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New Mexico Transportation Safety Summit

Intersection Control Evaluations in the West

September 16, 2025 | Jacob Farnsworth, PE

Agenda

- Background and Introduction
- Intersection Control Evaluation (ICE) Introduction
- National Best Practices/Literature Review
- ICE in the West
- Benefits & Application of ICE
- Questions

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Introduction and Background

- **Safety Experience**
  - Crash Prediction
  - Planning/Operations
  - Design
  - TRB Committee on Safety Data, Analysis, and Performance
- **Safety Projects**
  - Development of DOT ICE Programs
  - Strategic High Safety Plans (SHSP)
  - Road Safety Audits (RSA)

ICE Introduction

ICE Definition

Intersection Control Evaluation (ICE) is a data-driven, performance-based framework and approach used to objectively screen alternatives and identify an optimal geometric and control solution for an intersection. (FHWA)

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Intersection Control Evaluation (ICE) is a ***data-driven***, ***performance-based*** framework and approach used to ***objectively screen*** alternatives and identify an ***optimal geometric and control solution*** for an intersection. (FHWA)

Why ICE?

Although there are differences among states ICE policies and programs, they are consistent in emphasizing transparency, flexibility, and adaptability.

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Although there are differences among states ICE policies and programs, they are consistent in emphasizing ***transparency***, ***flexibility***, and ***adaptability***.

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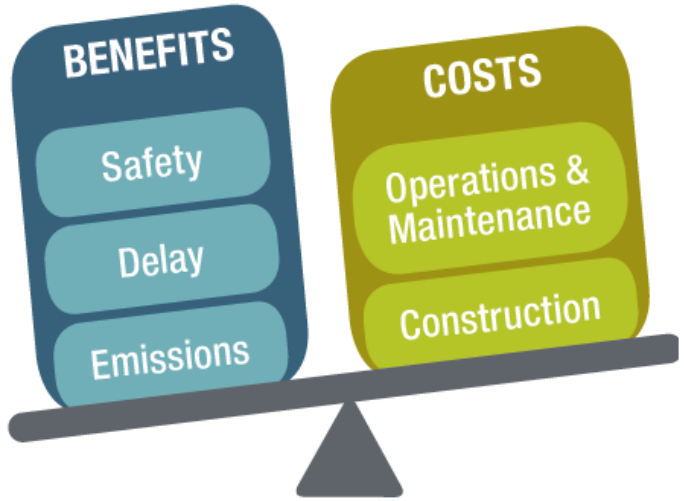
Performance Measures

1. **Safety**
2. **Delay** (travel time reduction savings)
3. **Emission reductions** (not used in some states)
4. **Operations and maintenance**
5. **Initial capital cost**

Benefit Performance Measures calculate the benefits of an alternative compared to the existing condition

Cost Performance Measures calculate the added costs of an alternative compared to the existing condition



When to use ICE?

ICE should be considered for new intersections or when considering a substantive changes to the traffic control or geometry of existing intersections.

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ICE should be considered for new intersections or when considering a ***substantive*** changes to the traffic control or geometry of existing intersections.

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What does ICE look like?

ICE procedures should be flexible, scalable, and encourage a level of analysis consistent with the questions that need to be answered and decisions that need to be made on a specific project.

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ICE procedures should be ***flexible, scalable***, and encourage a ***level of analysis*** consistent with the questions that need to be answered and decisions that need to be made on a specific project.

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Literature Review

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Literature Review Overview

- NCHRP Report 1087
- Other States ICE Practices
- ICE Implementation Tools
- Key Takeaways

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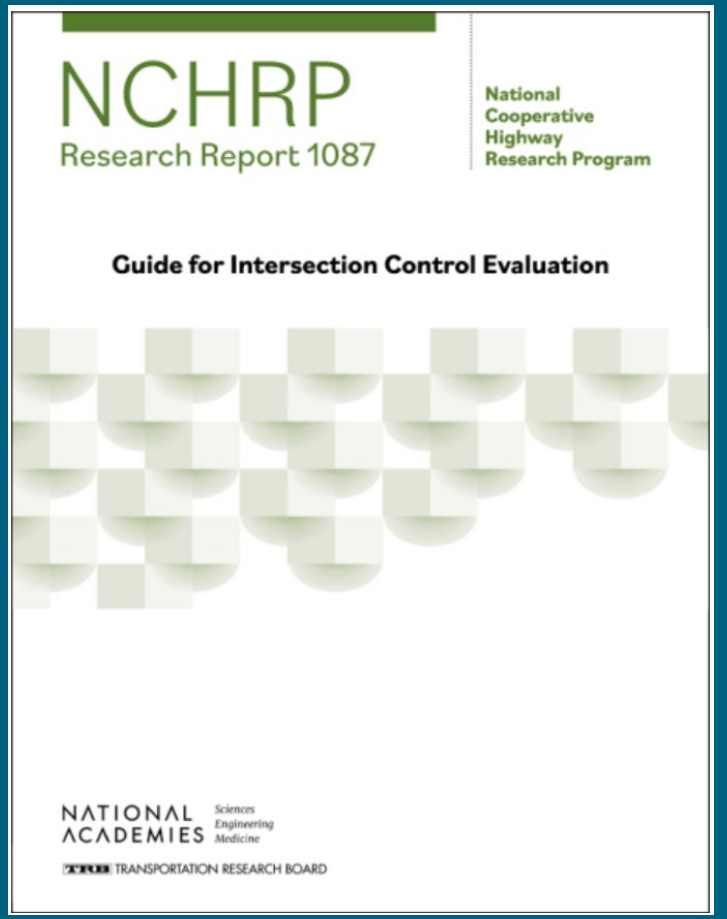
NCHRP Report

- **Introduction**
- **Framework for ICE**
  - Development Questions
- **Typical ICE Process – Stages**
- **Implementing ICE**
  - Testing & Refinement
  - Outreach
- **Analysis Methodology & Tools**



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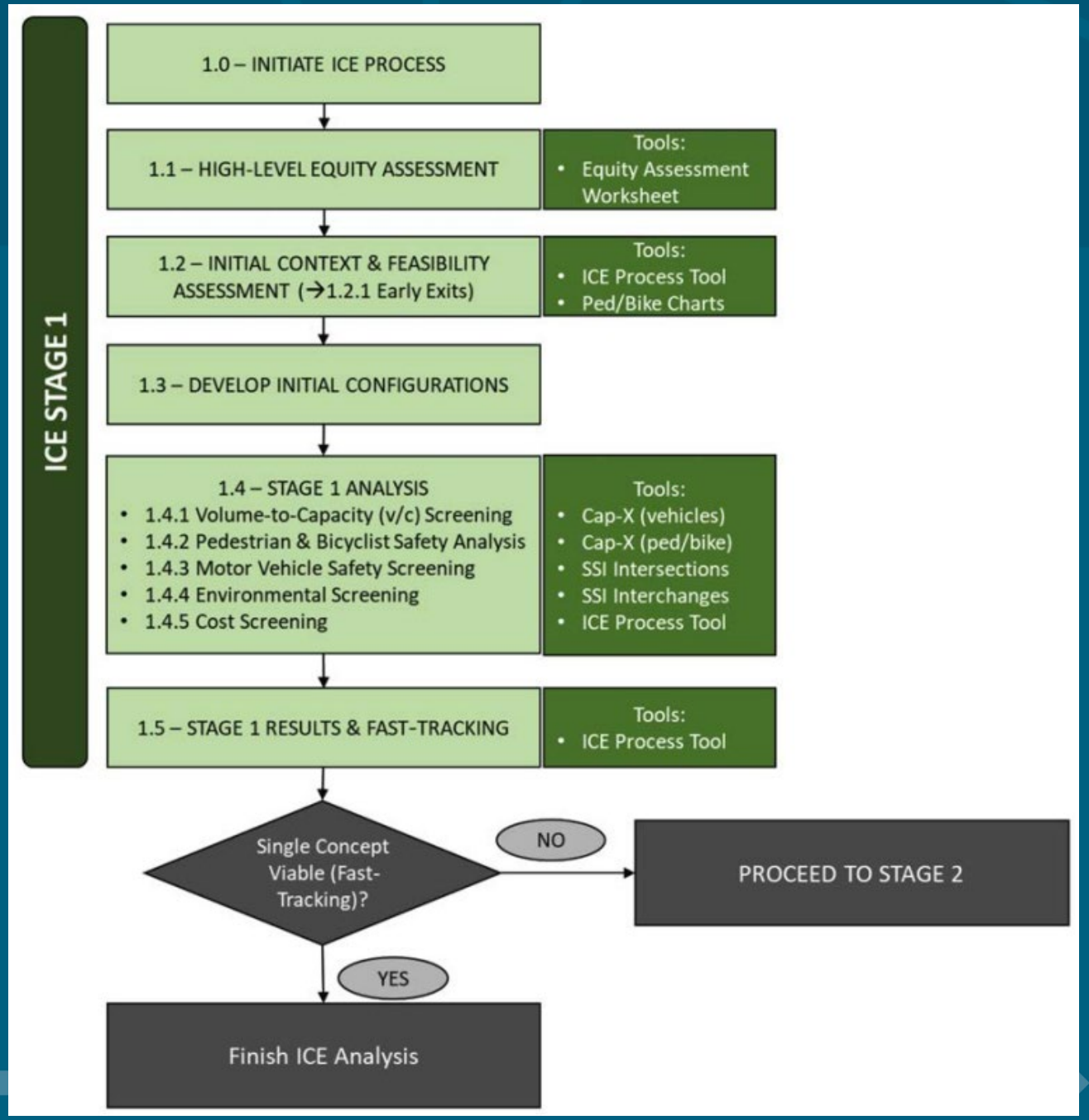
Development Questions

- Why is the agency implementing ICE?
- Who will apply the ICE process?
- When in the PDP is ICE first applied?
- How will intersection concept be identified?
- How many stages will the ICE process have?
- What methods & tools should be used?
- How will a preferred concept by selected?
- What approvals are needed?

Stage 1



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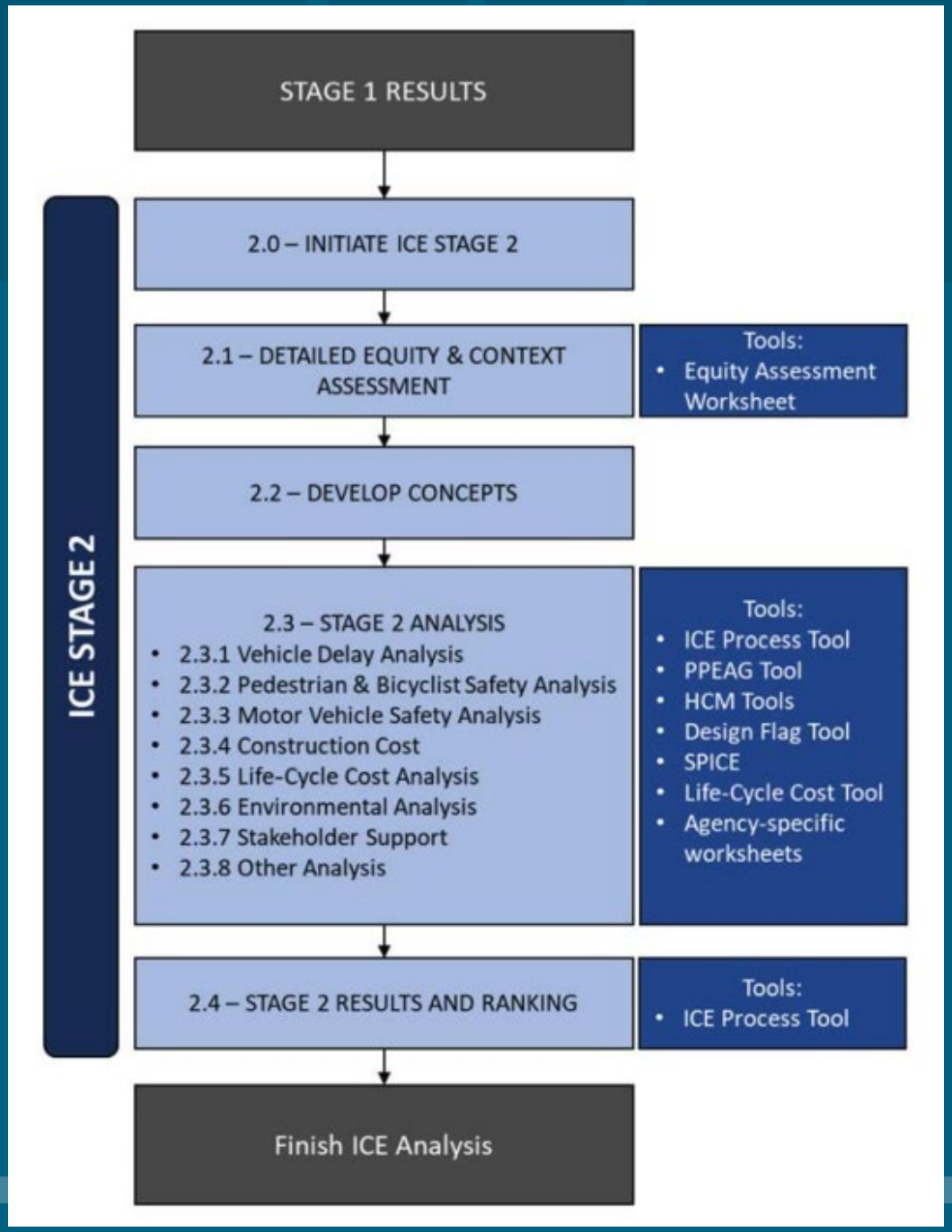
Stage 2



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Stages of ICE

- **Stage 1 – Alternative Screening**
  - Determine a short list of all possible alternatives
- **Stage 2 – Alternative Assessment**
  - Determine the preferred alternative based on more detailed evaluations

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States Summary

State	State ICE Tools				
	CAP-X	SPICE	State Tool	ICE Policy	ICE Manual
California	X	X	X	X	X
Colorado			X	X	
Florida	X	X	X		X
Georgia			X	X	X
Indiana	X			X	
Kentucky	X	X		X	
Louisiana	X	X		X	
Massachusetts	X		X	X	X
Minnesota				X	X
Nevada			X	X	
Utah	X	X	X		
Virginia			X		X

Common Elements

- **Formal Policy**
  - Background and/or purpose
  - When ICE is and is not required
  - Approval / waiver process
  - Fast tracking
  - Exceptions
- **2-3 Stages**
- **Workflow or Process**
- **ICE Tools**

Stages of ICE

- **2-Stage Process**
  - Screening / Preliminary Analysis
  - Detailed Analysis / Alternative Selection

- **3-Stage Process**
  - Screening
  - Initial Analysis / Assessment
  - Detailed Analysis / Assessment

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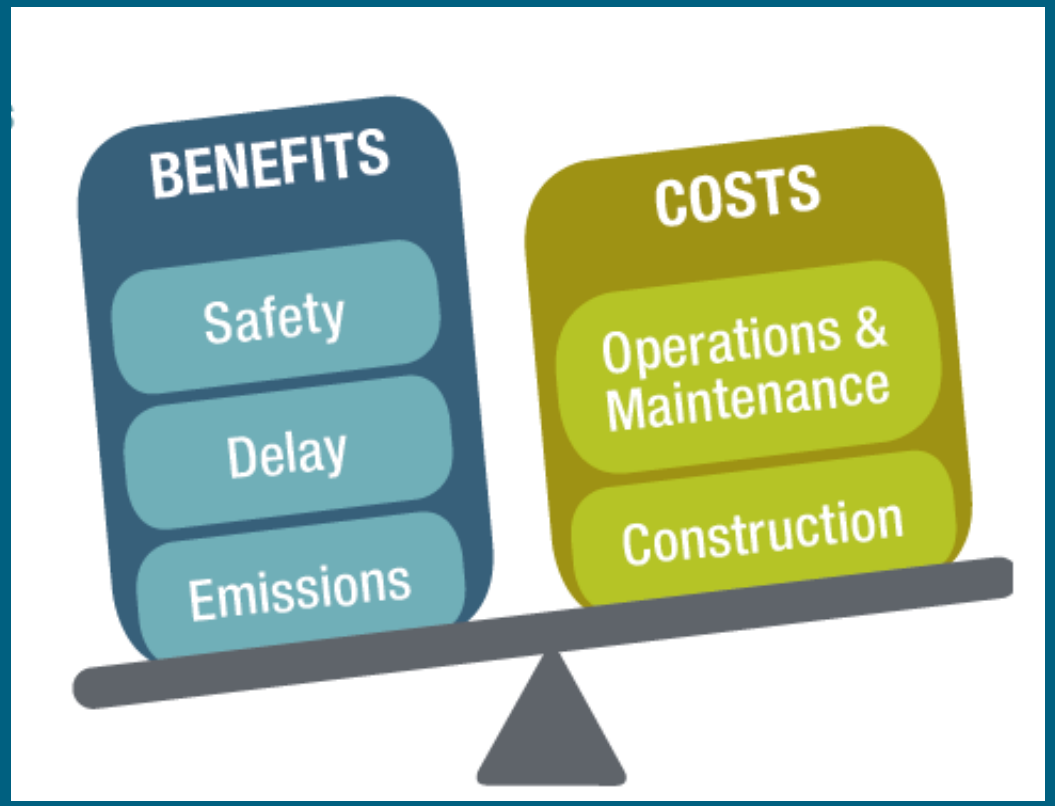
ICE Can Include

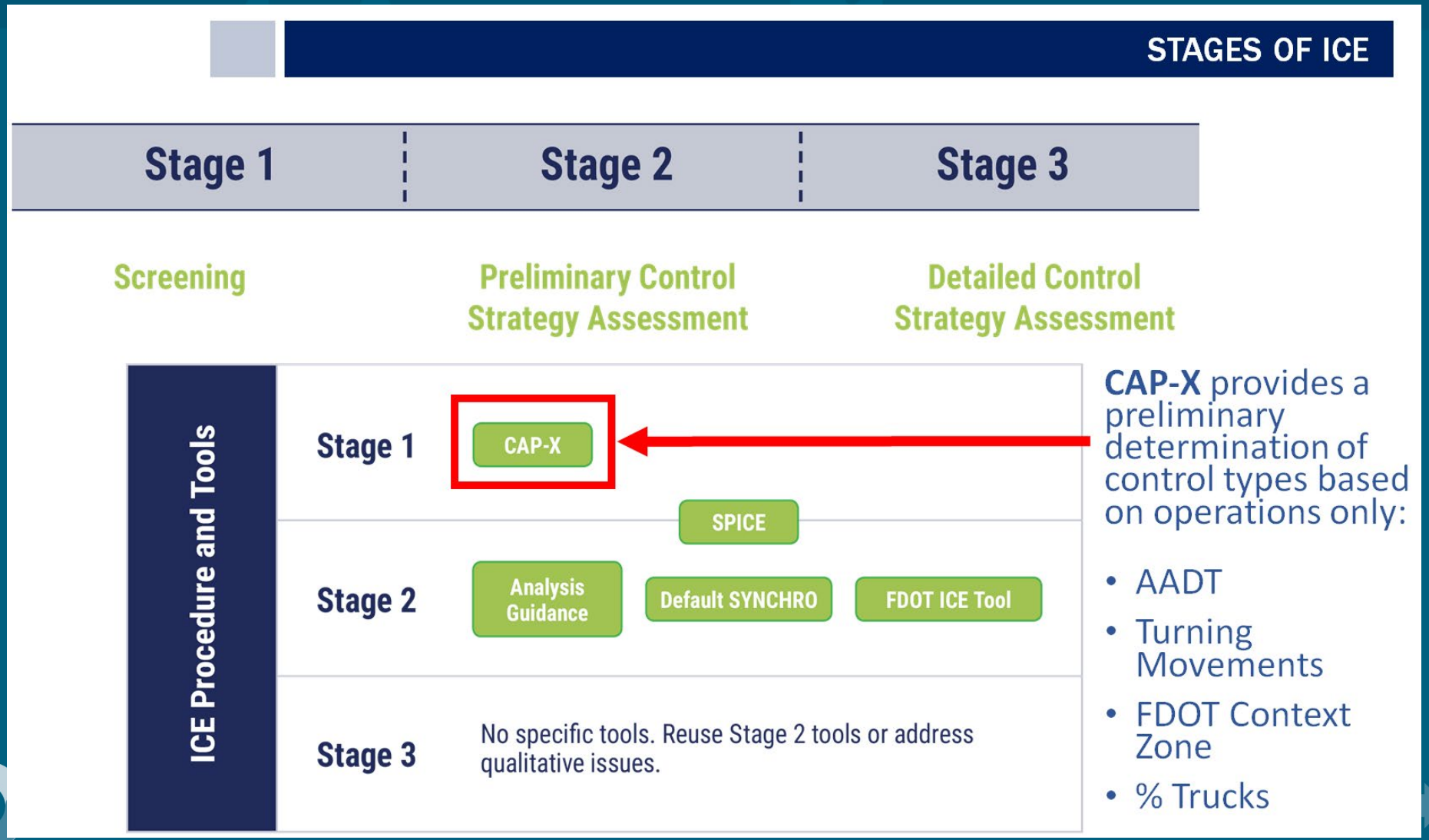
- Safety Analysis
- Operations Analysis
- Concept Layouts
- Maintenance Costs
- Construction Costs
- Public Involvement
- Active Transportation



Tools used in ICE

- Highway Capacity Manual (HCM)
- Capacity Analysis for Planning of Junctions (CAP-X)
- Highways Safety Manual (HSM)
- Safety Performance for Intersection Control Evaluation (SPICE)
- Traffic Simulation Models
- Life-Cycle Cost Analysis Tools
- State Specific ICE Evaluations Tools/Spreadsheets

FDOT ICE Stages



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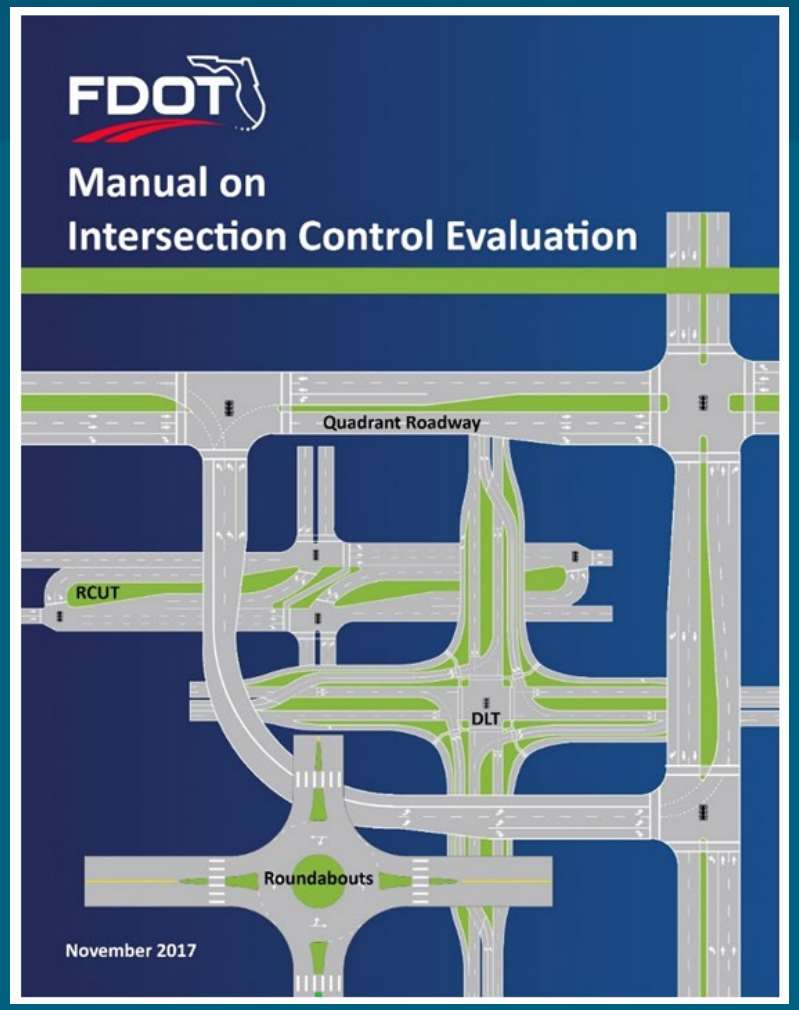
FDOT ICE Tools

- FDOT Manual on ICE
- FDOT CAP-X Tool
- FDOT SPICE Tool
- FDOT ICE Tool



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FDOT CAP-X Tool

- Volume/Capacity Ratio
- Pedestrian Score
- Bicycle Score

Traffic Volume Demand						
	Volume (Veh/hr)				Percent (%)	
	U-Turn	Left	Thru	Right	Heavy Vehicles	Volume Growth
						
Eastbound					2.00%	0.00%
Westbound					2.00%	0.00%
Southbound					2.00%	0.00%
Northbound					2.00%	0.00%
Adjustment Factor	0.80	0.95		0.85		
Suggested	**0.80**	**0.95**		**0.85**		

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ICE in the West

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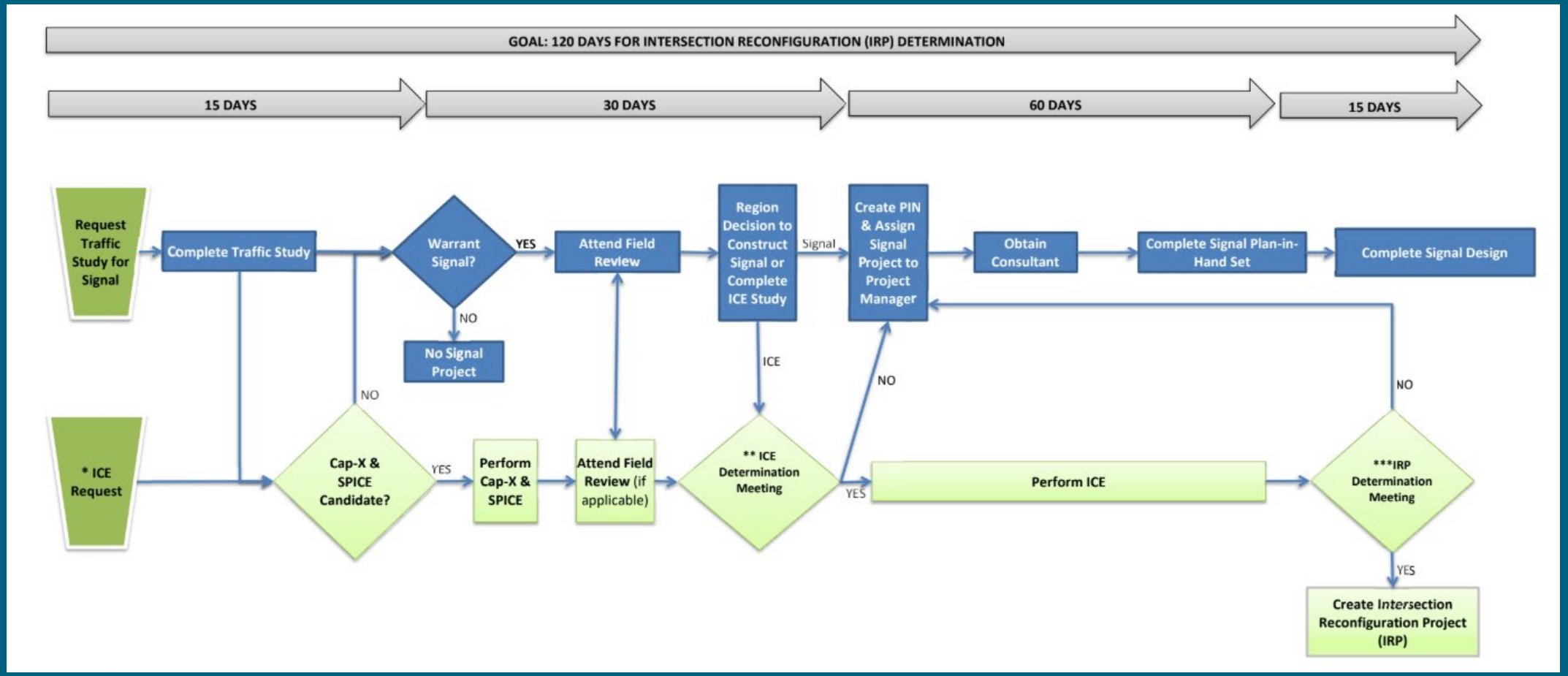
Utah DOT ICE Process



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UDOT Tool

1. Vehicle Occupancy and Delay Costs

3.00%	= Discount Rate		
5.00%	= % Trucks	1.14	= Truck Vehicle Occupancy
95.00%	= % Passenger Vehicles	1.50	= Passenger Vehicle Occupancy

Hourly Delay Cost (Based on the Urban Mobility Report)

$ 48.46	Truck Travel	$ 55.24	Truck Travel -Delay Cost Including Vehicle Occupancy
$ 20.17	Passenger Vehicle Travel		
$ 21.58	Average Rate		

WEEKDAY INTERSECTION DELAY

2. Intersection Volume (veh in peak hour)

	Year	AM	PM
Opening	2025	698	743
Interim	2030		
Design	2044	2,041	2,394

3. Peak Hour Vehicle Delay (sec)

	Year	Period	Existing	Unsignalized High-T	Signalized High-T	TDI	Roundabout	
Opening	2025	AM	1.8	1.9	3.7	0.9	4.6	
		PM	1.0	1.0	2.4	1.2	4.0	
Interim	2030	AM						
		PM						
Interim +1	2031	AM						
		PM						
Design	2044	AM	31.7	32.6	16.3	2.9	13.5	
		PM	43.4	43.7	22.1	10.0	12.5	

4. Weekday - Daily Vehicle Delay (sec)

	Year	Existing	Unsignalized High-T	Signalized High-T	TDI	Roundabout	
Opening	2025	4,199	4,345	9,168	1,623	12,984	-
Interim	2030	N/A	N/A	N/A	N/A	N/A	N/A
Interim + 1	2031	N/A	N/A	N/A	N/A	N/A	N/A
Design	2044	354,059	359,424	180,969	51,474	120,705	-

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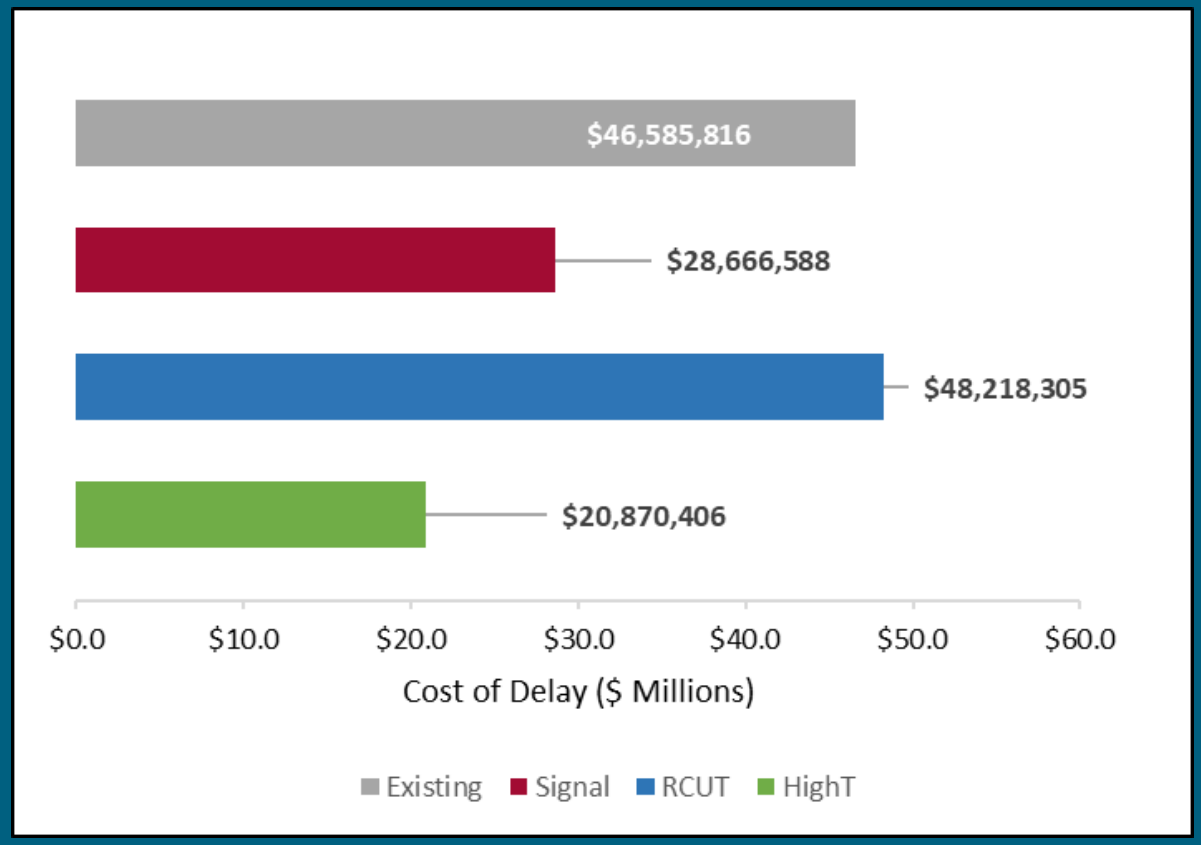
UDOT Outcomes

- **Societal Cost of Delay**
- Societal Cost of Safety
- Operation & Maintenance Cost
- Initial Capital Cost
- Accumulated Costs
- Life-Cycle Benefit-Cost Ratio



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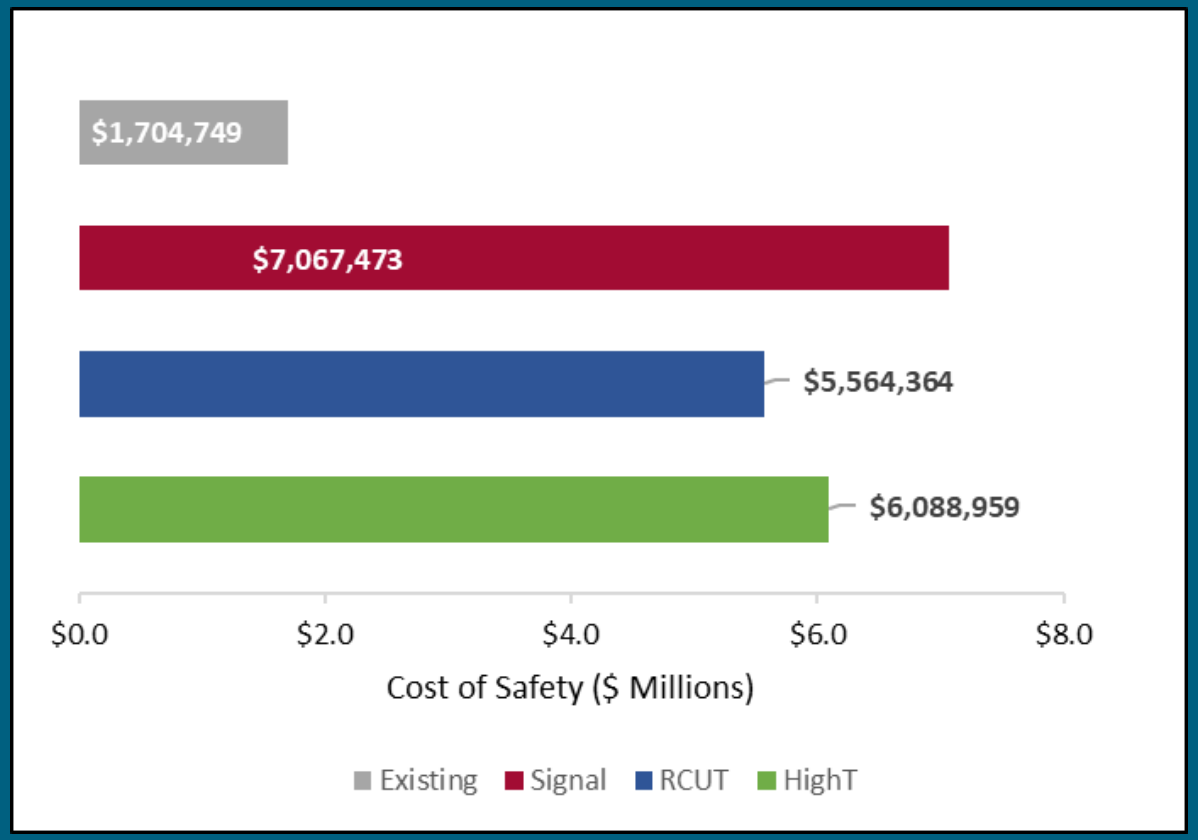

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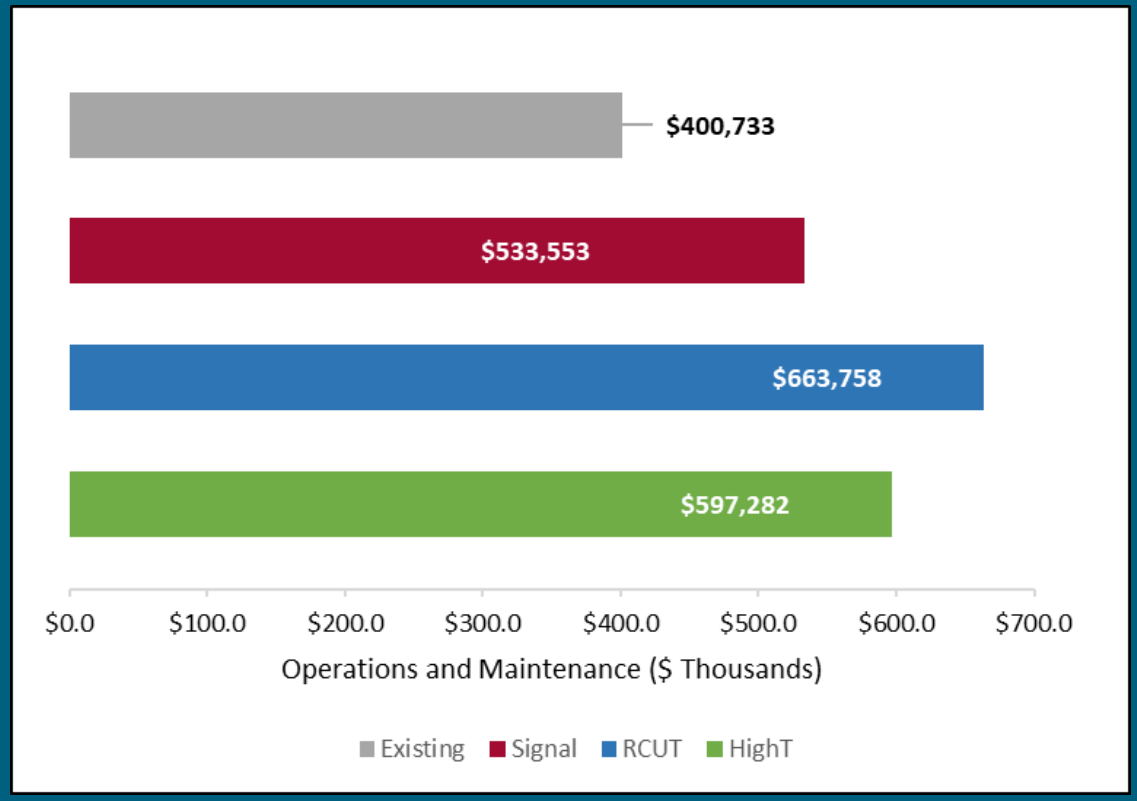

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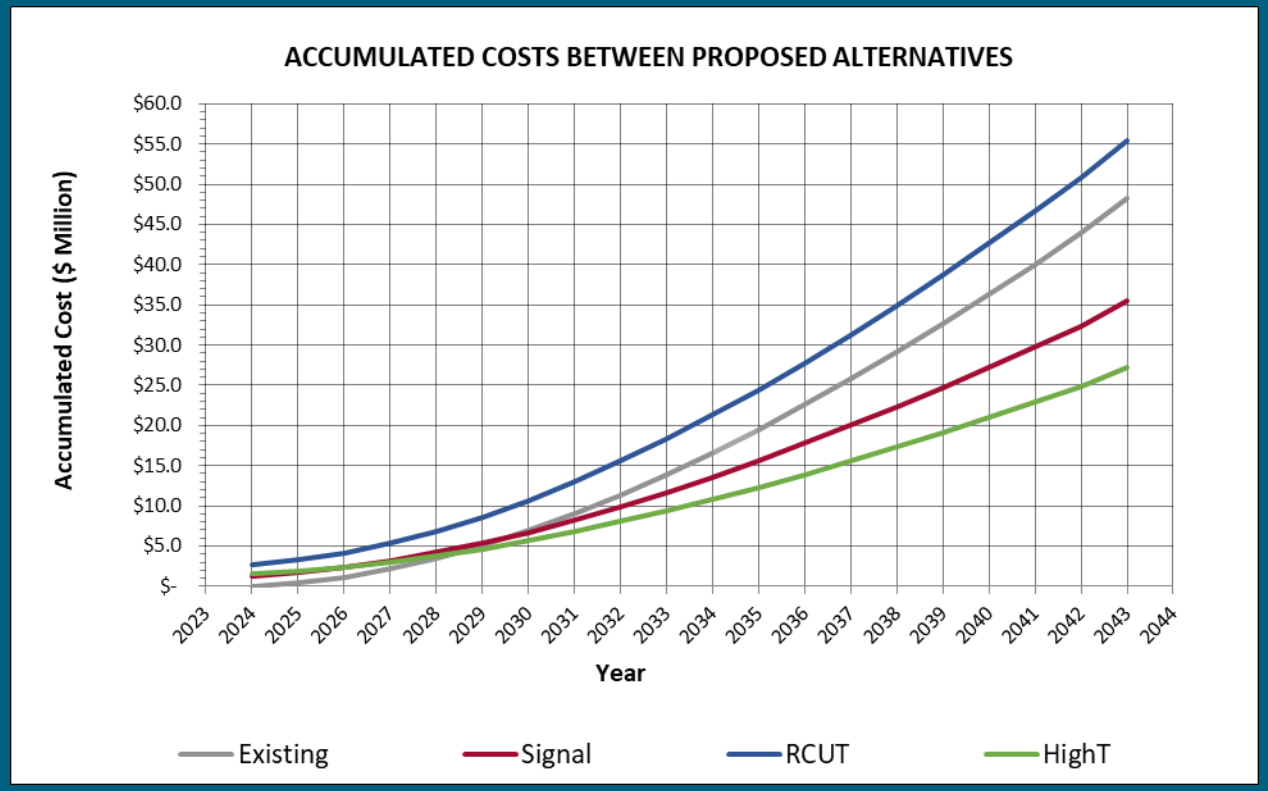

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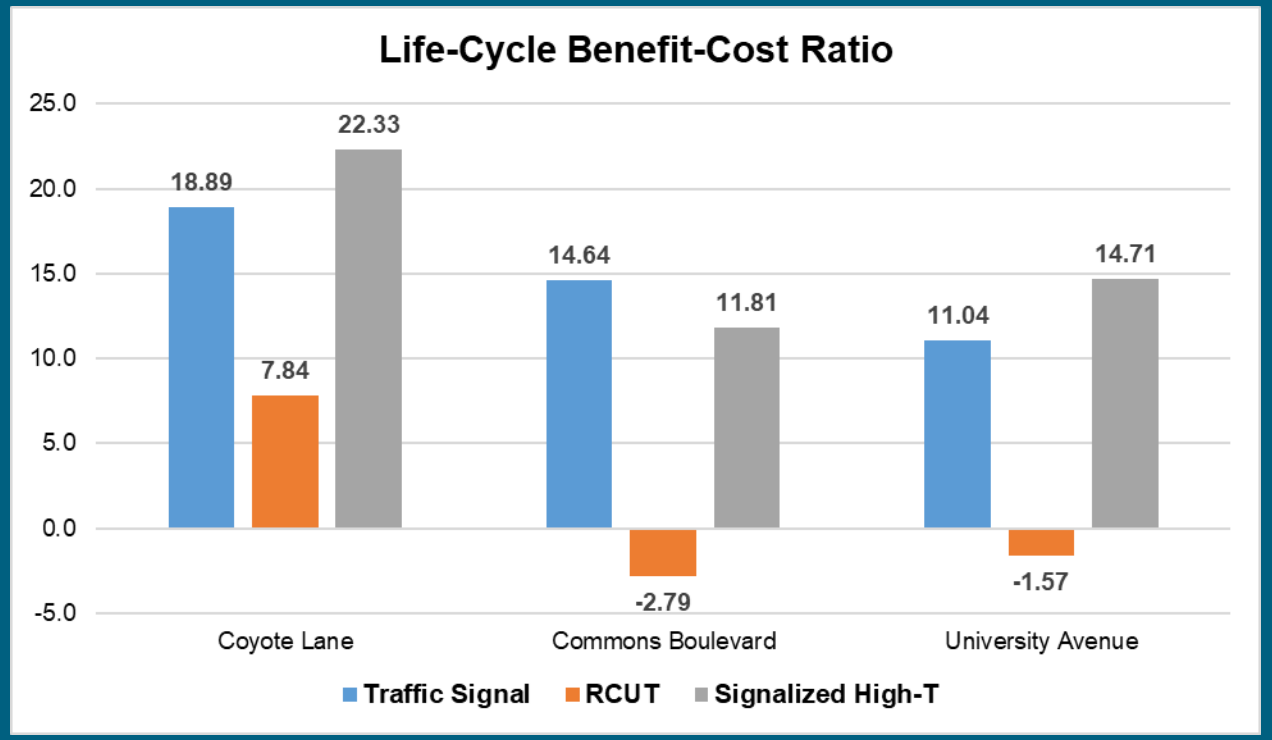

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Nevada DOT ICE

Table 1 – ICE Summary Table (Golden Valley Road and US 395)

Parameter	Existing Condition	Alt. 1 Signal	Alt. 2 RAB	Alt. 3 DDI
US 395 NB Ramp and Golden Valley Road				
Existing Delay AM (PM) [sec/veh]	3.1 (7.0)	4.8 (6.5)	5.9 (3.6)	12.9 (14.4)
Existing LOS AM (PM)	A (A)	A (A)	A (A)	B (B)
Design Year Delay AM (PM) [sec/veh]	* (*)	8.1 (6.5)	7.2 (6.6)	19.7(28.7)
Design Year LOS AM (PM)	* (*)	A (A)	A (A)	B (C)
Design Year Longest Queue 50% (95%) [feet]	880' (1,835')	330' (561')	** (96')	387' (**)
US 395 SB Ramp and Golden Valley Road				
Existing Delay AM (PM) [sec/veh]	49.2* (14.3)	10.2 (9.1)	7.8 (6.6)	6.3 (8.3)
Existing LOS AM (PM)	F (B)	B (A)	A (A)	A (A)
Design Year Delay AM (PM) [sec/veh]	* (*)	38.1 (18.3)	14.1 (8.4)	8.7 (8.7)
Design Year LOS AM (PM)	* (*)	D (B)	B (A)	A (A)
Design Year Longest Queue 50% (95%) [feet]	565' (578')	256' (392')	** (119')	147' (**)
US 395 and Golden Valley Road Interchanges				
Safety Analysis, predicted crashes per year (avg)	7.3	18.6	5.4	7.8
Right of Way Area [ft²]	N/A	2,760 ft²	0 ft²	2,760 ft²
Right of Way Utility Conflicts [Yes/No]	N/A	No	No	No
Retaining Walls/Structures [Yes/No]	N/A	Yes	Yes	Yes
Need for Environmental Evaluation [Yes/No]	N/A	Yes	Yes	Yes
Project Cost, initial	N/A	$5,803,780	$6,137,500	$13,022,800
Total Project and Life Cycle Costs	$46,126,621	$16,630,744	$11,909,572	$19,507,703
Parameter				
Safety Performance Benefit-Cost Ratio	N/A	-4.32	0.44	0.22
Life-Cycle Benefit-Cost Ratio	N/A	4.75	5.36	2.47
Life-Cycle Benefit-Cost Ratio with Sensitivity	N/A	4.61 – 4.89	5.21 – 5.53	2.40 – 2.55
Ranking	**4**	**2**	**1**	**3**

** Volume exceeds capacity, delay exceeds 300s, computation not defined, and/or all major volume in platoon.*
*** Only 50th Percentile Queue available for DDI from HCS7; only 95th Percentile Queue available from Sidra for roundabout.*

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Montana (MDT) ICE Program Development

- **Phase 1 - Policy**
  - Research
  - Upper Management Meetings
  - Visioning Charrette
  - Draft Policy & Workflow
  - ICE Testing & Validation – Case Studies
- **Phase 2 - Tool**
- **Phase 3 – Manual & Training**

MONTANA
Department of Transportation

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Montana (MDT) ICE Program Development

- **Phase 1 - Policy**
- **Phase 2 - Tool**
  - ICE Evaluation & Refinement
  - Policy Adoption & Roll Out
  - Tool Development
- **Phase 3 – Manual & Training**
  - Outreach
  - Training
  - Education
  - Support

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Arizona ICE (AICE) Program Development

- **Project Tasks**
  - Research
  - Visioning Charrette
  - ICE Tool Development
  - ICE Process Outline
  - ICE Case Studies Support
  - ICE Manual
  - ICE Training

ARIZONA DEPARTMENT OF TRANSPORTATION

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CDOT Tool

ICAT STAGE 1: ALTERNATIVE SHORT-LIST DECISION RECORD

Developed and Maintained in Cooperation with

Project Number:	0000000
Project Location:	Road 2 @ Road 1
Existing Control:	--Existing Control--
Prepared by:	0
Date:	1/0/1900

1 Answer questions 1-16 with rating of 0, 1 or 2.

2 Deselect or select any alternative by placing an X or Y (respectively) in column to right of score; Enter change justification in rightmost column

		Right of Way			*Safety*				*Roadway Context*				*Operations/Maintenance*			*Costs*	
		Q1*: Is ROW on major road constrained? (0=no, 1=somewhat, 2=highly)	Q2*: Is ROW on minor road constrained? (0=no, 1=somewhat, 2=highly)	Q3: Intersection quadrants constrained? (0=no, 1=somewhat, 2=highly)	Q4: Are there intersection safety issues? (0=low, 1=moderate, 2=crash hot spot) [From IntersectionData LOSS inputs]	Q5: Are there significant pedestrian crossings? (0=none/low, 1=moderate, 2=high) [From IntersectionData ped volume inputs]	Q6: Is there significant bicycle activity? (0=none/low, 1=moderate, 2=high)	Q7: Are one or more approach speeds high? (0=no, 1=moderate, 2=high) [From IntersectionData roadway speed inputs]	Q8:Do roadway contexts, characteristics transition at intersection? (0=no, 1yes)	Q9: Are there driveways or other access points within the intersection's functional area? (0=no, 1=few, 2=many)	Q10: What is adjacent intersection spacing? (0=isolated, 1=network, 2= dense network)	Q11: Is this a T-intersection? Or can minor ST thru or left turns be eliminated? (0=No, 2=Yes)	Q12: Are design yr no-build volumes high? No-Build 2022 V/C=0; (0=low, 2=mod, 4=high) [CLV based on design yr volume/lane capacity]	Q13: Are exist LT volumes high? (Max 2022 LT =0 vph) ; (0=no, 1=somewhat, 2=yes) AV8 [From IntersectionData LT volume data	Q14: Could intersection become interchange in next 20 yrs? (0=no, 1=maybe, 2=probably)	Q15: Are costs a primary decision factor? (0=no, 1=somewhat, 2=yes)	**Total Stage 1 Screening Evaluation Score**
Intersection Alternatives: (see Intersections tab for detailed description of intersection/interchange type)		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
onventional provements	-- select --																
	-- select --																
	Minor Street Stop	-4.00	-4.00	3	1	1	3	2	0	0	3	2	0	0	0	3	**0.0**

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Benefits & Application

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Benefits & Application of ICE

- Safer, balanced, and cost-effective solutions
- Data driven analysis
- Consistent documentation
- Transparency of transportation decisions
- Increased awareness of innovative intersection solutions
- Emphasis on objective performance measures
- Opportunity to consolidate and streamline existing intersection-related policies and procedures

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Questions

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