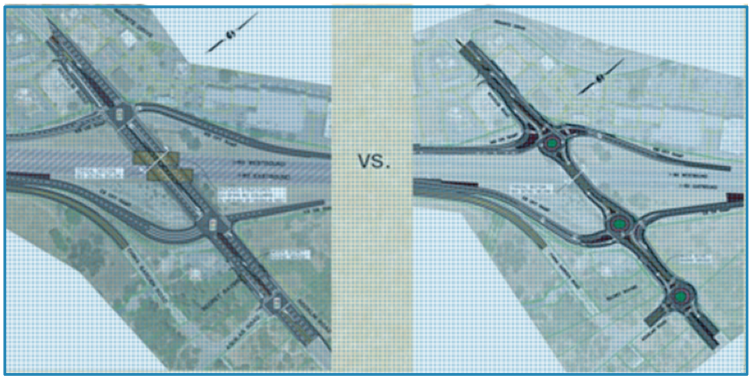
Intersection Control Evaluation

A type-selection framework & tool

for Roundabouts & Alternative Intersections

Jerry Champa | GHD (formerly Omni-Means)
Kamesh Vedula | Omni-Means, A GHD Company



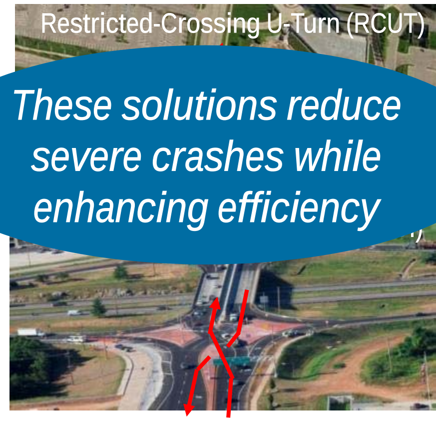
NorCal ITE Lunch Meeting September 19, 2018

Today's Agenda

Time	Topic	Presenters
12:10	**INTRODUCING:** **GHD: When two become one** **Interchange Control Evaluation (IICE)?**	**Kamesh Vedula** **Jerry Champa**
12:15	***Welcome to the Modern ICE Age*** Modern Solutions for Access Needs & Problems	Jerry Champa
12:25	**ICE Formula: Policy, Tools & Resources** How to Predict Size & Performance How ICE is Saving Lives, the Planet, Marriages, etc.	Jerry Champa
12:35	**Case Studies** How ICE changed project decisions & outcomes: Traffic & Safety Analysis Methodologies and Tools	Jerry Champa Kamesh Vedula
12:50	**Question & Answer Session**	All

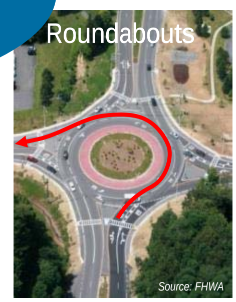
Intersection Control Evaluation:
Welcome to the Modern ICE Age & Solutions

Jerry Champa | GHD, Presenter



These solutions reduce severe crashes while enhancing efficiency

Every Day Counts
innovation ingenuity imagination invention



U.S. Department of Transportation
Federal Highway Administration

What is ICE?
Direction, Tool & Framework for *Critical* Decisions

Stage 1: high-level assessment, considers all possibilities, filters down to a short list of practical & viable solutions

Stage 2: Design, Traffic & Economic studies to estimate / predict performance & allow for comparison of short-listed alts

Stage 1 Screening to Identify Alts + **Stage 2** Performance & Economic Analysis = **Optimal Solution**

Goal: Well-informed investment decisions

Why is ICE needed?

- To **overcome barriers to use of new, innovative / evolved and highly effective solutions** with wide range of applications
- Ensure routine, objective and consistent consideration of emerging & creative concepts
- **Accelerate deployment of proven (best) safety countermeasure**
- Complements performance-oriented program framework and value-based project delivery

Intent of ICE

- To provide a **performance-based type-selection tool** for proposals to add, modify, expand, and fully control intersections
- **To integrate data-driven safety performance analysis into the identification of the optimal *access* solution**
- **Provide a framework (flexible) to allow for objective and strategic evaluation & comparison of all practical solutions, especially those which are newer, creative and proven - but under-utilized:**
  - roundabouts, U-turn based intersections, continuous flow intersections, diverging diamond interchanges, etc.
  - **Requires data-driven safety performance analysis**

Intent of ICE

- Creates a transparent & consistent approach **to identify optimal solution (investment)** based on modern performance metrics: *crash severity, travel time, queuing that blocks driveways, ped & bike conflict, cost-effectiveness, and impacts to land, community and health (e.g. air & water quality),*
- **Provides decision-makers with a "scorecard" (i.e. a summary performance matrix) to inform the selection** of the most critical (vulnerable) infrastructure – access points which connect system of streets, highways & freeways; and.the scorecard serves as documentation

Benefits of Innovative Intersections

SAFETY

- Fewer, less severe conflict points
- Speed management potential
- Significant crash reductions

MOBILITY

- Less delay
- Reduced congestion
- New/more pedestrian and bike opportunities

VALUE

- Smaller footprints
- Less ROW
- Less $
- Quicker construction
- Multiple Advantages

ICE and FHWA Safety PM Final Rule

Final Rule establishes 5 performance measures to carry out HSIP (5-year rolling averages):

- (1) Number of Fatalities
- (2) Rate of Fatalities per 100 million VMT
- (3) Number of Serious Injuries
- (4) Rate of Serious Injuries per 100 million VMT
- (5) Number of Non-motorized Fatalities and Serious Injuries

States establish and report on targets; annual evaluation on meeting or making significant progress toward targets

ICE Policies/Procedures can help achieve Safety PM targets across entire highway program (Not limited to HSIP)!

ICE Performance Criteria

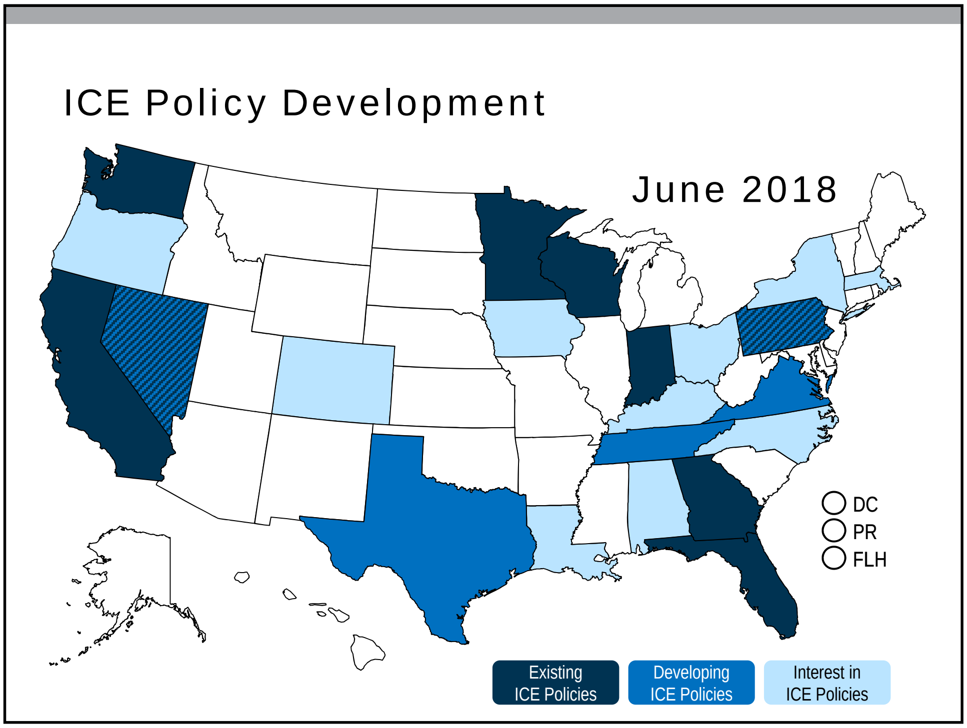
- Safety (substantive, not nominal)
- Operations (core MOEs, not LOS)
- Right-of-Way Impacts
- Costs
- Practical Feasibility (i.e., local posture)
- Pedestrians and Bicycles
- Freight Network (incl. OSOW)
- Environmental Impacts
- Others depend on community values (context)

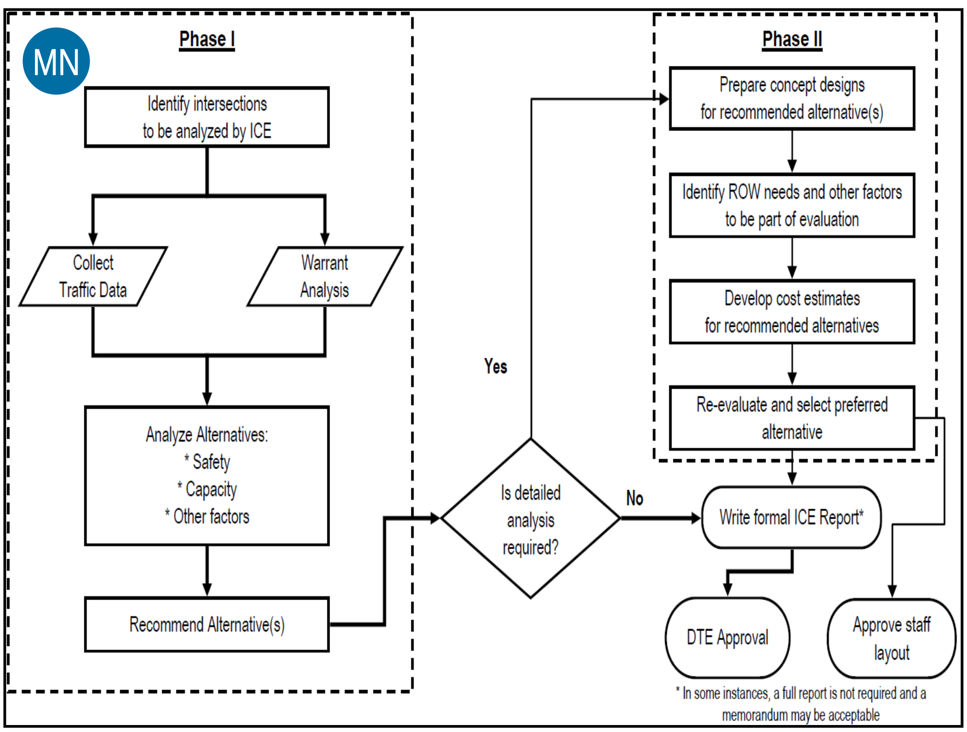
Benefits of ICE Process

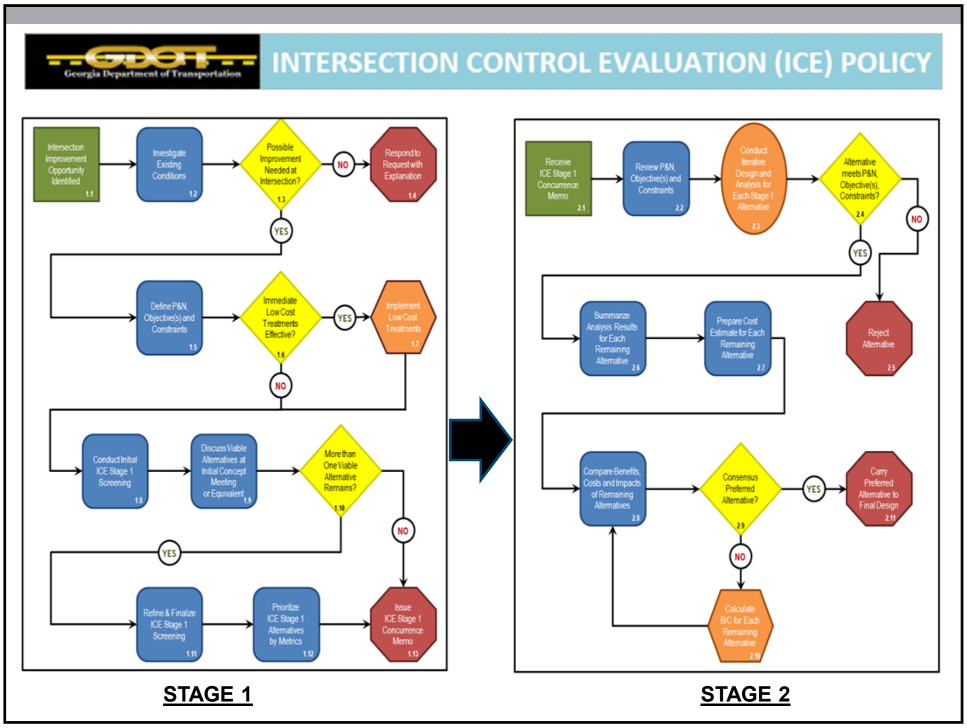
- Determine the optimal and “best value” combination of geometric design and traffic control strategy
- **Safety**, operational, multimodal, environmental, ROW, cost and political ***impacts and advantages compared***
- All viable alternatives receive preliminary screening, i.e. “*do they work?*” and “are they practical?” litmus test
- Efficiency: Only alternatives with highest potential effectiveness are carried forward for comparative analysis of impacts, performance & cost-effectiveness

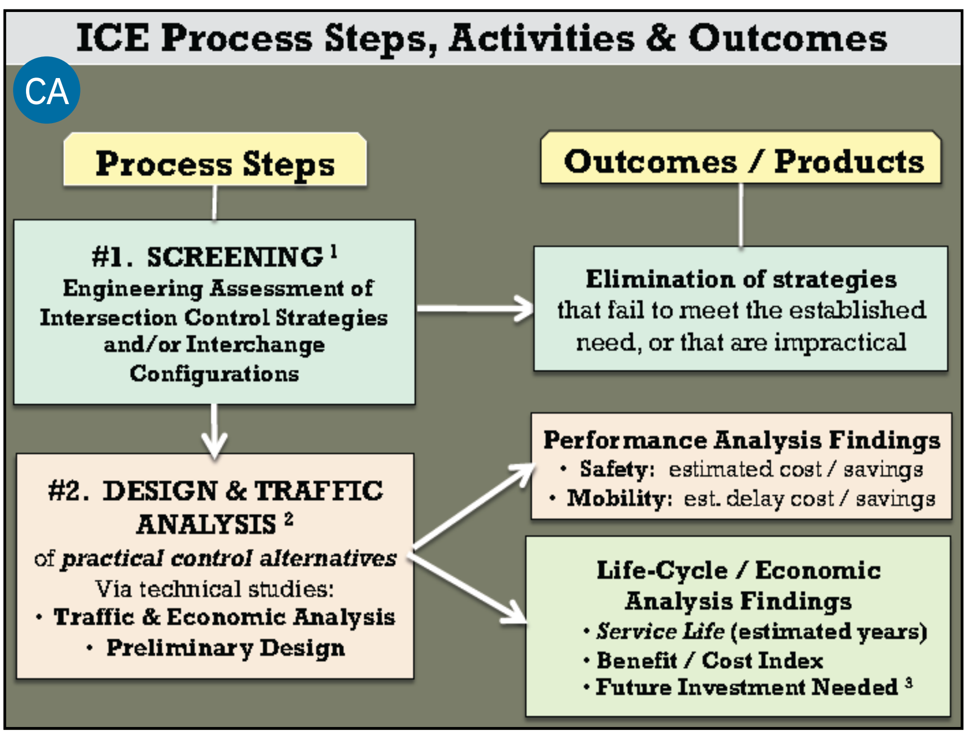
Where ICE Fits

- ICE should be customized to align with range of project planning & approval phases (studies)
- Stage 1 should occur as early as possible (preferably as a Scoping exercise)
- When development (Land Use) projects will invest, involve, affect, include **access**


ICE Policy Development
June 2018
DC
PR
FLH
Existing ICE Policies
Developing ICE Policies
Interest in ICE Policies


MN
Phase I
Identify intersections to be analyzed by ICE
Collect Traffic Data
Warrant Analysis
Analyze Alternatives:
* Safety
* Capacity
* Other factors
Recommend Alternative(s)
Is detailed analysis required?
Yes
No
Phase II
Prepare concept designs for recommended alternative(s)
Identify ROW needs and other factors to be part of evaluation
Develop cost estimates for recommended alternatives
Re-evaluate and select preferred alternative
Write formal ICE Report*
DTE Approval
Approve staff layout
* In some instances, a full report is not required and a memorandum may be acceptable


Georgia Department of Transportation
INTERSECTION CONTROL EVALUATION (ICE) POLICY
Intersection Improvement Opportunity Identified 1.1
Investigate Existing Conditions 1.2
Possible Improvement Needed at Intersection? 1.3
NO
Respond to Request with Explanation 1.4
YES
Define P&N, Objective(s) and Constraints 1.5
Immediate Low Cost Treatments Effective? 1.6
YES
Implement Low Cost Treatments 1.7
NO
Conduct Initial ICE Stage 1 Screening 1.8
Discuss Viable Alternatives at Initial Concept Meeting or Equivalent 1.9
More than One Viable Alternative Remains? 1.10
NO
YES
Refine & Finalize ICE Stage 1 Screening 1.11
Prioritize ICE Stage 1 Alternatives by Metrics 1.12
Issue ICE Stage 1 Concurrence Memo 1.13
STAGE 1
Receive ICE Stage 1 Concurrence Memo 2.1
Review P&N, Objective(s) and Constraints 2.2
Conduct Iterative Design and Analysis for Each Stage 1 Alternative 2.3
Alternative meets P&N, Objective(s), Constraints? 2.4
NO
YES
Reject Alternative 2.5
Summarize Analysis Results for Each Remaining Alternative 2.6
Prepare Cost Estimate for Each Remaining Alternative 2.7
Compare Benefits, Costs and Impacts of Remaining Alternatives 2.8
Consensus Preferred Alternative? 2.9
YES
Carry Preferred Alternative to Final Design 2.11
NO
Calculate B/C for Each Remaining Alternative 2.10
STAGE 2


ICE Process Steps, Activities & Outcomes
CA
Process Steps
Outcomes / Products
#1. SCREENING 1
Engineering Assessment of Intersection Control Strategies and/or Interchange Configurations
Elimination of strategies that fail to meet the established need, or that are impractical
#2. DESIGN & TRAFFIC ANALYSIS 2
of practical control alternatives
Via technical studies:
• Traffic & Economic Analysis
• Preliminary Design
Performance Analysis Findings
• Safety: estimated cost / savings
• Mobility: est. delay cost / savings
Life-Cycle / Economic Analysis Findings
• Service Life (estimated years)
• Benefit / Cost Index
• Future Investment Needed 3

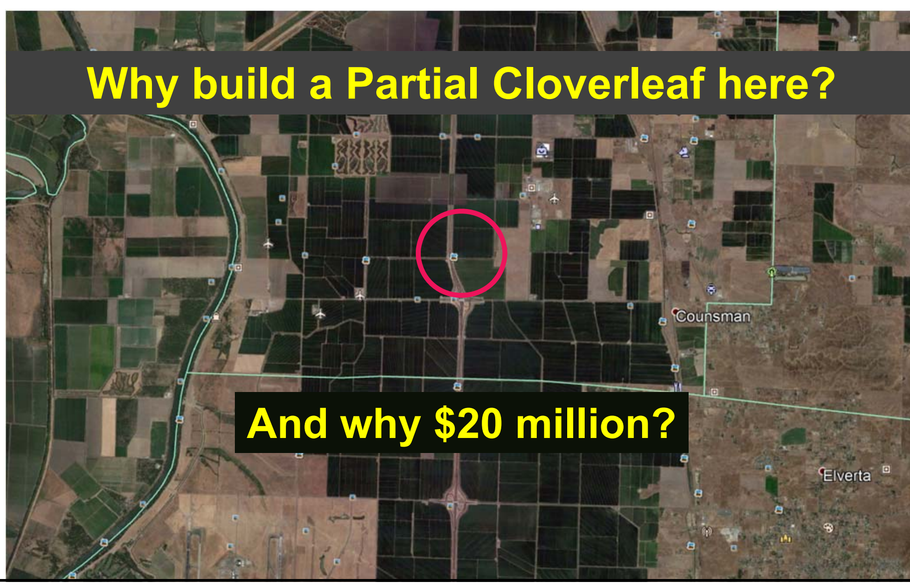
Before the modern ICE Age ...

Before the modern ICE Age ...

Before the modern ICE Age ...

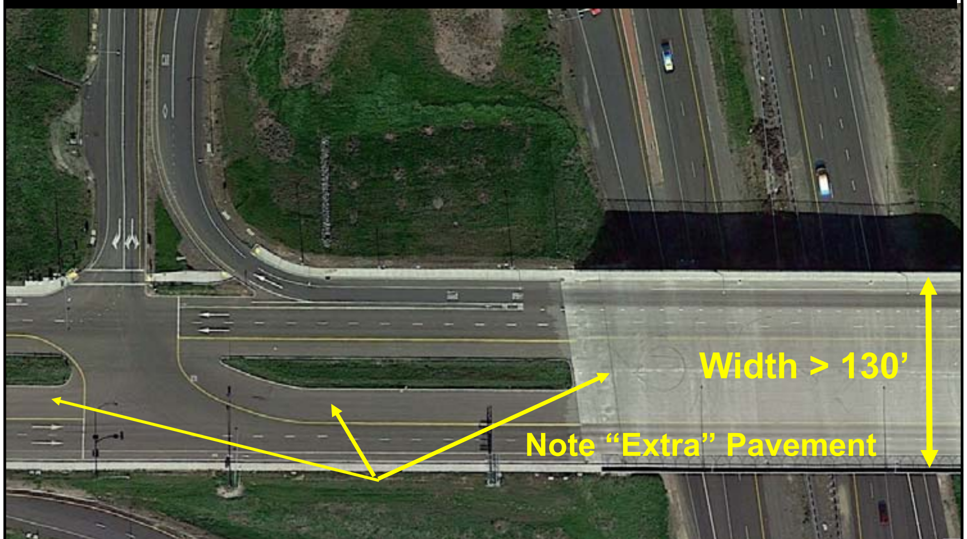
Before the modern ICE Age ...

Before the modern ICE Age ...



Cross-Section through Interchange

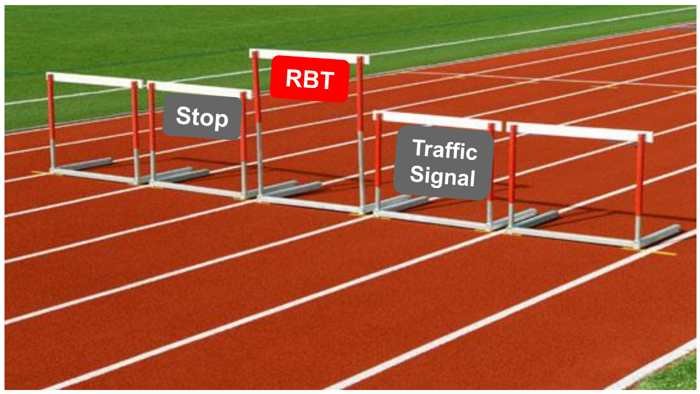
Structure is 4x wider than approach roadbeds



What if ICE Existed …

ICE applies to Selection of I/C Type & Ramp Terminal Control

Roundabouts: Pre-ICE Policy



DOT Perspective (Caltrans)

What is ICE?

Engineering Policy Directive & Type-Selection *TOOL*

- **Brings much needed focus to access-related decisions**

Flexible Framework comprised of 2 General Steps (+ activities):

1. **SCREENING eliminates impractical solution alternatives**
2. **ANALYSES produce key findings to inform decisions**

Mechanism which accelerates implementation of innovation

State DOT Perspective (Caltrans)

Roundabout Approvals: Pre-ICE Policy

Design Information Bulletin 80-01

RBT Conceptual Approval Report (CAR)

District Review

- **HQ Approval**

Deschutes Road Roundabout

Roundabouts: Pre-ICE Policy

Twin Cities Roundabouts

State DOT Perspective (Caltrans)

WHAT did the ICE Policy change?

Specific to RBTs:

- **Recognized RBTs as a standard intersection "type"**
- **Required (data-driven) Safety Performance Analysis**
- **Streamlined Approval Process**

Roundabouts: POST-ICE Policy

~~DIB 80-01~~ (replaced by ***ICE Policy & Framework)***
~~***Roundabout Conceptual Approval Report***~~
District Review
~~HQ Approval~~

- **Added *Technical Assistance* to:**
  - Support Implementation
  - **Take Advantage of flexibility provided by roundabouts**
  - Support Use of analytical tools

State DOT Perspective (Caltrans)

What has improved as a result of ICE?

- Decision-making (when makers are well-informed)
- **Decisions are being driven by:**
  - **Performance** Advantages of Roundabouts
  - **Higher ROI** (instead of lowest cost Alternative)
- **More RBTs have been selected for implementation, and**
  RBTs less often dropped due to bias, opinion, *confusion*
- Less Effort (time, resources) expended
- Quality of End Product (Design)

State DOT Perspective (Caltrans)

Roundabouts: Post-ICE Policy

State DOT Perspective (CA)

Roundabouts: Post-ICE Policy

ICE Lessons Learned

Keys to Objective:
Evaluation & Comparison of Roundabouts

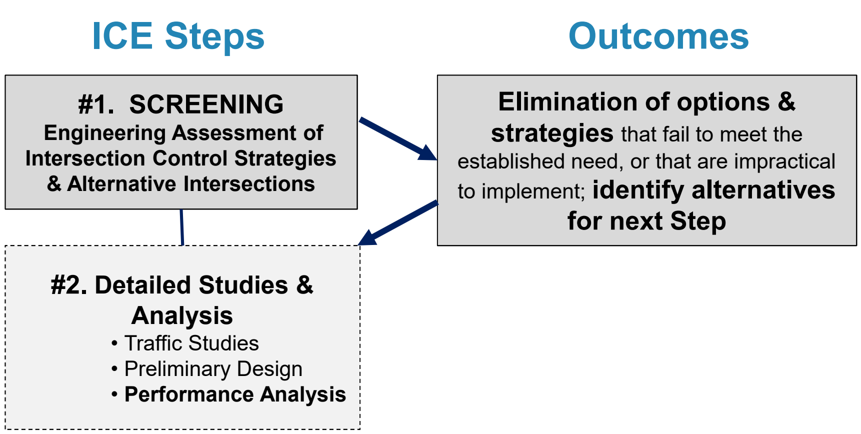
- **Safety Performance Analysis**
  - **Will recognize or emphasize advantage of RBT**
  - **State & National Methodologies & Tools Available**

ICE Lessons Learned

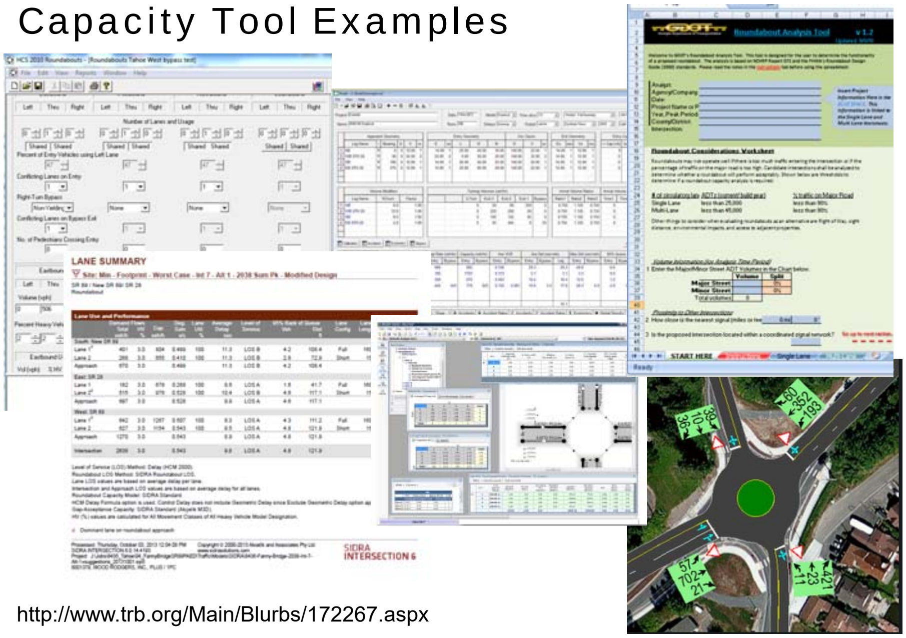
Keys to Objective:
Evaluation & Comparison of Roundabouts

- Safety Performance Analysis
- **Optimum Siting & *SIZING* (to define the build footprint)**
  - Design Flexibility needs to be understood & applied
  - **Sizing starts and relies upon:**
    - Capacity Assessment (to complete Step 1 – Screening)
    - Capacity & Operational Analysis (to complete Step 2)
  - **Sizing determines cost and R/W impacts (practical?)**

ICE Framework (California)



Capacity Tool Examples



http://www.trb.org/Main/Blurbs/172267.aspx

Planning Level Peak Hour Volumes

Volume Range, entry + circulating (pcephpl)	Number of Lanes Required / Needed
0 to 1,100	Single-lane entry is sufficient
1,100 to 1,400	**Single-lane may be sufficient**
1,400 to 1,900	Two-lane entry likely to be sufficient
1,900 to 2,300	**Two- lane entry may be sufficient**
2,300 to 2,900	Three- lane entry may be sufficient

Source: McCollough

FHWA Calibration & HCM 6th Edition

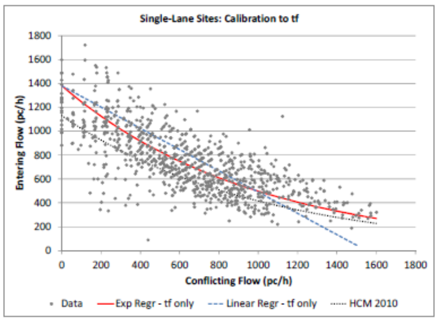
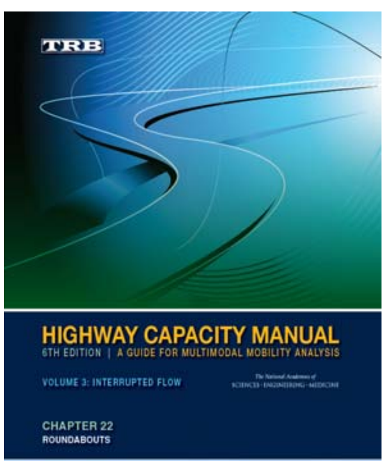


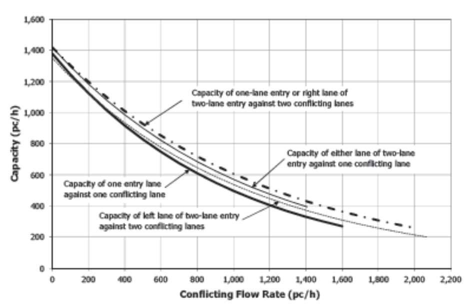
Figure 2. Scatter Plot. Regression models for single-lane roundabout sites with calibration to follow-up time.

Table 3. Recommended models for roundabout types, configuration, and entry lanes.

Lane configuration and entry lane	Model Equation
1x1	v_e = 1380 exp (-0.00102 * v_c)
2x2, right lane	v_e = 1420 exp (-0.00085 * v_c)
2x2, left lane	v_e = 1350 exp (-0.00092 * v_c)
2x1, both lanes	v_e = 1420 exp (-0.00091 * v_c)
1x2	Use 2x2 right lane model

HCM 6th Edition





FHWA Calibrated Capacity Model (HCM 6th Edition)- SLR

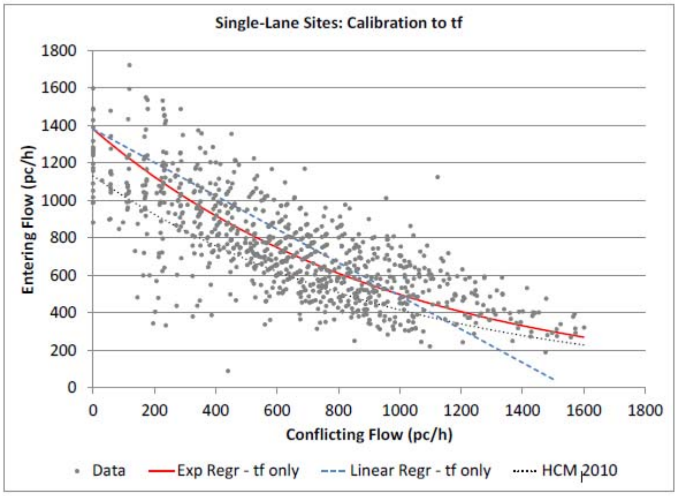


Figure 27. Scatter Plot. Regression models for single-lane roundabout sites with calibration to follow-up time.

FHWA Calibrated Capacity Model HCM 6th Edition – MLR (RT)

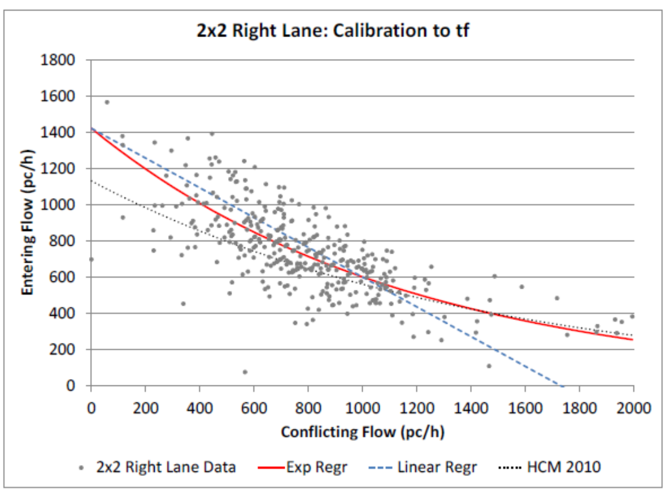


Figure 42. Scatter Plot. Regression models for multilane 2x2 roundabout sites, right entry lane with calibration to follow-up time.

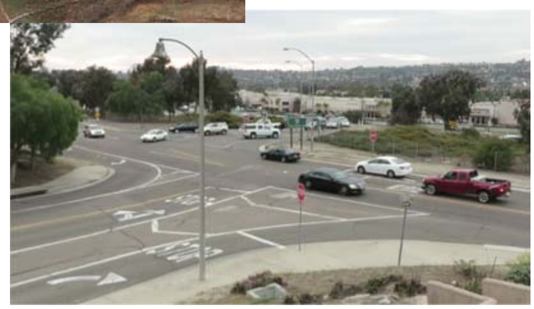
Intersection Control Evaluation:
Case Studies

Kamesh Vedula | GHD (Principal)
Jerry Champa | GHD (ICE & Safety Performance Specialist

Caltrans ICE Framework:
Steps, Activities & Outcomes

Steps & Activities	Outcomes / Products
#1. SCREENING [1]	**Elimination of options & strategies** that fail to meet the established need, or that are impractical to implement
	Product: Short List of Alts (1 or more)
#2. TRAFFIC ANALYSIS & DESIGN STUDIES (Performance & Cost Analysis) of ***practical control alternatives***	**Performance Analysis Findings** • **Safety:** est. cost / savings • **Mobility:** est. delay cost / savings • **Design** (RBT Performance Checks)
	Cost / Economic Analysis Findings • **Estimating** • ***Service Life*** (estimated years) • **Benefit / Cost Index**

San Juan Capistrano, CA



Source: Gary Warkentin, Michael Baker

Intersection Control Evaluation (ICE)

Traffic Operations Policy Directive 13-02 (PDF) : Intersection Control Evaluation (ICE)

Intersection Control Evaluation refers to the process and framework that a growing number of transportation agencies are adopting to provide a more balanced or holistic approach to the consideration and selection of access strategies and concepts during transportation planning, project identification and initiation processes that contemplate the addition, expansion or full control of major intersections (including interchange ramp termini). "Full control" involves the use of signal, stop or yield control on each of the through and most major movements.

- Traffic Operations Policy Directive 13-02, Intersection Control Evaluation (ICE) (PDF)
- Issuance Memorandum, dated August 23, 2013 (PDF)

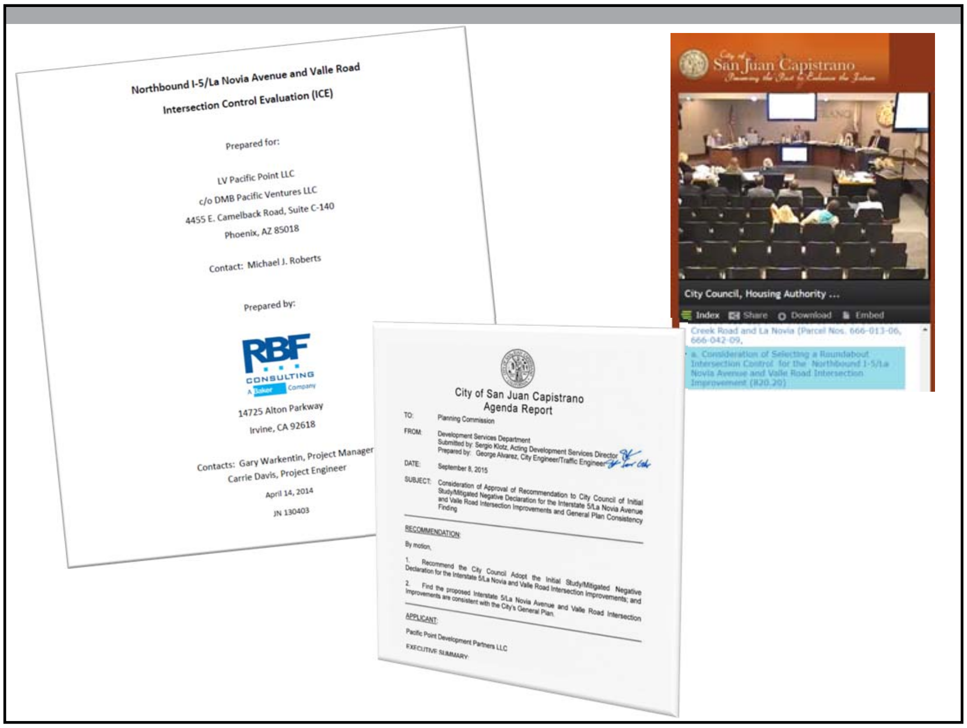
ICE Resources:

- Alternative Intersections/Interchanges: Informational Report (AIIR)
- FHWA Roundabout Website
- Roundabouts: An Informational Guide, Second Edition (NCHRP Report 672) (PDF)
- ICE TOPD Implementation (PDF)
- ICE Process Information Guide, Version 1.0 (PDF)
- Fact Sheet on ICE TOPD (PDF)
- List of Access Strategies & Configurations (PDF)

Traffic/Performance Analysis Methodologies & Tools:

- Roundabout Capacity and Operational Analysis
  - Publication No. FHWA-SA-15-070, Assessment of Roundabout Capacity Models for the Highway Capacity Manual, September 2015 (PDF)
- Safety Performance / Collision Cost Analysis Tool *(Excel spreadsheet)*
  - For general information, please contact a District ICE Coordinator or a Technical Assistance Program Coordinator (listed in the next sections).

http://dot.ca.gov/trafficops/ice.html



ICE Performance Matrix (Alternatives Comparison)

ICE Performance Summary Matrix for NB I-5 / LaNovia & Valle Road Interchange			
Performance Measure	**Alt 2: Signalize Existing I/S**	**Alt 3: Relign & Signalize**	**Alternative 4 Roundabout**
1. Existing AM/PM Average Delay (seconds per vehicle)*	29.6/29.1	28.6/28.7	7.9/9.6
2. Existing AM/PM Volumes Level of Service (LOS)	C/C	C/C	A/A
3. 2035 AM/PM Average Delay (seconds per vehicle)	44.9/46.8	35.7/35.5	24.2/24.4
4. 2035 AM/PM Volumes Level of Service (LOS)	D/D	D/D	C/C
5. Longest Vehicle Queue (2035 pm)	25 cars	17 cars	18 cars
6. Right-of-Way Requirement	None	3,500 ft^2	40 ft^2
7. Construction Traffic Control	$39,100	$108,400	$69,800
8. Retaining Wall	No	Yes	No
9. Project Cost	$940,000	$2,891,000	$1,682,000
10. Benefit (Delay Savings) / Cost Ratio	**2.61**	**0.7**	**6.18**
11. Environmental Document	Mitigated Negative Declaration	Mitigated Negative Declaration	Mitigated Negative Declaration
12. Collision Cost Savings (Life of Project)	**$2,026,000**	**$1,170,000**	**$9,537,000**
13. Safety Performance B/C Ratio	**2.16**	**0.4**	**5.68**

*** The existing average delay (s/veh) based on 2012 traffic volumes is 23.4 (AM) & 59.0 (PM)**

Roundabout Alternative Selected

Photo Source: Gary Warkentin, Michael Baker

Photo source: Brad Orien, MUROW|CM

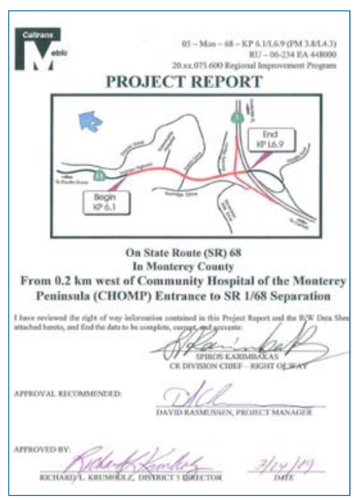
Case Study: Holman Highway Roundabout

Pre-Project Conditions

Case Study: Holman Highway Roundabout

Process

- 2009 Project Report & Environmental Document
  - Roundabout Alternative Rejected
  - Signalize Alternative Approved


05 – Mon – 68 – KP 6.1/L6.9 (PM 3.8/L4.3)
RU – 06-234 EA 448000
20.xx.075.600 Regional Improvement Program

PROJECT REPORT

On State Route (SR) 68
In Monterey County
From 0.2 km west of Community Hospital of the Monterey Peninsula (CHOMP) Entrance to SR 1/68 Separation

I have reviewed the right of way information contained in this Project Report and the R/W Data Sheet attached hereto, and find the data to be complete, current, and accurate:

SPIROS KARIMBAKAS
CR DIVISION CHIEF – RIGHT OF WAY

APPROVAL RECOMMENDED:

DAVID RASMUSSEN, PROJECT MANAGER

APPROVED BY:

RICHARD L. KRUMHOLZ, DISTRICT 5 DIRECTOR

3/24/09
DATE

Ramp Variations - Roundabout

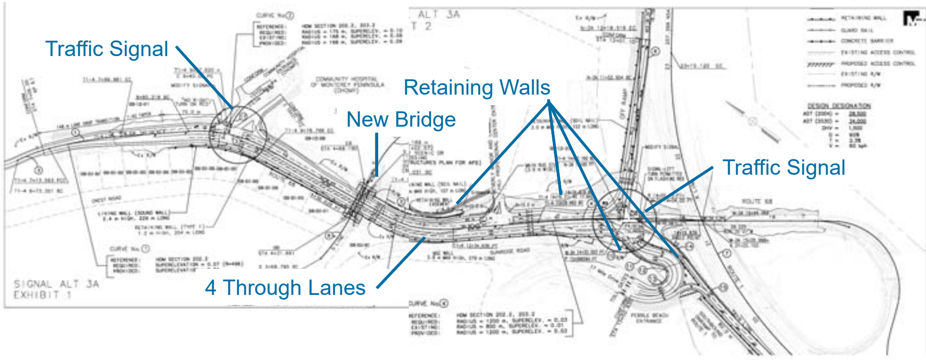
This ramp variation is characterized as a roundabout that would result in one-way circular traffic flow at the intersection of SR 68 and the SR 1 on- and offramps. Traffic would enter this circle in a free-flowing movement with yield at the point of entry into the circle. The southbound offramp right turn movement would bypass the roundabout.

Roundabout variation was rejected by PDT because a one lane roundabout could not provide acceptable level of service and a two lane roundabout could not be constructed given the geometric constraints of the two lane structure over SR 1.

Case Study: Holman Highway Roundabout

Process

Original Approved Project Alternative (2009)



Total Estimated Cost = $21,170,000 (2009)

Case Study: Holman Highway Roundabout

Process

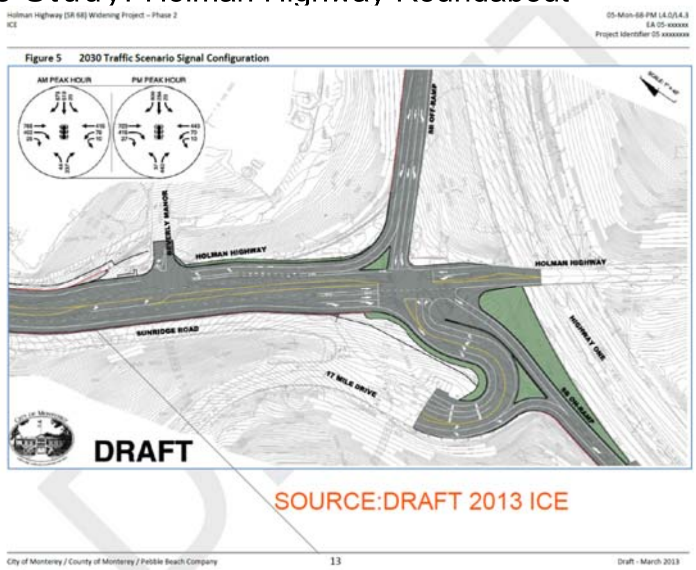
- 2009 Project Report & Environmental Document
  - Roundabout Alternative Rejected
  - Signalize Alternative Approved
- Funding not available – Project Shelved
- 2013 Caltrans Adopts ICE
- The project is revisited through ICE
  - The Roundabout Alternative returns

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION
POLICY DIRECTIVE

TRAFFIC OPERATIONS POLICY DIRECTIVE	NUMBER: 13-02	PAGE: 1 of 10
DENNIS T. AGAR, Chief, Division of Traffic Operations	DATE ISSUED: August 23, 2013	EFFECTIVE DATE: August 30, 2013
SUBJECT: Intersection Control Evaluation (ICE)	DISTRIBUTION:	

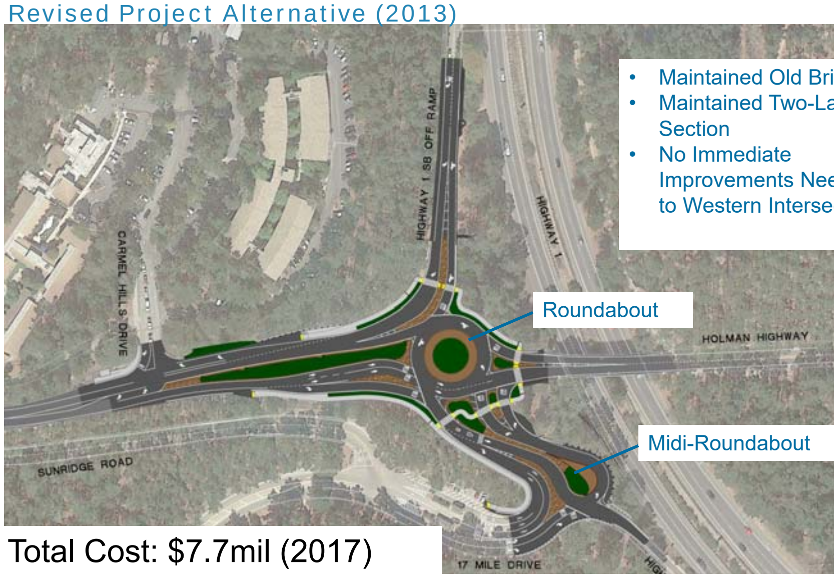
- ☒ All District Directors
- ☒ All Deputy District Directors - Traffic Operations
- ☒ All Deputy District Directors - Maintenance
- ☒ All Deputy District Directors - Construction
- ☒ All Deputy District Directors - Design
- ☒ All Deputy District Directors - Transportation Planning
- ☐ Chief, Division of Engineering Services
- ☒ Chief Counsel, Legal Division

Case Study: Holman Highway Roundabout



Case Study: Holman Highway Roundabout

Revised Project Alternative (2013)



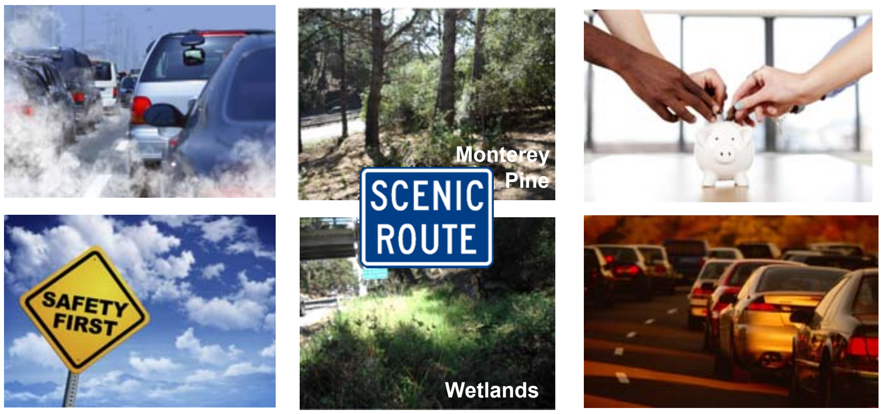
- Maintained Old Bridge
- Maintained Two-Lane Section
- No Immediate Improvements Needed to Western Intersection

Total Cost: $7.7mil (2017)

Case Study: Holman Highway Roundabout

Process

- Roundabout Alternative Selected Because:



ICE Case Studies for 2018 Western/Texas ITE Annual Conference

Case Study: California Blvd Roundabouts

Project Facts

- Safety Concerns
- High congestion area
- Reversal of one way streets
- Entrance to Downtown Napa
- City and State involvement
- Strong cycling community
- Technically challenging

Case Study: California Blvd Roundabouts

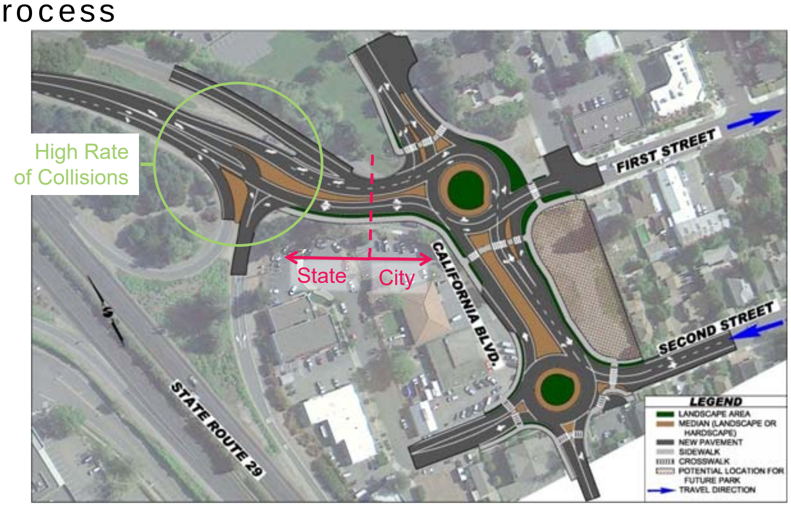
Case Study: California Blvd Roundabouts

Process

- 2012 City Project:
  - Two roundabouts along California Blvd
  - Reduce Congestion
  - Improve pedestrian and cyclists mobility
  - Reverse one way couplet
  - Improve safety

Case Study: California Blvd Roundabouts

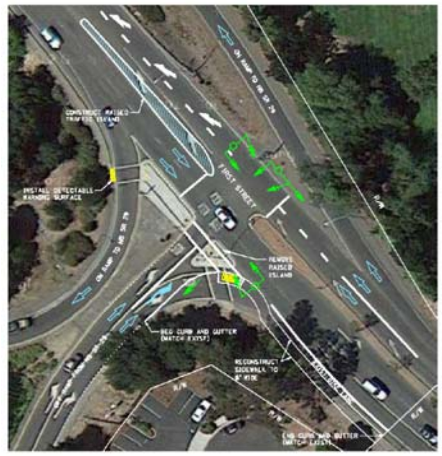
Process



Case Study: California Blvd Roundabouts

Process

- 2012 City Project:
  - 2 Roundabouts + Modification
- 2012 State Programmed Signal Project:
  - Fully signalized intersection impacts adjacent roundabout operations.

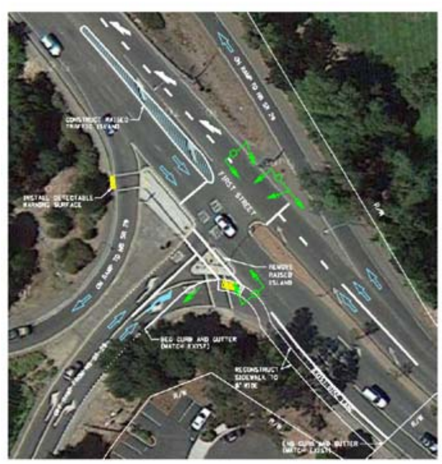


Case Study: California Blvd Roundabouts

Process

- 2012 City Project:
  - 2 Roundabouts + ~~Modification~~
- 2012 State Programmed Signal Project

Signal at Ramps = Significant Queue Spillback into Roundabout



Case Study: California Blvd Roundabouts

Process

- 2012 City Project
  - 2 Roundabouts ~~+ Modification~~
- 2012 State Programmed Signal Project
  - ~~Signal~~
- Back to the drawing board
  - Develop new alternatives
    - Continuous green signal westbound
      - Met Operations
      - Safety concerns still remain

Case Study: California Blvd Roundabouts

Process

- Find a project that:
  - Addresses ramp terminus safety
  - Meeting operational needs for California Blvd

Case Study: California Blvd Roundabouts

Process

- Solution
  - Add a 3rd roundabout

Case Study: California Blvd Roundabouts

Process

- Original Project Costs

Cost Estimate Scenarios	Total Cost (Sup. + Cap.)
2013 City Project	$6.6M
2013 State Project	$1.4M
Total Cost	**$8.0M**

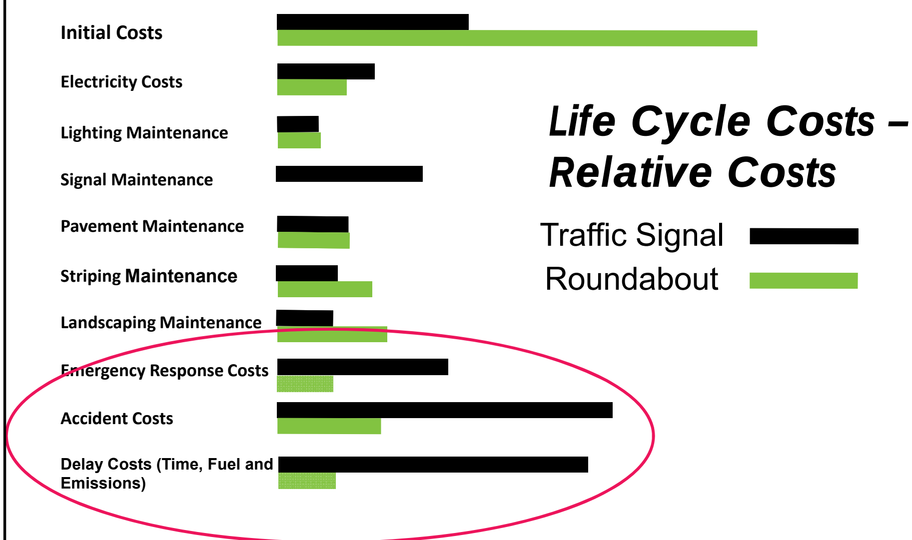
- Revised Stand Alone Projects

Cost Estimate Scenarios	Total Cost (Sup. + Cap.)
2013 City Project	$6.6M
State Roundabout	$5.8M
Total Cost	**$12.4M**

- Combined Project
  3 Roundabouts

Cost Estimate Scenarios	Total Cost (Sup. + Cap.)
Combined Project Delivered Together	**$11.5M**

Case Study: California Blvd Roundabouts



Case Study: California Blvd Roundabouts

Case Study: Interstate 5 / South Bonnyview

ICE Case Studies for 2018 Western/Texas ITE Annual Conference

Case Study: Interstate 5 / South Bonnyview

ICE Case Studies for 2018 Western/Texas ITE Annual Conference

Case Study: Interstate 5 / South Bonnyview

ICE Case Studies for 2018 Western/Texas ITE Annual Conference

Case Study: Twin Cities Road/State Route 99 Roundabout Interchange

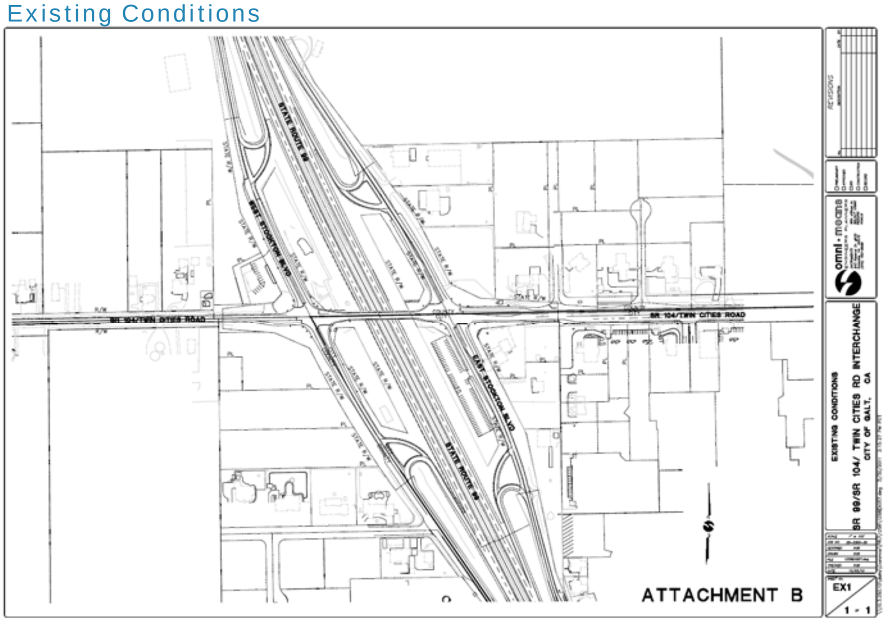
Project Facts

- Pre- ICE
- Unacceptable Levels of Service and Queues
- Two State Highways
- State, City, County, and Private property owner involvement
- Signal Alternative was $32 Million more than roundabouts

Case Study: Twin Cities/SR 99 Interchange

Case Study: Twin Cities/SR 99 Interchange

Existing Conditions

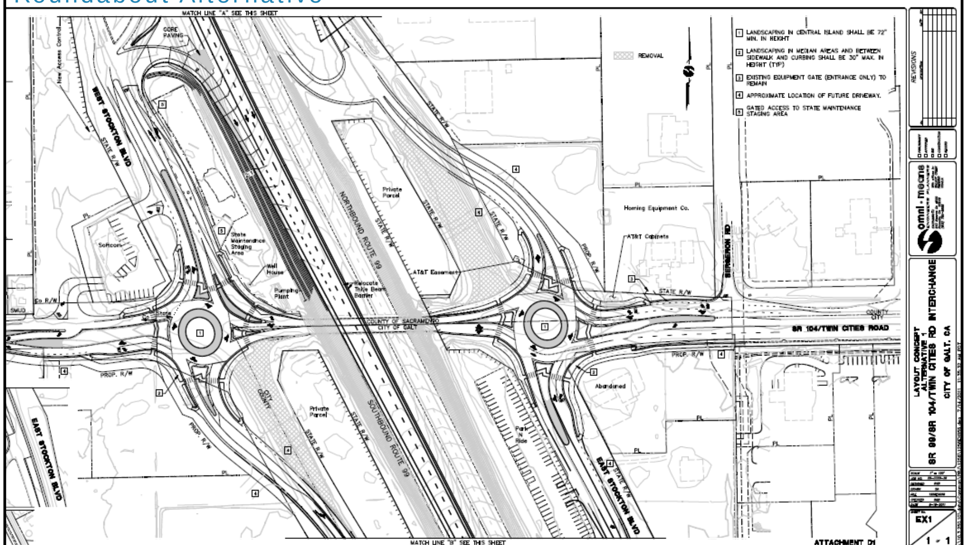


Case Study 3: Twin Cities/SR 99 Interchange

Signal Alternative

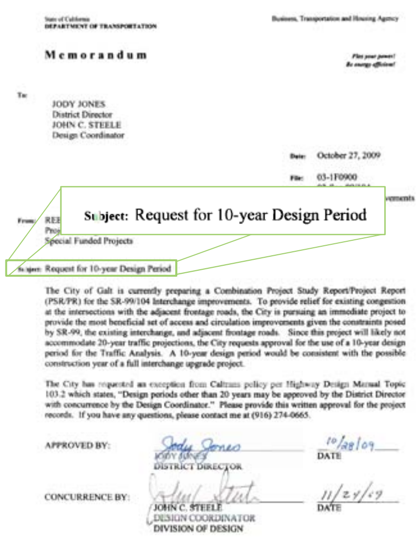
Case Study 3: Twin Cities/SR 99 Interchange

Roundabout Alternative



Case Study: Twin Cities/SR 99 Interchange

Process



State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power! Be energy efficient!

To: JODY JONES
District Director
JOHN C. STEELE
Design Coordinator

Date: October 27, 2009

File: 03-1F0900

From: REE...
Pro...
Special Funded Projects

Subject: Request for 10-year Design Period

The City of Galt is currently preparing a Combination Project Study Report/Project Report (PSR/PR) for the SR-99/104 Interchange improvements. To provide relief for existing congestion at the intersections with the adjacent frontage roads, the City is pursuing an immediate project to provide the most beneficial set of access and circulation improvements given the constraints posed by SR-99, the existing interchange, and adjacent frontage roads. Since this project will likely not accommodate 20-year traffic projections, the City requests approval for the use of a 10-year design period for the Traffic Analysis. A 10-year design period would be consistent with the possible construction year of a full interchange upgrade project.

The City has requested an exception from Caltrans policy per Highway Design Manual Topic 103.2 which states, "Design periods other than 20 years may be approved by the District Director with concurrence by the Design Coordinator." Please provide this written approval for the project records. If you have any questions, please contact me at (916) 274-0665.

APPROVED BY: Jody Jones — JODY JONES, DISTRICT DIRECTOR — 10/28/09 DATE

CONCURRENCE BY: JOHN C. STEELE, DESIGN COORDINATOR, DIVISION OF DESIGN — 11/24/09 DATE

"Caltrans improves mobility across California"

03-SAC-99/104
EA 03-1F0900
September 2011

Project Study Report – Project Report
To
Provide Project Approval

On Route 99 and 104/Twin Cities Road

Between PM 3.6

And PM 4.2

I have reviewed the right of way information contained in this Project Study Report-Project Report and the R/W Data Sheet attached hereto, and find the data to be complete, current and accurate:

BRENDA L. SCHIMPF, PMP
CHIEF NORTH REGION RIGHT OF WAY

APPROVAL RECOMMENDED: REBECCA MOWRY, PROJECT MANAGER

APPROVED: JODY JONES, DISTRICT DIRECTOR — 9/19/11 DATE

Case Study: Twin Cities/SR 99 Interchange

Case Study: Holman Highway Roundabout

Project Facts

- Pre-ICE/During ICE Implementation
- High congestion area
- High profile area
- Environmentally sensitive & scenic location
- Junction of two State Highways
- Only access to peninsula’s community hospital
- Multiple stakeholders – public and private
- Technically challenging
- Public-private partnership

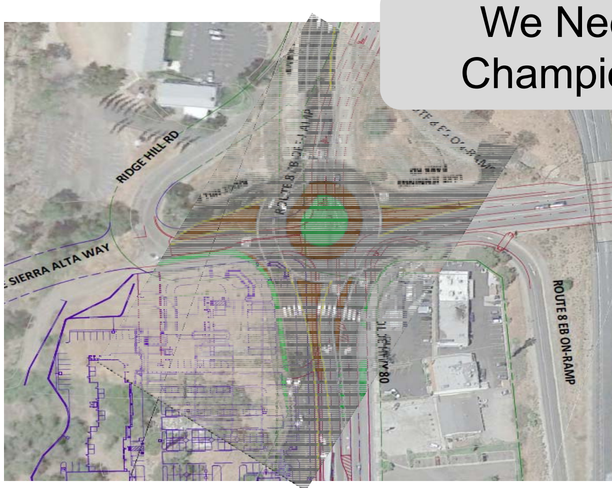
Innovative Intersections as a Solution: Under-utilized or Resisted

Proven as an effective solution:

- ~25 RNDBT VS 8,000 Signals (Caltrans)
- Nationally??
- has **not been tried (locally, regionally or statewide)**
- viewed as **unconventional, controversial, or inappropriate** (risky)

Under-utilized or Resisted

We Need Champions



Why?

Resistance at local/state level

~50% of the States missing out on benefits

Medium for promoting innovative intersections

Raise Awareness among DOT’s

- Peer-Peer Exchanges

TRB Webinars

Case Study Acknowledgements

MTJ Roundabout Engineering

Roundabout Concept Design/ Optimization/ Peer Review Services on:

- Twin Cities/SR 99
- Holman Highway Roundabout
- California Blvd. Roundabouts

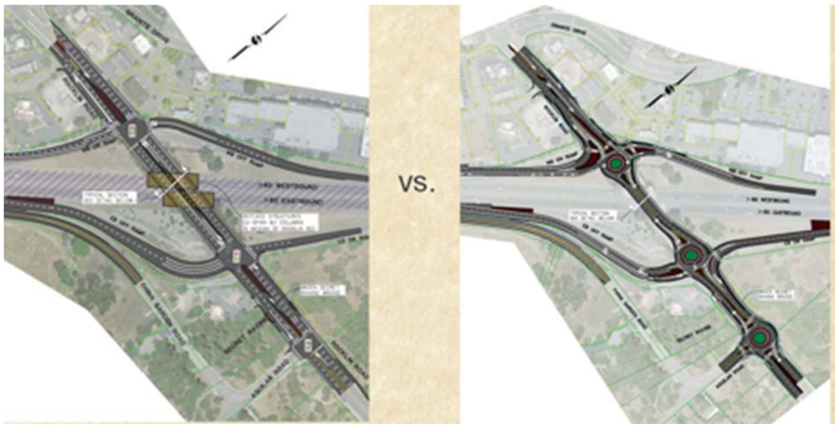
Questions?

Case Study: Rocklin Road Roundabout Corridor

Project Facts

- Poor traffic operations in existing condition
- Originally planned 6 lane corridor
- Originally required acquisition of multiple properties
- Adjacent to a fire station
- Adjacent to police department
- Adjacent to a school
- Part of a 5 roundabout corridor

Case Study: Rocklin Road Roundabout Corridor



Case Study: Rocklin Road Roundabout Corridor

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ICE Case Studies for 2018 Western/Texas ITE Annual Conference

Case Study 3: Rocklin Road Roundabout Corridor

Before

After

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Case Study: State Route 49/Main Street Roundabout

Project Facts

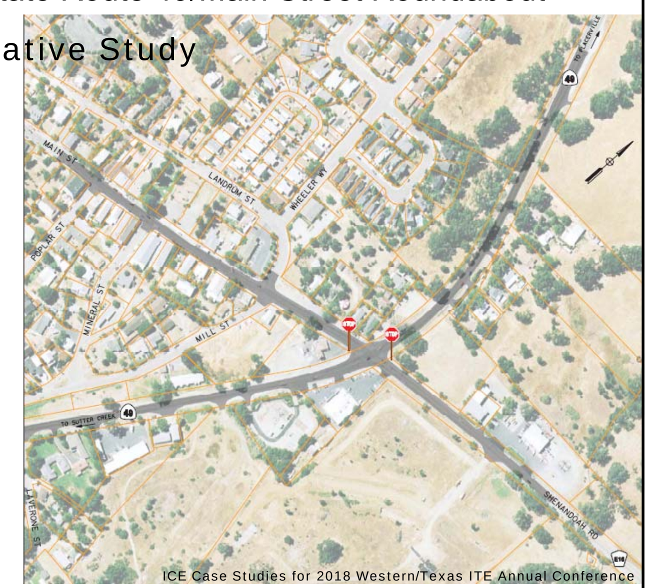
- Higher than average collision rates
- High speed approach
- Sight distance issues
- Gateway to local wine region
- Publicly sensitive project

Case Study: State Route 49/Main Street Roundabout

Project Alternative Study

Alternative 1
Existing Condition
(at time of study):

No Build - Partial Stop Control



Case Study: State Route 49/Main Street Roundabout

Project Alternative Study

Alternative 2:

Roundabout Control

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Case Study: State Route 49/Main Street Roundabout

Project Alternative Study

Alternative 3:

Signalized Intersection

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Case Study: State Route 49/Main Street Roundabout

Project Alternative Study

	Roundabout Alternative 2	Traffic Signal Alternative 3
Roadway Construction	$2,200,000	$4,200,000
Structures Construction	$0	$0
Right of Way / Utilities	$500,000	$600,000
Capital Cost Subtotal	**$2,700,000**	**$4,800,000**
Preliminary Engineering	$656,000	$656,000
Right of Way Support	$85,000	$85,000
Construction Engineering	$252,000	$480,000
Support Cost Subtotal	**$993,000**	**$1,221,000**
Project Total Cost	**$3,693,000**	**$6,021,000**

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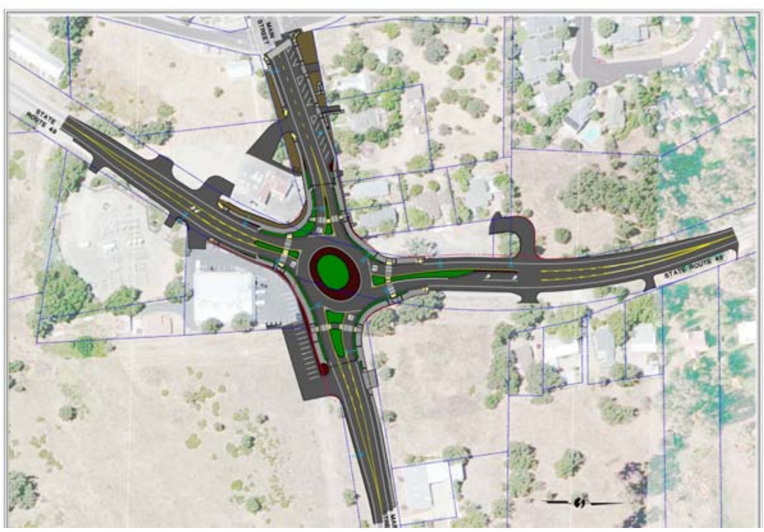
Case Study: State Route 49/Main Street Roundabout



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Case Study: State Route 49/Main Street Roundabout

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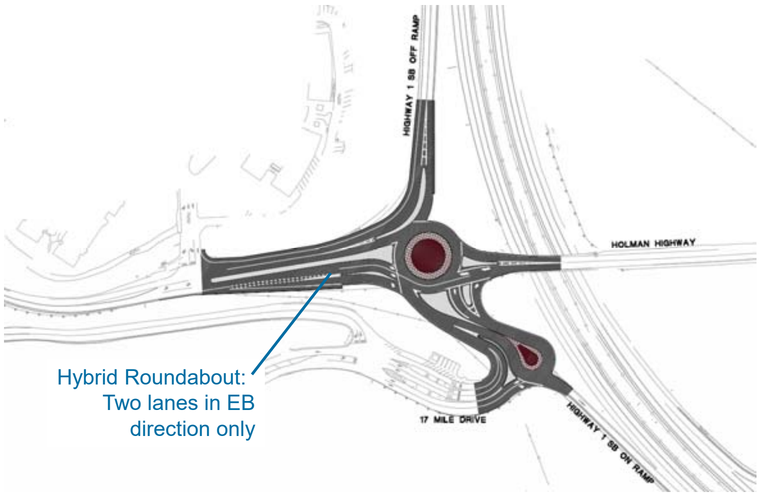
Why? Cost Effective

Real Project Example: Lifecycle Cost Analysis

Life Cycle Costs (Interim design)	Roundabouts	Signals
Benefits - due to reduced Collision and Mobility Costs (Roundabout VS Signals)		
Collision Costs of predicted crashes	$4,950,000	$15,520,000
Delay Costs	$899,343	$2,476,619
Fuel and GHG Costs	$1,753,112	$2,275,501
Total Benefit (due to reduced costs)	$7,602,454	$20,272,120
Project Costs including design, construction and maintenance (Roundabouts VS Signal)		
Operations and Maintenance Costs	$18,250	$32,444
Project Costs (including soft costs)	$8,250,000	$7,112,000
Total Costs	$8,268,250	$7,144,444
Total Life Cycle Costs (Opening Year $) - Net Present Value	$15,870,704	$27,416,564
Life Cycle Benefit/Cost Ratio		
Benefit (Total Benefit Signal - Roundabout)	$12,669,666	
Costs (Total Costs Roundabout - Signal)	$1,123,806	
B/C Ratio (Roundabout to Signal)	11.3	

Modern Roundabouts for 2017 MASITE Annual Conference

Case Study: Holman Highway Roundabout



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Case Study: Holman Highway Roundabout

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ICE Case Studies for 2018 Western/Texas ITE Annual Conference

Case Study: Holman Highway Roundabout

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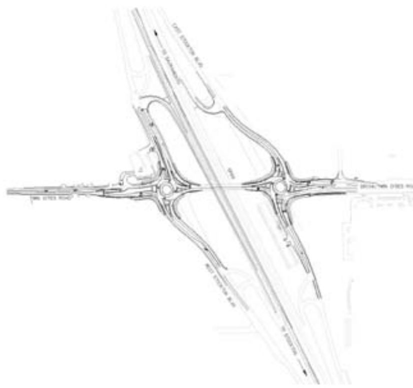
Case Study: Twin Cities/SR 99 Interchange

Process

03-SAC-99/104
PM 3.60/4.20
SR99 at SR104/Twin Cities Road
EA 03-1F0900

Concept Approval Report (CAR)

State Route 99 at State Route 104/Twin Cities Road/ Stockton Boulevard
Interchange Project



Located in Sacramento County, Galt, California

1

February, 2011

03-SAC-99/104
EA 03-1F0900
July 2011

Project Study Report – Project Report

To
Provide Conceptual Approval
and
Approve Circulation of the
Draft Environmental Document

On Route 99 and 104/Twin Cities Road

Between PM 3.6

And PM 4.2

I have reviewed the right of way information contained in this Project Study Report-Project Report and the R/W Data Sheet attached hereto, and find the data to be complete, current and accurate:

BRENDA L. SCHIMPF, PMP
CHIEF NORTH REGION RIGHT OF WAY

APPROVAL RECOMMENDED:
REBECCA MOWRY
PROJECT MANAGER

APPROVED:
JODY JONES
DISTRICT DIRECTOR

7/11/11
DATE

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Case Study: Twin Cities/SR 99 Interchange

Process

TABLE 5A
YEAR 2013 - ALTERNATIVE 1, OPTION 2
SURFACE STREET CONDITIONS: INTERSECTION LEVEL OF SERVICE

#	Intersection	Control Type[1,2]	Target LOS	AM Peak Hour		PM Peak Hour	
				Delay	LOS	Delay	LOS
3	Twin Cities Road/West Stockton Boulevard	RNDBT	D	8.0	A	9.6	A
4	Twin Cities Road/East Stockton Boulevard	RNDBT	D	8.8	A	8.1	A
5	Twin Cities Road/Bergeron Road	TWSC	D	31.8	D	25.7	D

Notes:
1. TWSC = Two Way Stop Control
2. LOS = Delay based on worst minor street approach for TWSC intersections
3. RNDBT = Roundabout

TABLE 5B
YEAR 2013 - ALTERNATIVE 1, OPTION 2
SURFACE STREET CONDITIONS: 95TH PERCETILE QUEUE LENGTHS

Queue Segment - Direction	No. Lanes	Total Avail. Storage (ft)	95th Percentile Queue: AM Peak Hour	95th Percentile Queue: PM Peak Hour
Twin Cities Road/West Stockton Boulevard				
Northbound Left-Through-Right	1	500	25	55
Westbound Left-Through	1	400	40	30
Westbound Right	1	100	0	0
Southbound Left-Through	1	400	60	125
Southbound Right	1	400	25	20
Eastbound Left-Through	1	500	40	100
Eastbound Right	1	150	20	45
Twin Cities Road/East Stockton Boulevard				
Northbound Left-Through	1	500	35	35
Northbound Right	1	150	30	95
Westbound Left-Through	1	280	275	160
Westbound Right	1	280	105	70
Southbound Left-Through-Right	1	400	15	10
Eastbound Left-Through-Right	2	450	75	155

TABLE 5C
YEAR 2023 - ALTERNATIVE 1, OPTION 2
SURFACE STREET CONDITIONS: INTERSECTION LEVEL OF SERVICE

#	Intersection	Control Type[1,2]	Target LOS	AM Peak Hour		PM Peak Hour	
				Delay	LOS	Delay	LOS
3	Twin Cities Road/West Stockton Boulevard	RNDBT	D	8.5	A	13.7	B
4	Twin Cities Road/East Stockton Boulevard	RNDBT	D	11.2	B	12.8	B
5	Twin Cities Road/Bergeron Road	TWSC	D	31.8	D	25.7	D

Notes:
1. TWSC = Two Way Stop Control
2. LOS = Delay based on worst minor street approach for TWSC intersections
3. RNDBT = Roundabout

TABLE 5D
YEAR 2023 - ALTERNATIVE 1, OPTION 2
SURFACE STREET CONDITIONS: 95TH PERCETILE QUEUE LENGTHS

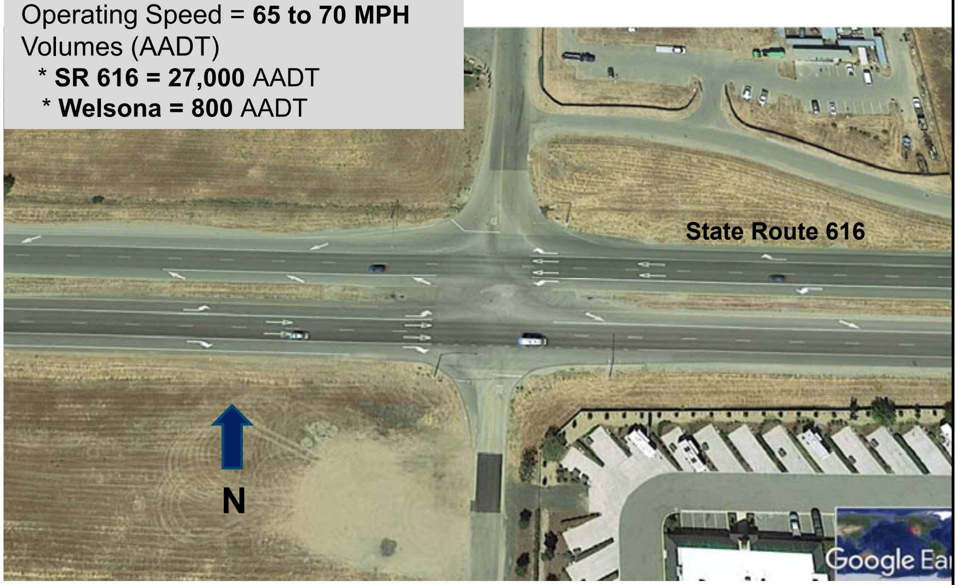
Int #	Queue Segment - Direction	No. Lanes	Total Avail. Storage (ft)	95th Percentile Queue: AM Peak Hour	95th Percentile Queue: PM Peak Hour
3	***Twin Cities Road/West Stockton Boulevard***				
	Northbound Left-Through-Right	1	500	55	50
	Westbound Left-Through	1	400	65	75
	Westbound Right	1	100	0	0
	Southbound Left-Through	1	400	80	250
	Southbound Right	1	400	35	30
	Eastbound Left-Through	1	500	55	225
	Eastbound Right	1	150	40	90
4	***Twin Cities Road/East Stockton Boulevard***				
	Northbound Left-Through	1	500	45	75
	Northbound Right	1	150	65	325
	Westbound Left-Through*	1	280	275	160
	Westbound Right	1	280	200	170
	Southbound Left-Through-Right	1	400	40	40
	Eastbound Left-Through-Right	2	450	105	235

* Reported queue is maximum queue per VISSM

ICE Screening Example:
Intersection Crash Concentration

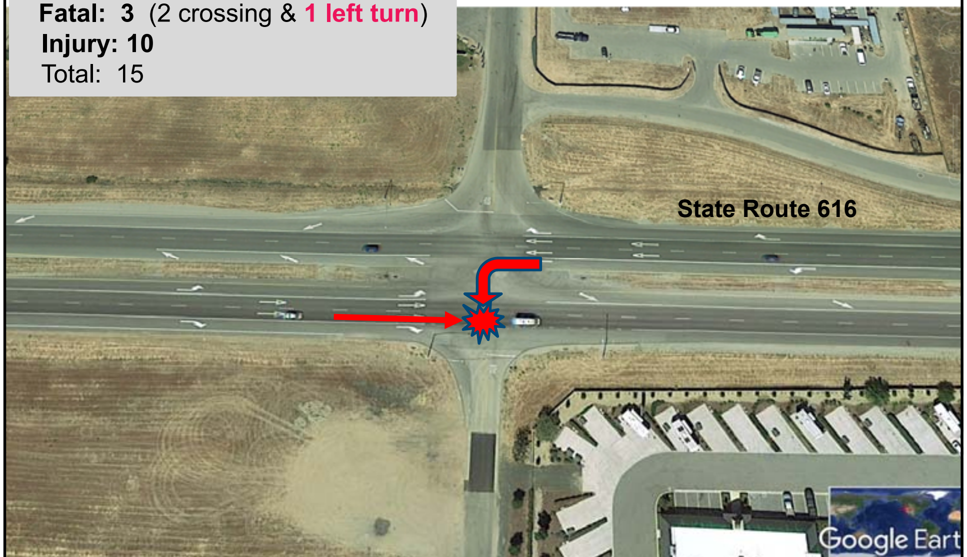
Location: State Route 616 at Welsona Road (minor)

Existing Control: **2-Way Stop Only**
Operating Speed = **65 to 70 MPH**
Volumes (AADT)
* **SR 616 = 27,000** AADT
* **Welsona = 800** AADT



Collision History (3 years)

Fatal: 3 (2 crossing & **1 left turn**)
Injury: 10
Total: 15



Collision History (3 years)

Fatal: 3 (**2 crossing** & 1 left turn)
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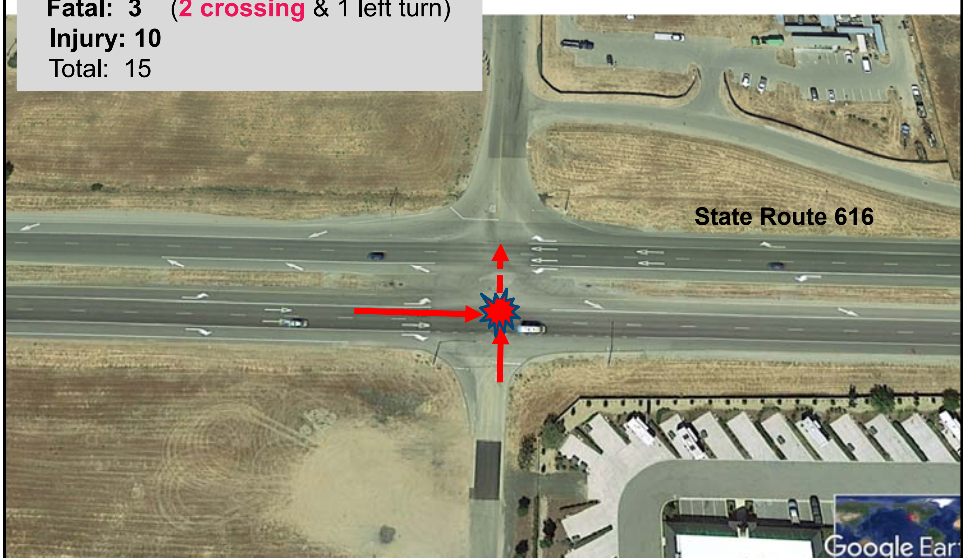


Preparation for ICE Step 1

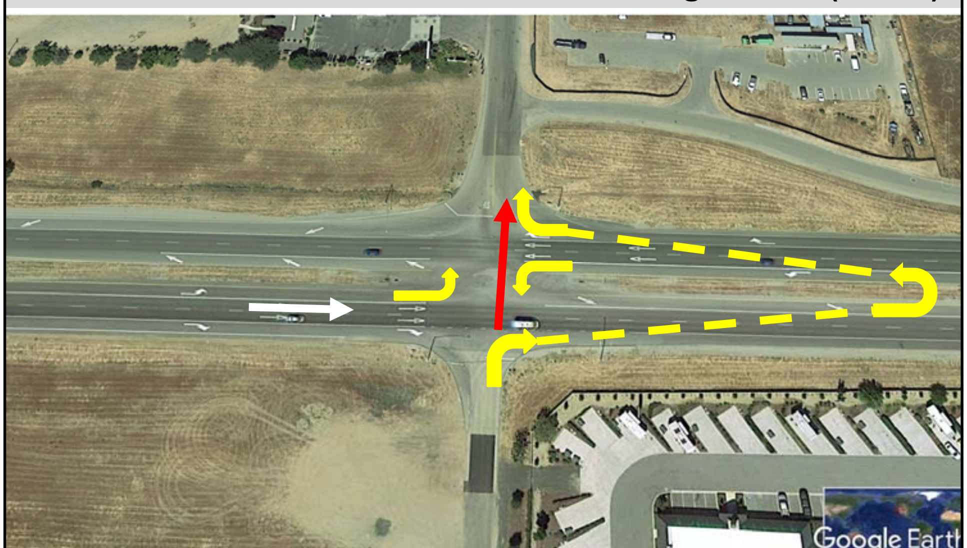
Identify Potential Safety Countermeasures for consideration *(what do you suggest?)*

Alternative Solution: **Traffic Signal**

Alternative Solution: **ROUNDABOUT** (***Size / Type?***)

Operating Speed = **65 to 70 MPH**
Volumes (AADT)
* **SR 616 = 27,000**
* **Welsona = 800**

Alternative Solution: **Restricted Crossing U-Turn (RCUT)**



Preparation for ICE Step 1

List of Potential Safety Countermeasures:

- Convert to Multi-Way Stop Control
- Install Traffic Signal
- Convert to Roundabout
- Restrict Crossing and/or Turning Movements
- **Other?**

KEYS:

1. **Do "partners" agree on countermeasures that can be dropped based on collective engineering judgment?**
2. **Which partners matter?**

Interchange Alternative

ICE Step 1: Screening *RESULTS*

Which Potential Countermeasures can be discarded?

- ~~Multi-Way Stop Control~~
- ~~Traffic Signal~~
- ✓ Roundabout
- ✓ Restricted Crossing U-Turn (RCUT)
- Other?
  - ✓ **Interchange Concept *(yes, but ....)***

NOTE: Principals need to agree on RESULTS

ICE Step 1: Cost Assessment

~~**Traffic Signal:**~~
Roundabout: $3 M (approximate for multi-lane)
RCUT: $1 M (approximate)
Interchange: $11 M (approximate)

ICE Step One: Safety Assessment

Safety Performance Analysis estimates the:

* Reduction in crashes
* Crash cost savings ($)

Analytical Tools

* State DOT Crash Prediction Spreadsheet

Methodology & Tools

* **Highway Safety Manual Methodology**
  - High-level examples

Replace with a Roundabout

Table 14-4. Potential Crash Effects of Converting a Stop-Controlled Intersections into a Modern Roundabout (29)

Setting (Intersection Iype)	Traffic Volume	Crash Iype (Severity)	CMF	Std. Error
All settings (One or two lanes)		All types (All severities)	0.56	0.05
		All types (Injury)	0.18	0.04
Rural (One lane)		All types (All severities)	0.29	0.04
		All types (Injury)	0.13	0.04

Replace with a Signal

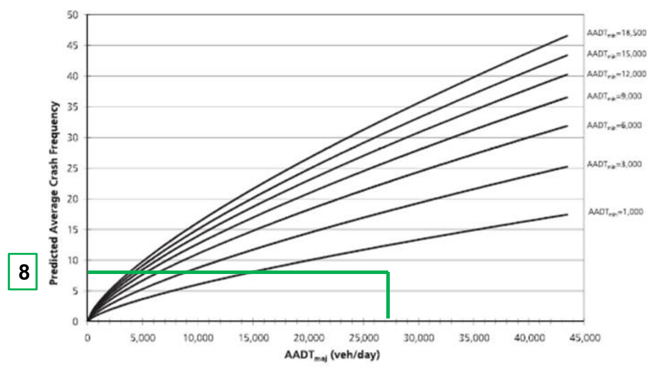


Figure 11-7. Graphical Form of SPF for Four-leg Signalized Intersections—for Total Crashes Only (from Equation 11-11 and Table 11-7)

ICE Safety Performance Analysis

How do we estimate / predict collisions frequency & severity for:

- **Interchange Alternative**

How will an “Interchange” change this crash type?

Where are crashes most expected to occur?

ICE Safety Performance Assessment

For Interchange Alternative:

- **All crossing & left-turn crashes will be eliminated or converted to fewer & lower speed (severity) crashes at ramp intersections**

  → Crash Cost Savings per year …?

Ultimately, a *Safety Benefit / Cost Ratio* can be calculated for each Alternative

Tools to Support ICE

National Resources

- CAP-X (**UPDATED Coming Summer 2018!**)
- SPICE (**NEW Coming Summer 2018!**)
- LCCET (via NCHRP 03-110)

State Resources

- Kentucky (IDAT)
- Georgia (ICE Tool)
- Virginia (V-JuST)
- Florida, Pennsylvania

Pre-ICE Control Options

- Mostly ("de facto") minor route stop (TWSC), All Way Stop (AWSC) or Traffic Signal
- Largely viewed through a mainline operations lens (i.e., volume-based warrants, no explicit safety screening)
- Separate and involved process(es) for vetting "other", non-conventional alternatives
  - Some recent state policies require roundabout "consideration" but lack performance-based metrics

Lead State Lessons Learned

ICE helped meet the following needs:

- advancement of alternative intersections
- Consideration of data-driven safety performance analysis
- Addresses concerns about the sufficiency and consistency of documentation
- Provides a framework for early assessment of non-motorized travel options

Long Term Vision for IIG

Agencies include these EDC intersection solutions in their evaluation processes or policies in a manner that ensures they are considered and evaluated alongside other improvement alternatives, and implemented when appropriate.

aka Intersection Control Evaluation (ICE) Policies/Procedures

Today's Agenda

Time	Topic	Presenters
2:30	Welcome Introduction of Presentation Team	Jerry Champa
2:35	Welcome to the Modern ICE Age Why Policy Matters Modern Solutions for Access Needs & Problems	Jeff Shaw
2:50	ICE Formula: Policy, Tools & Key Resources How to Predict Size & Performance How ICE is Saving Lives, the Planet, Marriages, etc.	Jerry Champa Hillary Isebrands
3:20	Case Studies How ICE changed project decisions & outcomes: Traffic & Safety Analysis Methodologies and Tools	Hillary Isebrands Kamesh Vedula Lindsey Van Parys
4:10	Question & Answer Session	All Presenters & Special Guests

2018 Western/Texas ITE Annual Conference

THE ORANGE COUNTY REGISTER

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TRENDING: Where to watch World Cup | Chapman's Koch controversy | Cheesecake Factory wage theft | Swim coach's questionable legacy

NEWS > LOCAL NEWS

Traffic circle to bring relief to San Juan Capistrano drivers

San Juan Capistrano's first roundabout, nearing completion at Valle Road and La Novia Avenue, is designed to improve flow at a disjointed intersection off I-5

By FRED SWEGLES | fswegles@scng.com | Orange County Register
January 31, 2017 at 8:14 pm

SAN JUAN CAPISTRANO – The city is just weeks away from opening its first traffic circle, expected to ease the way for motorists as they exit northbound I-5 into what, until now, has been a disjointed San Juan Creek Road off-ramp.

Streets there aren't symmetrically lined up, and drivers arriving at stop signs have tended to hesitate, unsure if it is their turn to go. The off-ramp sometimes backs up.

Putting a traffic circle at the intersection of Valle Road and La Novia Avenue is designed to create much freer flow, eliminating the need for stop signs. Instead of drivers having to stop on each corner, they will be free to enter the circle if no one in the circle is approaching them.

"The person in the circle has the right of way," said George Alvarez, city engineer. "The person entering the roundabout has to yield."

Taylor Morrison Homes is building the roundabout for the city, estimated to cost over $1.6 million, as an offset for impacts of the nearby 416-home Pacifica San Juan community. Pacifica San Juan presently has no road connection to Valle Road, but once the roundabout opens, Taylor Morrison will be authorized to provide one.