 sec
2036 PM - LOS F – 95.6 sec

–


MaCabe Avenue
2nd Street
12'
24'
24'
30'
30'
30'


SR 33
Sorensen Ave
Naples St
McCabe Ave
33
Oller St
180
SR 33
SR 180
Burger King

Stage 1 Screening and Initial Assessment

- **Step 1.5 – Transit and freight assessment**

  There is currently only one round trip fixed route bus trip in the morning on Route 180 between Firebaugh and Fresno, and another round trip in the afternoon.

  Both Routes 33 and 180 are STAA Terminal Access routes. Large agricultural equipment passes through the intersection. A booster truck should be accommodated.

Stage 1 Screening and Initial Assessment

- **Step 1.6 – Initial safety assessment**
  There is no history of collisions at Jct 33/180 or Route 33 at McCabe Avenue.

- **Step 1.7 – Eliminate infeasible strategies**
  Neither the roundabout nor traffic signal is rejected.

- **Step 1.8 – Findings and recommendations**
  Proceed to Stage 2 due to controversy regarding roundabout.

Stage 2 Detailed Analysis

- Step 2.1 – Detailed safety analysis using Highway Safety Manual (HSM) if applicable

HSM

UrbanSuburbanArterials_v3.2_GLopez_Ex3STInt2.xlsx - Read-Only • Saved to this PC

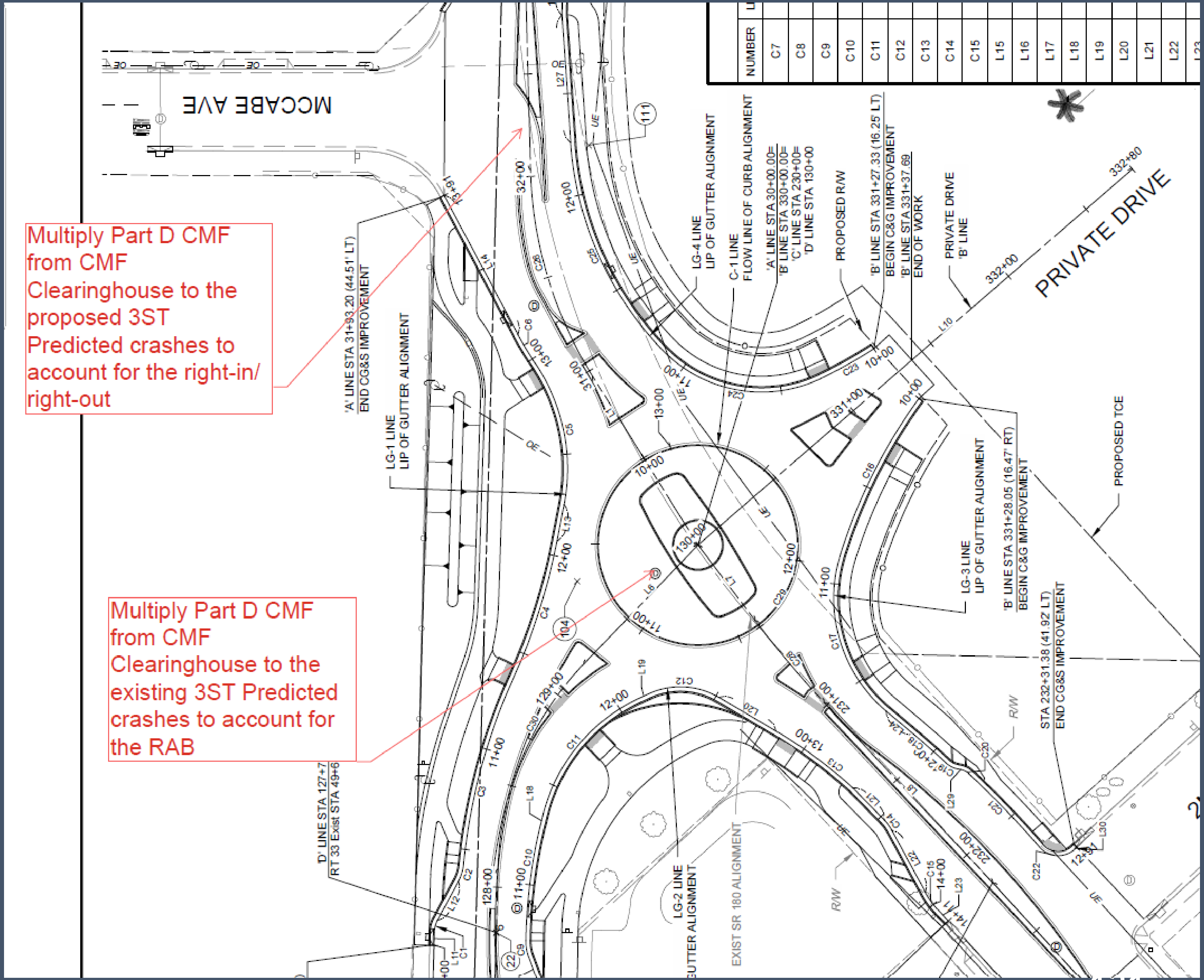
J8 | Site Conditions

Worksheet 2A -- General Information and Input Data for Urban and Suburban Arterial Intersections

General Information		Location Information	
Analyst	Gina Lopez	Roadway	McCabe Roundabout Project
Agency or Company	HQ Design	Intersection	Existing McCabe Avenue and SR 33.
Date Performed	11/14/24	Jurisdiction	Mendota
		Analysis Year	2045

Input Data		Base Conditions	Site Conditions
Intersection type (3ST, 3SG, 4ST, 4SG)		--	3ST
AADT $_{major}$ (veh/day)	$AADT_{MAX}$ = 45,700 (veh/day)	--	23,385
AADT $_{minor}$ (veh/day)	$AADT_{MAX}$ = 9,300 (veh/day)	--	5,975
Intersection lighting (present/not present)		Not Present	Present
Calibration factor, C_i		1.00	1.00
Data for unsignalized intersections only:		--	--
Number of major-road approaches with left-turn lanes (0,1,2)		0	0
Number of major-road approaches with right-turn lanes (0,1,2)		0	0

HSM



Multiply Part D CMF from CMF Clearinghouse to the proposed 3ST Predicted crashes to account for the right-in/ right-out
Multiply Part D CMF from CMF Clearinghouse to the existing 3ST Predicted crashes to account for the RAB
PRIVATE DRIVE

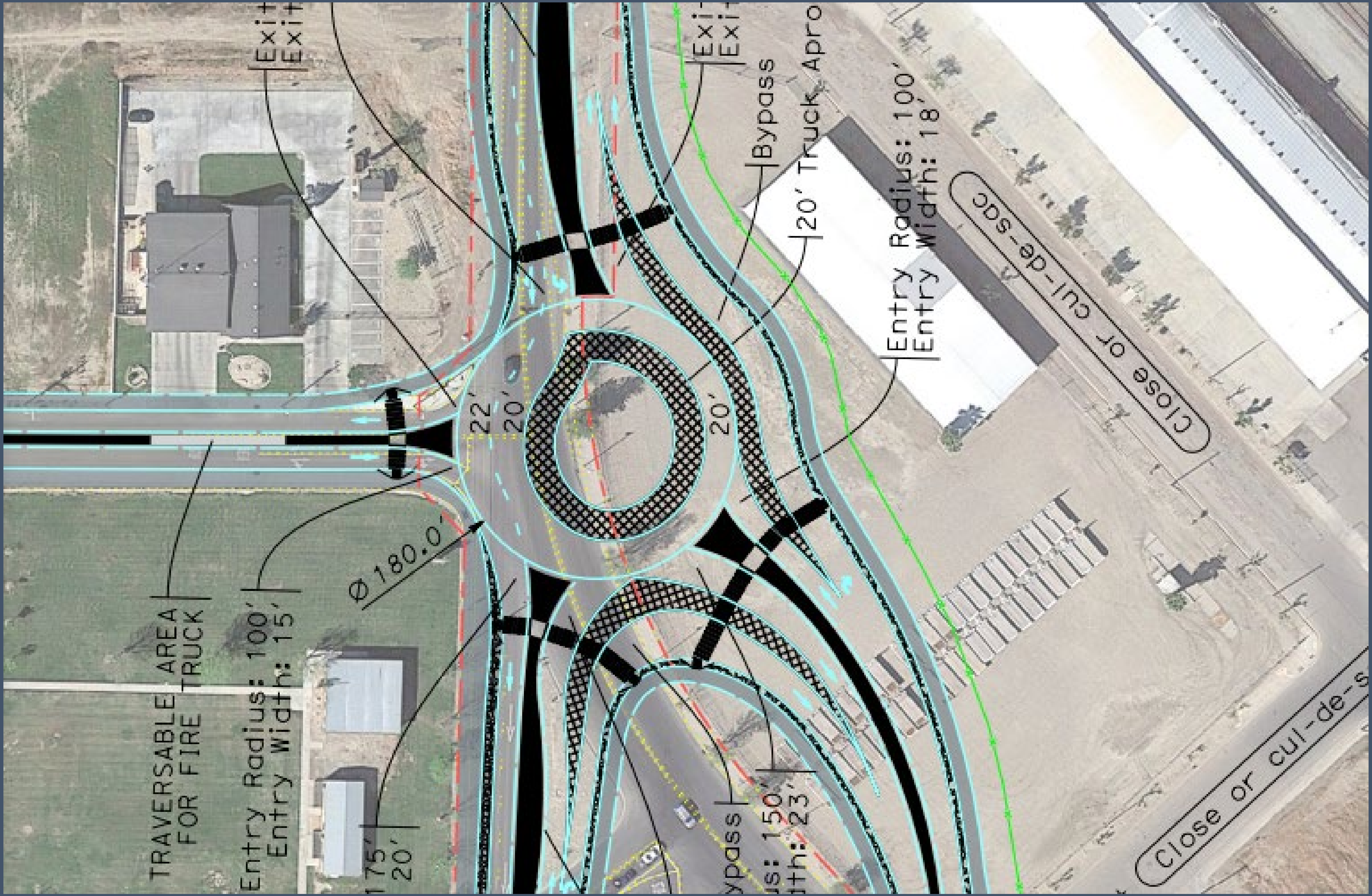
Stage 2 Detailed Analysis

- **Step 2.2 – Detailed operational analysis;** use appropriate measure of effectiveness (MOE)

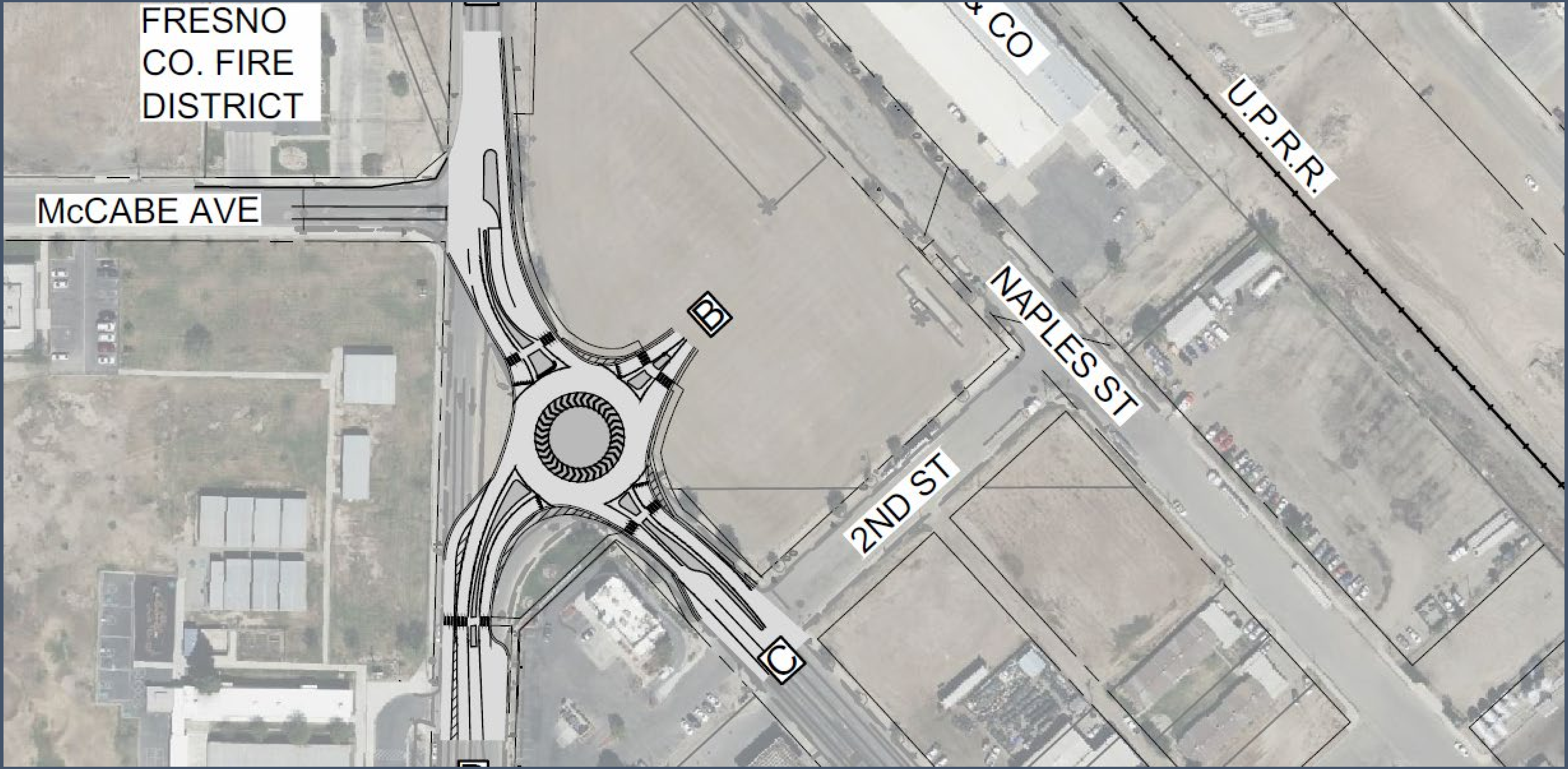
  Use MOE of DPHD.

  Delay savings compared to two-way stop control (TWSC):

  - Roundabout – 570.4 minutes
  - Signal – 160.0 minutes



TRAVERSABLE AREA
FOR FIRE TRUCK
Entry Radius: 100'
Entry Width: 15'
Ø180.0'
22'
20'
20'
Bypass
20' Truck Apron
Entry Radius: 100'
Entry Width: 18'
Close or cul-de-sac


FRESNO
CO. FIRE
DISTRICT
McCABE AVE
CO
U.P.R.R.
NAPLES ST
2ND ST
B
C

Stage 2 Detailed Analysis

- **Step 2.4 – Cost estimate, life-cycle costs**
  Traffic signal - $4.2 million
  Roundabout - $2.75 million

- **Step 2.5 – Performance-based analysis matrix**

Safety Cost-Benefit Ratio

		No-Build			Alternative A - Signal			Alternative B - Roundabout						
Project Cost		$0			$4,200,000			$2,750,000						
Intersection		Derrick/ SR 180	McCabe /SR 33	Total Collisions	Total Collisions	Change from No-Build (Collisions)	Change from No-Build (Collision Cost)	Derrick/ SR 180	Derrick/SR 180 w/Part D Roundabout CMF CMF = 0.68	McCabe /SR 33	McCabe/SR 33 w/ Right In, Right Out Part D CMF CMF = 0.55	Total Collisions	Change from No-Build (Collisions)	Change from No-Build (Collision Cost)
Collision Severity		Collisions	Collisions					Collisions	Collisions	Collisions	Collisions			
20 Year Design Period	F+I	11.461	23.78	35.241	19.52	15.721		11.461	7.79348	15.94	8.767	16.56	18.68052	
	PDO	22.91	49.04	71.95	33.62	38.33		22.91	15.5788	32.86	18.073	33.652	38.2982	
	Total			107.19	53.14	54.051						50.212	56.97872	
	Total Change ($) (B = Benefit)						$6,475,310							$6,826,084
	B/C Ratio	n/a			1.54			2.48						

Mobility Cost-Benefit Ratio

- Life of Project: 20 years
- Costs – Signal ($4,200,000), Roundabout ($2,750,000)
- Dollars per person-hours Delay Savings = $13.65/person-hours
- Signal Operational B/C:

  B/C = 11,356,800 / 4,200,000 = 2.70
- Roundabout Operational B/C:

  B/C = 40,486,992 / 2,750,000 = 14.72

Performance-Based Analysis Matrix

			Performance Metrics					
Improvement Strategy (Alternative)	**Capital Cost** ($)	**Service Life** (years)	***Mobility*** **Delay Benefit ($)**	***Safety*** **Crash Benefit ($)**	***Maint.*** **Cost ($)**	***Life-Cycle*** **Cost ($)**	***Other*** **Cost ($)**	**Benefit / Cost Ratio*** (BCR)
Traffic Signal	4,200k	20	11,357k	6,475k				4.2
Roundabout	2,750k	20	40,487k	6,826k				17.2

Maintenance costs and life-cycle costs (including technology refresh costs for signals) can also be included.

Stage 2 Detailed Analysis

- **Step 2.6 – Findings and recommendation**
  Roundabout is recommended.

Case Study 2: Urban Roundabout vs Signal (Mad-145 at C St)

Mad-145 at C Street in Madera

Stage 1 Screening and Initial Assessment

- **Step 1.1 – Is ISOAP required?**

  Yes, change in traffic control is proposed, with the traffic signal replaced with a roundabout.

- **Step 1.2 – Determine intended project outcome, place type, design vehicle, and gather data**

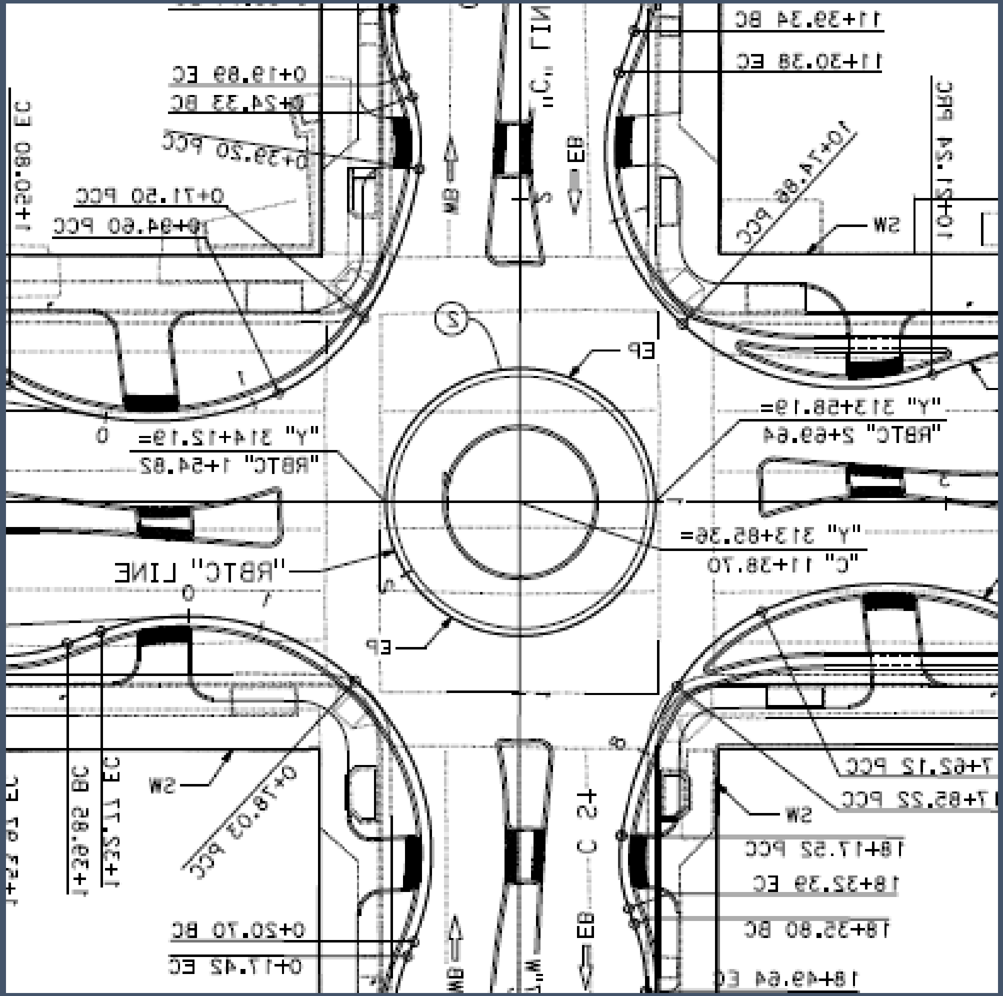
  Add complete streets elements to the downtown area. It is desirable to maintain operations while doing a road diet. The City wants to improve the aesthetics with a raised median and trees. The place type is city center. The design vehicle is an STAA truck as Route 145 is an STAA Terminal Access Route. Route 145 AADT is 15,100. 2035 Concept and UTC are 4-lane conventional highways.

Stage 1 Screening and Initial Assessment

- **Step 1.3 – Ped and bike planning and feasibility assessment**
  Downtown area with storefronts at the right of way line. City would like the sidewalks to be widened. Class II buffered bike lanes and road diet identified in the City's Active Transportation Plan.

- **Step 1.4 - R/W and operational feasibility assessment**
  Right of way is constrained due to buildings at right-of-way line. Some basements extend into the right-of-way. Any encroachment into the existing sidewalk area should be avoided. A compact roundabout can fit within existing right-of-way.

Stage 1 Screening and Initial Assessment



Stage 1 Screening and Initial Assessment

- **Step 1.5 – Transit and freight assessment**

  Madera Metro runs fixed-route buses with 30-minute headways on Route 145.

  Route 145 is an STAA Terminal Access route. Large trucks are to remain on the highway and not turn onto the minor street. Turning movements should be designed to accommodate smaller box trucks.

Stage 1 Screening and Initial Assessment

- **Step 1.6 – Initial safety assessment**

  2 collisions were reported in 3-year period. Collision rates are less than average. Intersection is currently signalized with protected left turns on Route 145 only. Marked crosswalks are placed on all four legs.

- **Step 1.7 – Eliminate infeasible strategies**

  Perpetuating traffic signals is rejected due to poor operations in conjunction with the road diet.

Stage 1 Screening and Initial Assessment

- **Step 1.8 – Findings and recommendations**

  Compact roundabout will perform acceptably and is the recommended configuration. Class II bike lanes to be added to the route but will drop approaching the roundabout. No shared use path will be provided due to constrained right-of-way. ISOAP concludes.

Case Study 3: Suburban Roundabout vs Signal vs PHB (Fre-180 at 1st St)

State Route 180

Existing Traffic Signal

Stage 1 Screening and Initial Assessment

- **Step 1.1 – Is ISOAP required?**

  Yes, change in traffic control and new leg added to intersection.

- **Step 1.2 – Determine intended project outcome, place type, design vehicle, and gather data**

  Facilitate students walking from high school to athletic facility. Place type is suburban area. Design vehicle is STAA truck as Route 180 is an STAA Terminal Access Route. Route 180 AADT is 16,300. 2035 Concept of a 4-lane conventional highway, UTC of 4-lane expressway.

Stage 1 Screening and Initial Assessment

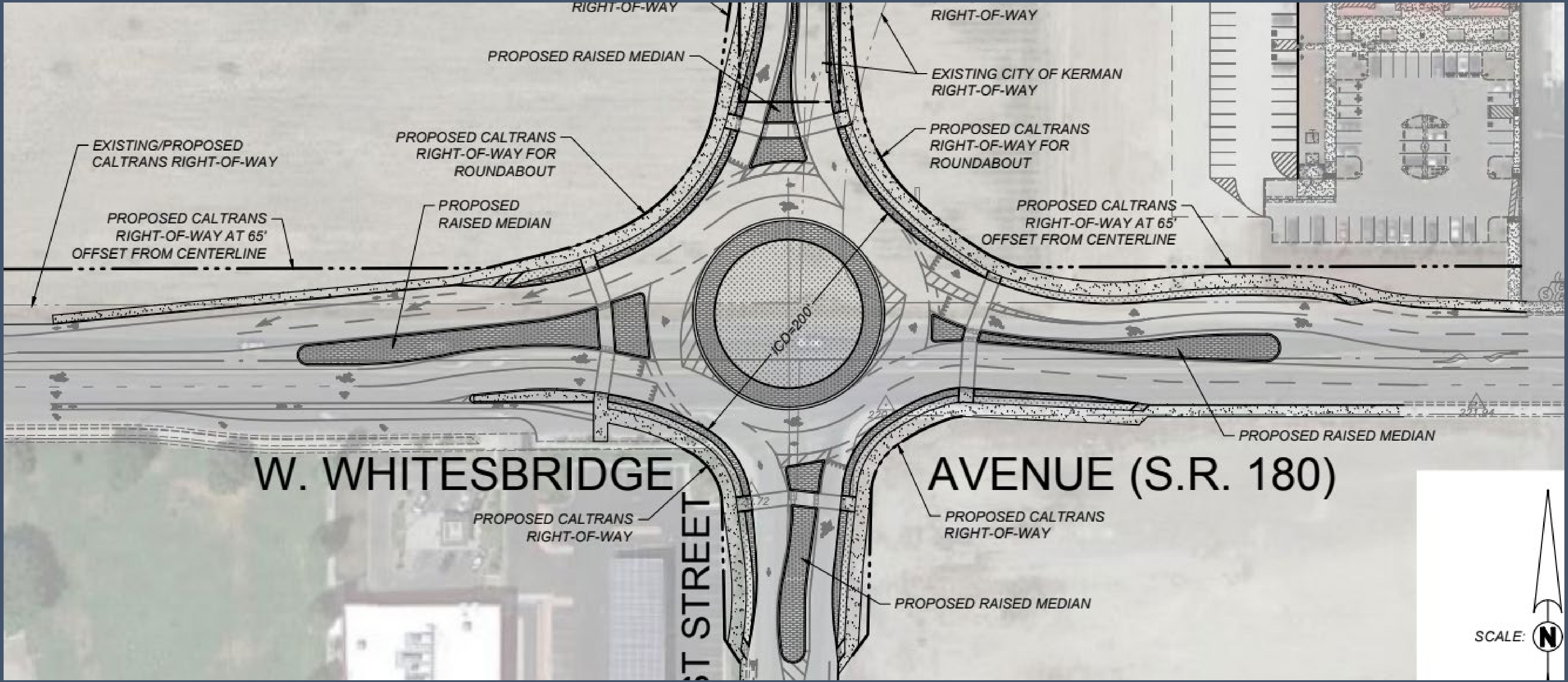
- **Step 1.3 – Ped and bike planning and feasibility assessment**

  Pedestrians and bicyclists will need to cross Route 180 at this location to get from the high school and homes on the south side to the planned athletic facility on the north side.

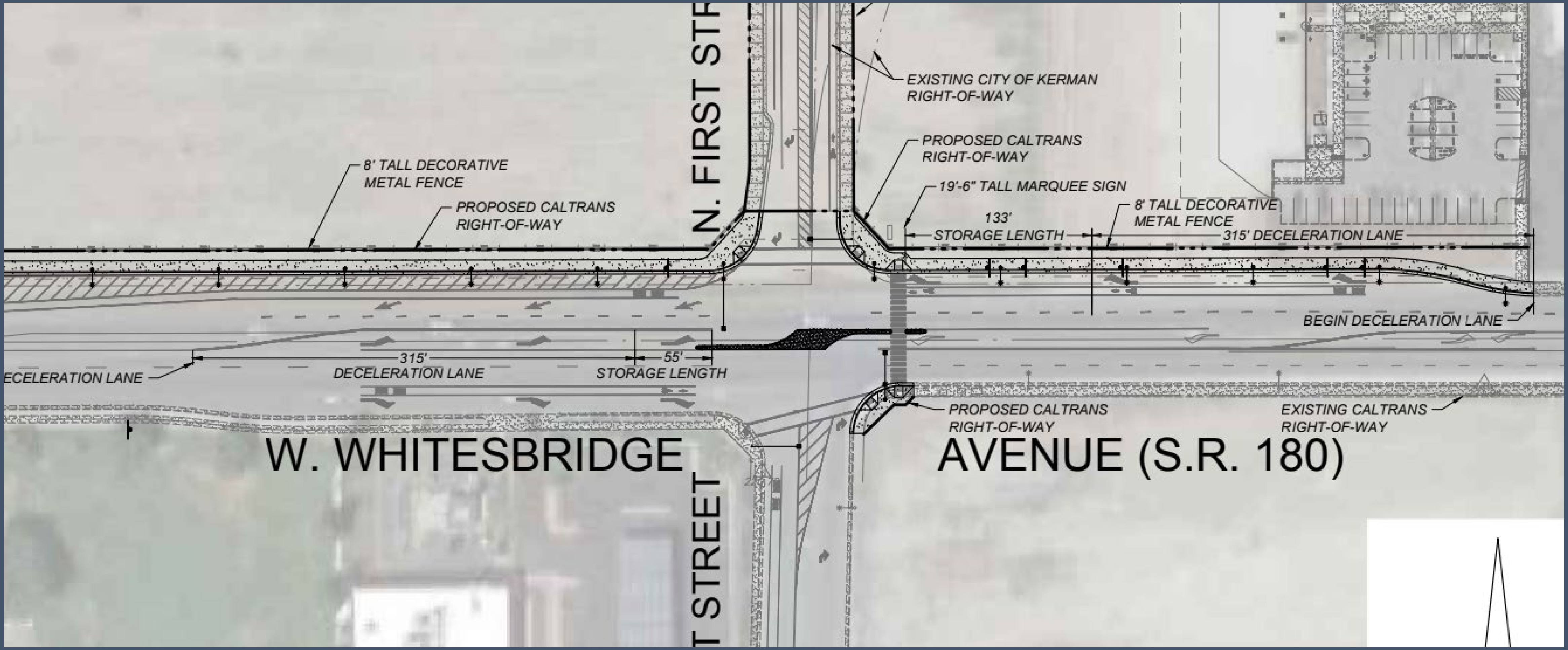
- **Step 1.4 - R/W and operational feasibility assessment**

  Traffic signal or PHB can be accommodated in existing right-of-way. A roundabout would require right-of-way at all corners. Only the SW corner is currently improved, with a parking lot for the school.

Roundabout


RIGHT-OF-WAY
RIGHT-OF-WAY
PROPOSED RAISED MEDIAN
EXISTING CITY OF KERMAN RIGHT-OF-WAY
EXISTING/PROPOSED CALTRANS RIGHT-OF-WAY
PROPOSED CALTRANS RIGHT-OF-WAY FOR ROUNDABOUT
PROPOSED CALTRANS RIGHT-OF-WAY FOR ROUNDABOUT
PROPOSED RAISED MEDIAN
PROPOSED CALTRANS RIGHT-OF-WAY AT 65' OFFSET FROM CENTERLINE
PROPOSED CALTRANS RIGHT-OF-WAY AT 65' OFFSET FROM CENTERLINE
ICD=200'
PROPOSED RAISED MEDIAN
W. WHITESBRIDGE
AVENUE (S.R. 180)
PROPOSED CALTRANS RIGHT-OF-WAY
PROPOSED CALTRANS RIGHT-OF-WAY
ST STREET
PROPOSED RAISED MEDIAN
SCALE:
N

Pedestrian Hybrid Beacon



Stage 1 Screening and Initial Assessment

- **Step 1.5 – Transit and freight assessment**

  There is currently only one round trip fixed route bus trip in the morning between Firebaugh and Fresno, and another round trip in the afternoon.

  Route 180 is an STAA Terminal Access route. Turning movements for STAA trucks do not need to be accommodated for the minor legs.

Stage 1 Screening and Initial Assessment

- **Step 1.6 – Initial safety assessment**
  There were no reported collision in a 3-year period.

- **Step 1.7 – Eliminate infeasible strategies**
  Cost of the roundabout is beyond available funding in the near or long-terms. Traffic signal is not consistent with planned signal spacing for the corridor.

Stage 1 Screening and Initial Assessment

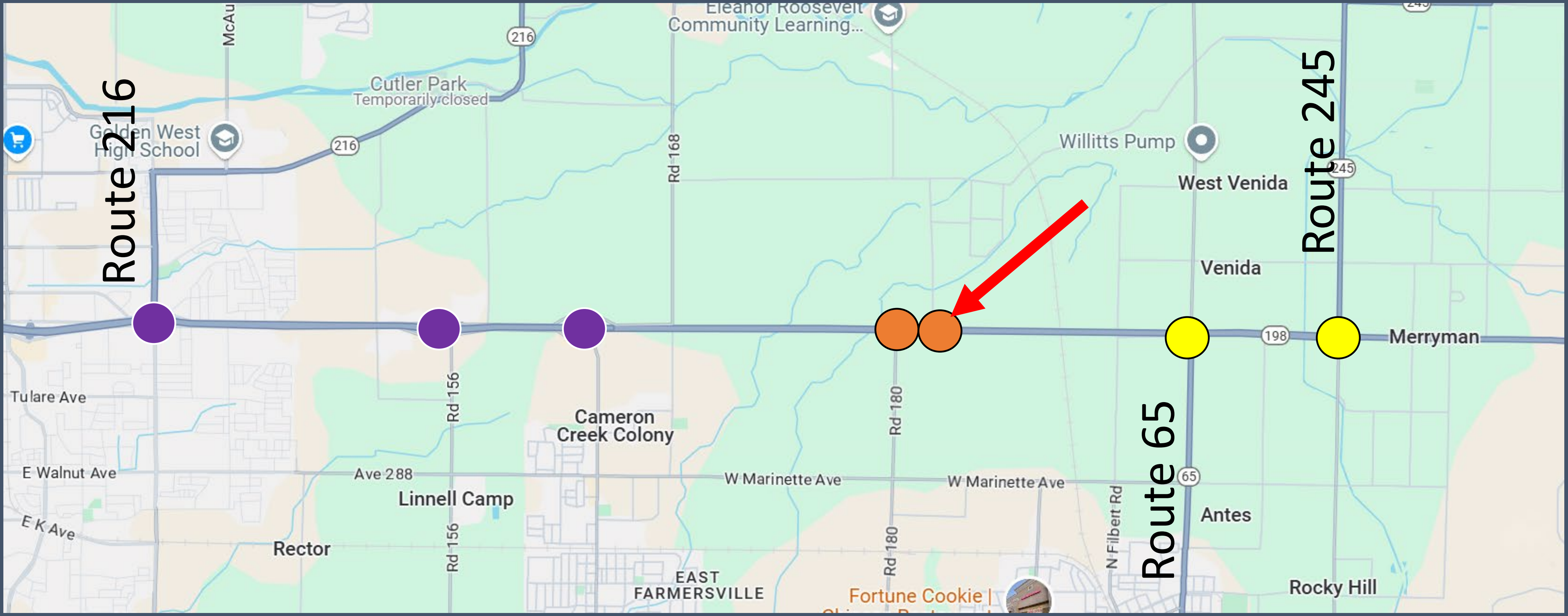
- **Step 1.8 – Findings and recommendations**

  PHB facilitates pedestrians to cross the highway and is recommended. Traffic diverter added to reduce conflicting movements. ISOAP concludes.

Case Study 4: Rural Roundabout vs Signal vs RCUT (Tul-198 at Rd 182)

- ¼ mile intersection spacing
- Diverter previously placed at Road 180

Control along the Route 198 Corridor



Existing Interchange   Existing Minor Stop   Existing Traffic Signal

Stage 1 Screening and Initial Assessment

- **Step 1.1 – Is ISOAP required?**

  Yes, widening is proposed to add acceleration lanes with the RCUT.

- **Step 1.2 – Determine intended project outcome, place type, design vehicle, and gather data**

  There is a pattern of eastbound left-turn collisions with westbound through vehicles. The place type is undeveloped corridor, with scattered rural residential land use. The design vehicle is STAA truck as Route 198 is an STAA Terminal Access Route. The 2040 Concept and UTC are both 4-lane expressways. However, some right-of-way was previously acquired for a future interchange.

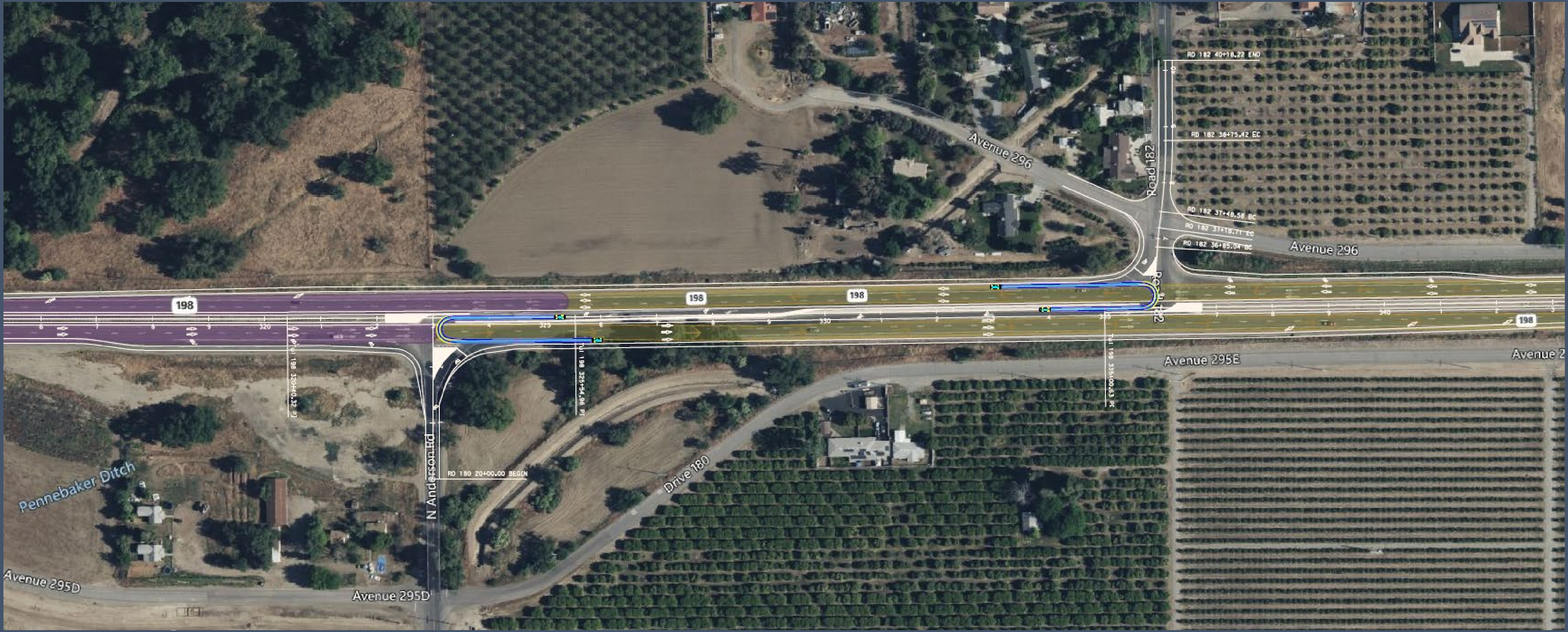
Stage 1 Screening and Initial Assessment

- **Step 1.3 – Ped and bike planning and feasibility assessment**
  There is no notable pedestrian or bicycle activity at the intersection. Immediate vicinity is expected to remain agricultural.

- **Step 1.4 - R/W and operational feasibility assessment**
  Existing expressway right-of-way is narrower than for typical expressways, with closely spaced frontage roads. Right-of-way is more expansive at Road 180 for the potential trumpet interchange. Route 198 AADT is 25,000. AM peak volumes of 98 EB U-turns and 54 left turns vs 1131 WB approaching vehicles.

Proposed RCUT with Acceleration Lanes and Extended LT Lanes

Proposed RCUT with Acceleration Lanes



Stage 1 Screening and Initial Assessment

- **Step 1.5 – Transit and freight assessment**

  Existing Tulare County Regional Transit Agency fixed-route buses run on Route 198 with approximate 30-minute headways.

  Route 198 is an STAA Terminal Access route. STAA trucks should be accommodated for all turning movements.

Stage 1 Screening and Initial Assessment

- **Step 1.6 – Initial safety assessment**

  There were 9 collisions in 3 years. The predominant collision pattern is eastbound left-turn vehicles colliding with westbound through vehicles. There is a secondary pattern of southbound left-turn vehicles colliding with eastbound or westbound through vehicles.

  Adding acceleration lanes for the U-turn movement would reduce the potential conflict with fast-moving vehicles.

Stage 1 Screening and Initial Assessment

- **Step 1.7 – Eliminate infeasible strategies**
  Cost of the roundabout is beyond available funding in the near or long-terms. Introducing a traffic signal 1.75 miles from the nearest traffic signal is not desirable. RCUT with extended left-turn lanes does not satisfy the Safety Index.

- **Step 1.8 – Findings and recommendations**
  The RCUT with added acceleration lanes addresses the safety concern and is recommended. Cost is $2.3 million, and Safety Index is satisfied for a safety project. ISOAP concludes.

Case Study 5: Interchange Improvement (Tul-99 at Paige Ave)

Stage 1 Screening and Initial Assessment

- **Step 1.1 – Is ISOAP required?**

  Yes, interchange is to be reconstructed.

- **Step 1.2 – Determine intended project outcome, place type, design vehicle, and gather data**

  Replace outdated interchange to improve safety and operations. Place type is suburban community. Design vehicle is STAA truck as Route 99 is an STAA National Network Route and commercial truck stops and agricultural areas are accessed from the interchange. A previous PSR proposed a partial cloverleaf interchange on the east side of the freeway, with a tight diamond on the west side.

Stage 1 Screening and Initial Assessment

- **Step 1.3 – Ped and bike planning and feasibility assessment**
  Pedestrian and bicycle facilities should be provided consistent with a suburban area. There are residents and hotels on the east side of the freeway and commercial and industrial areas on the west side. Class II bike lanes should be placed on Paige Avenue, with shared use path around roundabouts.

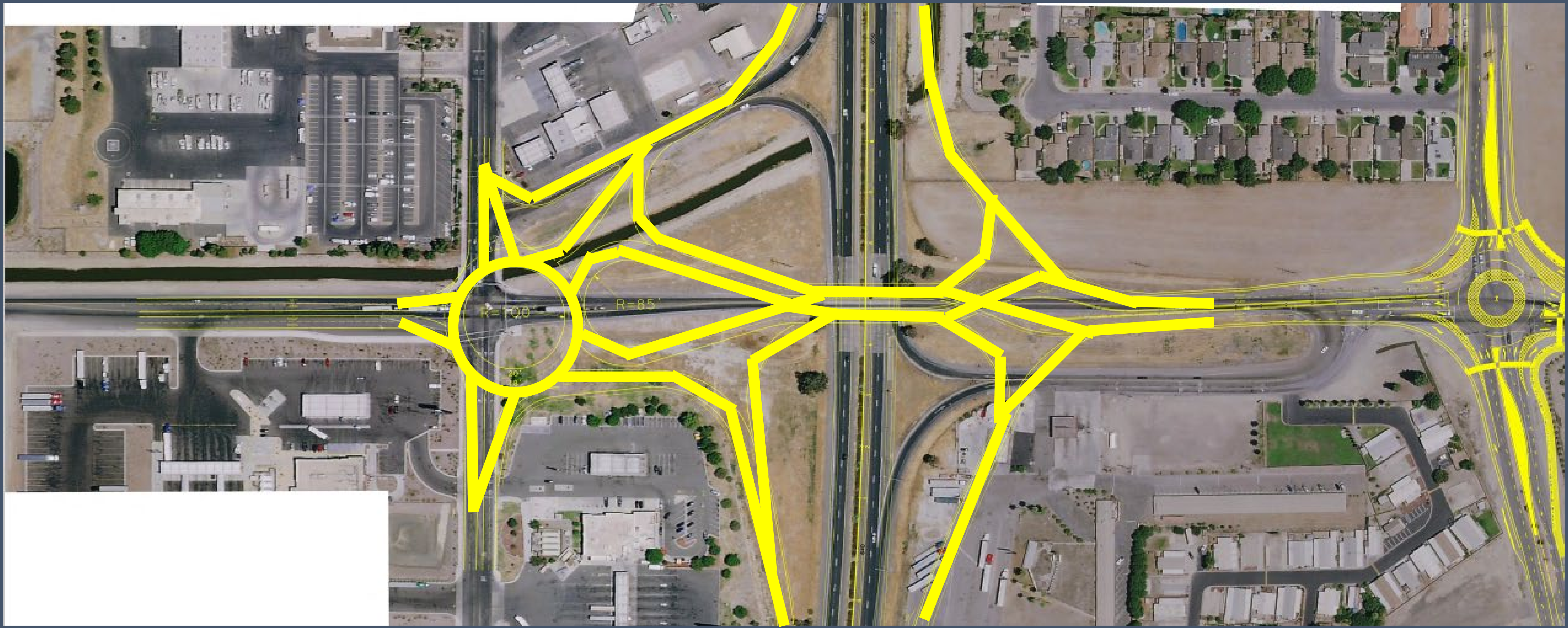
Stage 1 Screening and Initial Assessment

- **Step 1.4 - R/W and operational feasibility assessment**

  There is a canal in the northern quadrants. Commercial property in the SE quadrant is expected to be acquired for the project. Homes in the NE quadrant and mobile home park in SE quadrant should be avoided. Centerline distance between Blackstone Street and Route 99 is only 750'.

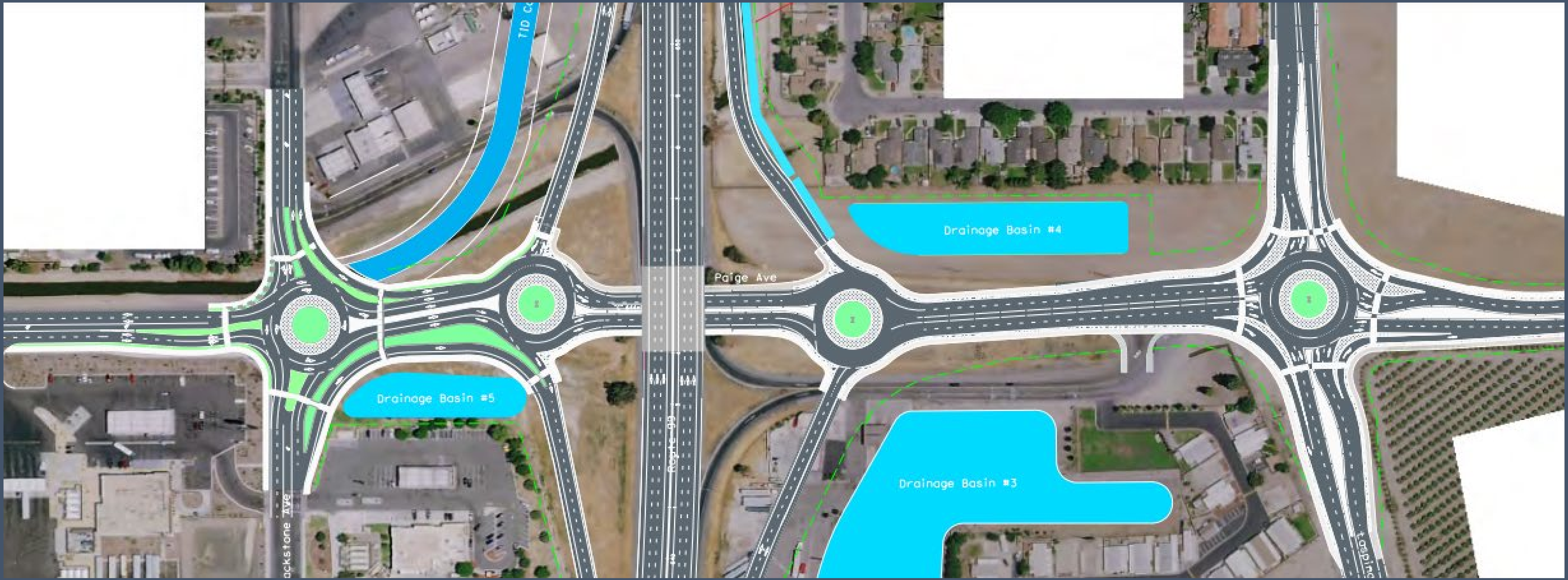
- 3 concepts developed:
  1. DDI with one roundabout
  2. Single roundabout interchange
  3. Diamond with roundabouts

DDI with One Roundabout

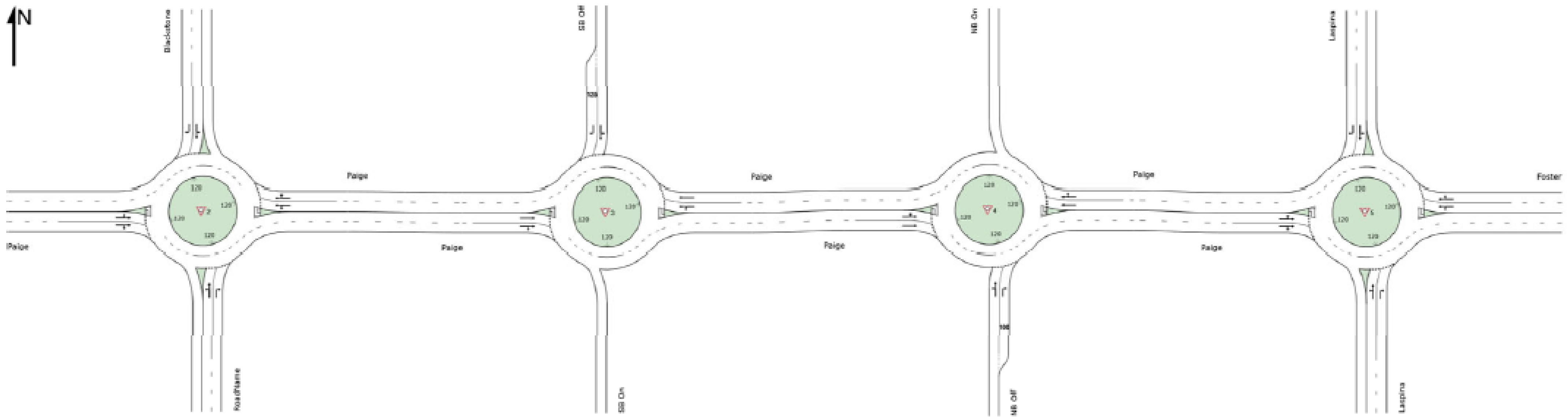


Single Roundabout Interchange

Diamond Interchange with Roundabouts



Stage 1 Screening and Initial Assessment



SITES IN NETWORK		
Site ID	**CCG ID**	**Site Name**
2	NA	Paige/Blackstone
3	NA	SB Ramps
4	NA	NB Ramps
5	NA	Paige/Laspina

Stage 1 Screening and Initial Assessment

Locations	*Traffic Control*	*2029 LOS (Completion)*		*2039 LOS (10 Yr)*		*2049 LOS (20 Yr)*	
		AM	*PM*	*AM*	*PM*	*AM*	*PM*
NB Ramps at Paige Avenue	Stop Control	C	C	F	D	F	F
SB Ramps at Paige Avenue		C	C	D	D	F	F
NB Ramps at Paige Avenue	Signal	C	C	E	E	F	F
SB Ramps at Paige Avenue		C	C	D	D	F	F
NB Ramps at Paige Avenue	Roundabout	A	A	A	A	A	A
SB Ramps at Paige Avenue		A	A	A	A	A	A

Stage 1 Screening and Initial Assessment

- **Step 1.5 – Transit and freight assessment**

  There is currently no fixed route transit at this location.

  There is significant truck traffic with two commercial truck stops and industrial and agricultural land use on the west side of the interchange. Paige Avenue is a truck route. Route 99 is an STAA National Network Route.

Stage 1 Screening and Initial Assessment

- **Step 1.6 – Initial safety assessment**

  Existing hook ramps transition to city streets and not at the intersecting cross street. Collision rates on the off-ramps are above average. There is short deceleration on the off-ramps. There are no sidewalks or bicycle facilities on cross street.

- **Step 1.7 – Eliminate infeasible strategies**

  DDI is rejected due to constraints for properly sizing the roundabout. Single roundabout interchange is rejected to due to excessive speed during performance checks.

Stage 1 Screening and Initial Assessment

- **Step 1.8 – Findings and recommendations**

  The diamond interchange with roundabouts is recommend. Shared use path be placed around the roundabouts. ISOAP concludes.

Support

- **ISOAP website:** www.dot.ca.gov/programs/traffic-operations/isoap
- **ISOAP Technical Assistance Program (TAP)**
  - Program Coordinator Zifeng “Lilian” Wu, Traffic Operations
  - Qingmeng Li, Safety Programs
  - District ISOAP Coordinators
  - John Liu, District 6 Maintenance and Operations
- **Upcoming workshops**
  - 8-hour in-person workshops with exercises and case studies
  - Planned for early 2025 in HQ and Districts 4, 6, 7, 8, and 11

Questions?

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