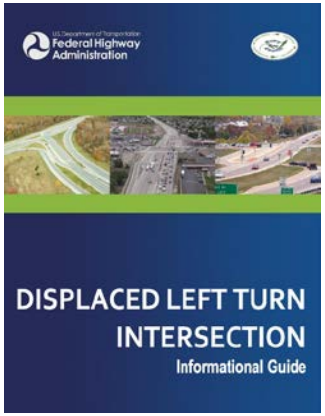
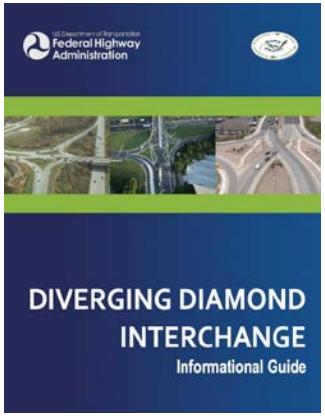
PennDOT ICE Policy

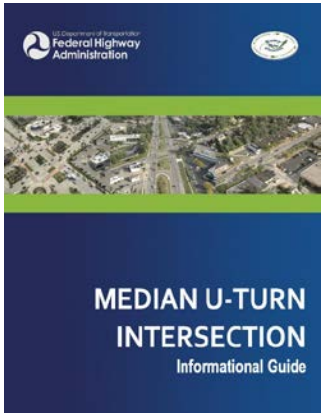
An Introduction

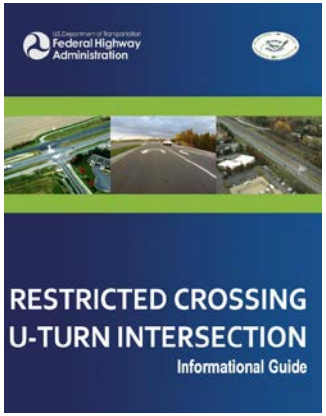
January 2018

PennDOT Connects
Planning with our communities









What is Intersection Control Evaluation (ICE)?

Purpose: To consistently consider and screen among many proven combinations of geometry and traffic control when a new intersection or existing intersection modification is first contemplated.

Goal: To better inform, identify, and select an alternative that meets the project purpose and reflects the overall best value, in terms of specific performance-based criteria within available resources.

ICE Overview

- **Will be incorporated into DM1-X**
- **Scalable 3-Stage Screening Process**
- **Projects may be initiated for a variety of reasons –** traffic operations, safety, multimodal access, land access, and placemaking

Intersection Control Evaluation (ICE) Background

- **States with objective intersection control evaluation policies:**
  - California
  - Indiana
  - Minnesota
  - Wisconsin
  - Washington
  - Georgia
  - Florida
  - Others pending

- **Supported by FHWA's Every Day Counts Initiative**
  - Shortening project delivery
  - Enhancing roadway safety
  - Protecting the environment

- **FHWA provides guides on Alternative Intersections and Interchanges**

"DOTs should consider and evaluate [roundabouts, diverging diamond interchanges (DDIs) and intersections with displaced left-turns or variations on U-turns] early in the project scoping, planning and decision-making stages, as they may serve as more efficient, economical and safer solutions than traditional designs."
-FHWA

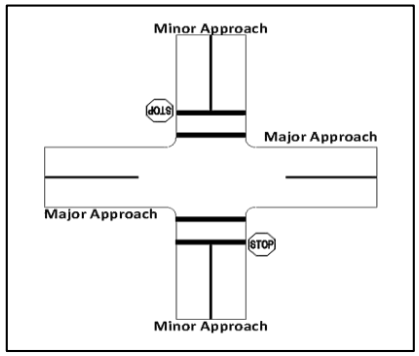
http://www.fhwa.dot.gov/everydaycounts/edctwo/2012/geometrics.cfm

Intersection Control Evaluations

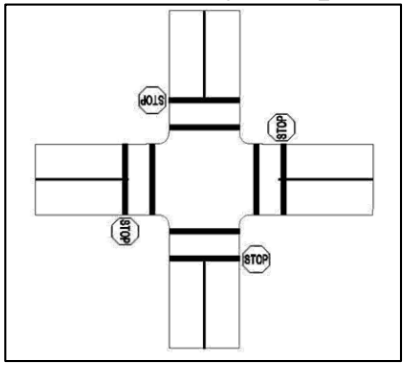
- **What is an Intersection?**
  - The connection or crossing of two or more roadway facilities
- **Typical focus: At-grade forms**
  - We have been challenged implementing roundabouts over the last 15 years
  - We now have more “innovative” forms to consider
    - Mostly treatments of left-turning vehicles
- **Intersection control evaluations apply to grade separated facilities**
  - Objective look at interchange form and function
  - Focus is most often upon the ramp terminal intersection control
    - Stop
    - Yield (roundabout)
    - Signalized – conventional
    - Signalized – crossover (diverging diamond)
    - Signalized – single intersection (single-point diamond)

Intersection Control Evaluation (ICE)

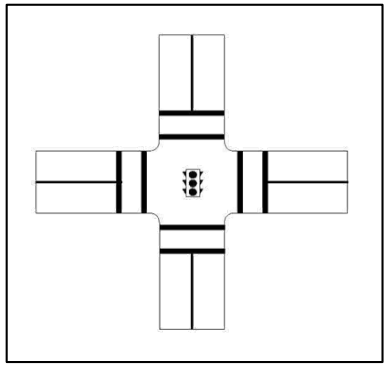
Two Way Stop



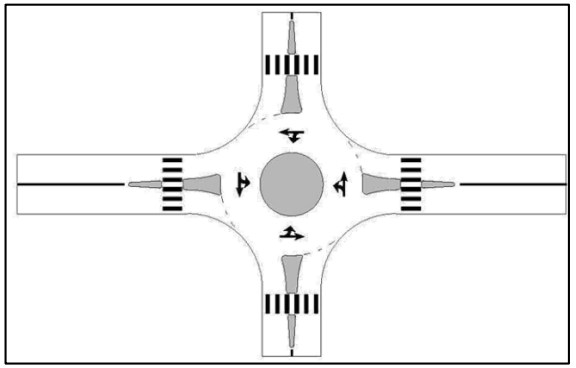
All Way Stop



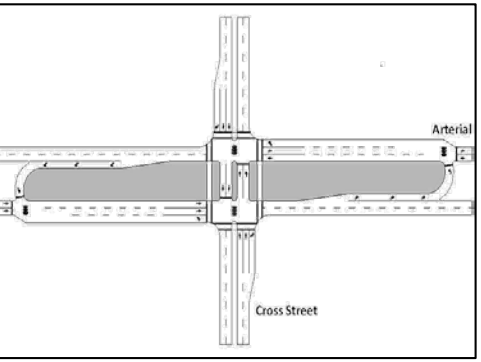
Signalized Control



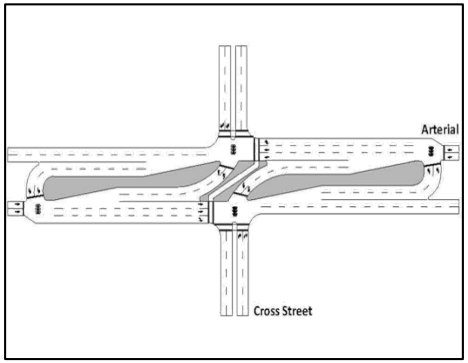
Roundabout



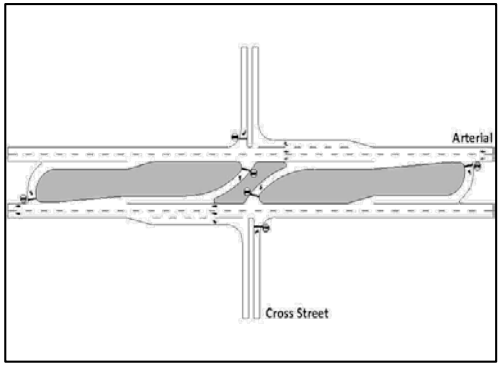
Median U-Turn



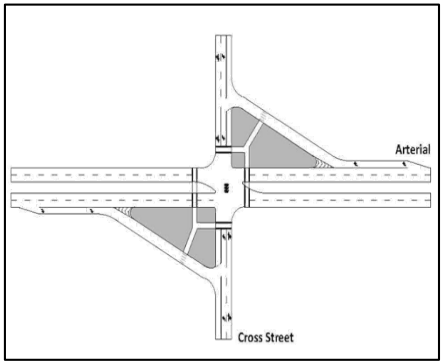
Superstreet



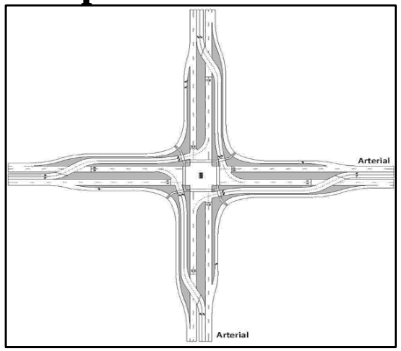
J-Turn



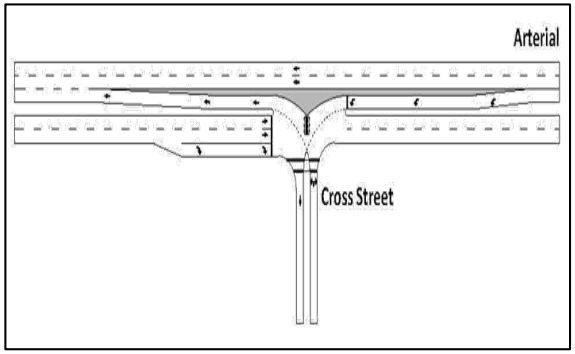
Jughandle



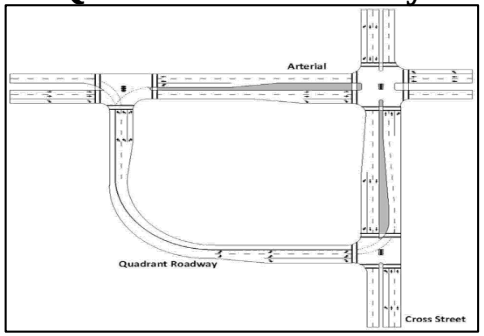
Displaced Left Turn



Continuous Green Tee



Quadrant Roadway

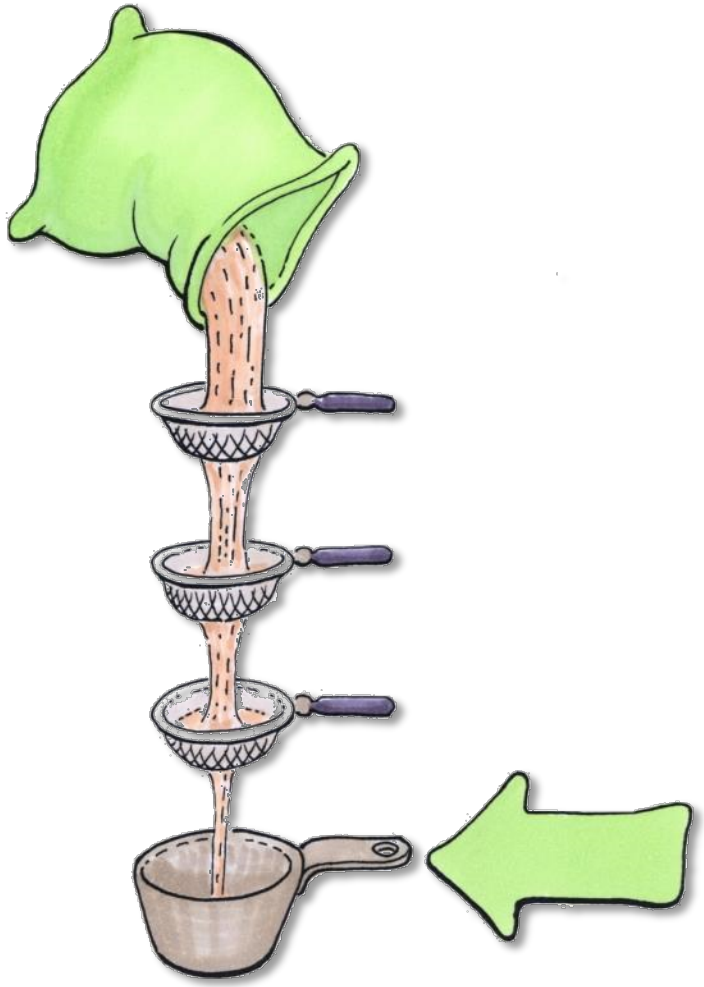


3 – Step Screening Process

- Stage 1: Screening – completed during a project's scoping stage
- Stage 2: Initial Control Strategy Assessment – completed following a project's scoping stage
- Stage 3: Detailed Control Strategy Assessment – completed prior to Design Field View

Stages of ICE

- Each stage requires completion of a form
- Memo/report/analysis outputs may be helpful, but not required
- Spreadsheet tool geared towards Stage 2 analysis
- District Traffic Engineer approves form
- Stages 2 and 3 are not always required



ICE Stage 1 – Preliminary Analysis

- **Determines if there is one viable alternative or more than one**
  - If only 1 alternative, Stage 2 and 3 are not necessary
- **Intent – Don't make ICE a burden if the choice is straightforward**

ICE Stage 2 – Concept Design

- **Detailed analysis to help differentiate alternatives**
- **Concept design drawings prepared for each alternative**
- **PennDOT ICE Tool used**
- **Consider a wide range of criteria**
  - Operations
  - Safety Performance
  - Right-of-way impacts
  - Costs
  - Environmental impacts
  - Political/public considerations
  - Terrain
  - Adjacent intersections and coordinated signal systems
  - System consistency
  - Pedestrian/bike accommodations
- **Possible outcomes**
  - One alternative is clearly preferred – ICE ends
  - Further analysis needed – Continue to Stage 3

ICE Stage 3 – Detailed Design Analysis

- **Consider the same criteria as Stage 2, but in greater detail**
  - More developed drawings and associated information (costs, impacts, etc.)
  - Additional public and local government outreach
  - Additional traffic analysis- microsimulation?
  - Additional pedestrian and bicycle needs assessment

- **May have fewer alternatives than Stage 2**

ICE-Required Projects

- Creation of a new intersection
- Creation of a medium volume or high volume driveway
- Adding a leg to an existing intersection
- Adding a through lane or turning lane at an existing intersection, or changing the lane configuration at an existing intersection
- Changing control at an existing intersection
- Full-depth reconstruction of an existing intersection
- Other efforts determined by DTE

What tools/materials will be available?

- ICE forms
- ICE policy
- ICE procedure (DM-1X, Appendix AH)
  - "How to" do ICE
  - Appendices with information on alternative intersections, analysis information, etc.
- ICE Case Studies
- FHWA CAP-X Spreadsheet (optional Stage 1 analysis tool)
- PennDOT ICE tool (required Stage 2 analysis tool)

Stage 1: Screening

Pennsylvania Department of Transportation

Intersection Control Evaluation (ICE) Form

Stage I: Screening

To fulfill the requirements of Stage 1 (Screening) of PennDOT's ICE procedures, complete the following form and append all supporting documentation. Completed forms can be submitted to the District Traffic Engineer (DTE) for the project's location.

Project Information			
Project Name	Project Setting	Project ICE Reference Number	
Submitted By	Agency/Company	Email	
Project Purpose (*What is the catalyst for this project and why is being*)			
Project Setting Description (*Describe the area surrounding the intersection*)			
County	Project Locality (Township/Borough/City)		
PennDOT District	Project Type (select most appropriate)		
Multimodal Context (*Describe pedestrian, bicycle, and transit activity in the area and the potential for activity based on surrounding land uses and development pattern*)			

Basic Intersection Information				
Major Street				
Major Street Route Number(s)	Major Street Route Name(s)		SR Segment #	SR Offset
Primary Functional	Secondary Functional Class. (if		Existing AADT	Existing Control
Major Street Ownership		Sidewalks are present along:		
Crosswalks? ☐	On-Street Bike Facilities ☐	Multi-Use Path? ☐	Scheduled Bus Service ☐	Bus stop at intersection? ☐
AM Peak Period				
Approach #1	Number of Lanes (Count Shared Lanes as Through):	Left-Turn	Through	Right-Turn
	Peak Hour Traffic Volumes:	Left-Turn	Through	Right-Turn
Approach #2	Number of Lanes (Count Shared Lanes as Through):	Left-Turn	Through	Right-Turn
	Peak Hour Traffic Volumes:	Left-Turn	Through	Right-Turn
PM Peak Period				
Approach #1	Number of Lanes (Count Shared Lanes as Through):	Left-Turn	Through	Right-Turn
	Peak Hour Traffic Volumes:	Left-Turn	Through	Right-Turn
Approach #2	Number of Lanes (Count Shared Lanes as Through):	Left-Turn	Through	Right-Turn
	Peak Hour Traffic Volumes:	Left-Turn	Through	Right-Turn
Minor Street	Existing ☐	New ☐		
Major Street Route Number(s)	Major Street Route Name(s)		SR Segment #	SR Offset
Primary Functional	Secondary Functional Class. (if		Existing AADT (if available)	
Minor Street Ownership		Sidewalks are present along:		
Crosswalks? ☐	On-Street Bike Facilities ☐	Multi-Use Path? ☐	Scheduled Bus Service ☐	Bus stop at intersection ☐
AM Peak Period				
Approach #1	Number of Lanes (Count Shared Lanes as Through):	Left-Turn	Through	Right-Turn
	Peak Hour Traffic Volumes:	Left-Turn	Through	Right-Turn
Approach #2	Number of Lanes (Count Shared Lanes as Through):	Left-Turn	Through	Right-Turn
	Peak Hour Traffic Volumes:	Left-Turn	Through	Right-Turn
Approach #3	Number of Lanes (Count Shared Lanes as Through):	Left-Turn	Through	Right-Turn
	Peak Hour Traffic Volumes:	Left-Turn	Through	Right-Turn
PM Peak Period				
Approach #1	Number of Lanes (Count Shared Lanes as Through):	Left-Turn	Through	Right-Turn
	Peak Hour Traffic Volumes:	Left-Turn	Through	Right-Turn
Approach #2	Number of Lanes (Count Shared Lanes as Through):	Left-Turn	Through	Right-Turn
	Peak Hour Traffic Volumes:	Left-Turn	Through	Right-Turn
Approach #3	Number of Lanes (Count Shared Lanes as Through):	Left-Turn	Through	Right-Turn
	Peak Hour Traffic Volumes:	Left-Turn	Through	Right-Turn

Stage 1: Screening

Crash History (Existing Intersections Only)
Append the most recent five-years of crash data for the intersection from the CDART. If the crash data evidences any issues relating to safety performance, discuss briefly here:

Screening Evaluation			
Provide a brief justification as to why each of the following control strategies should be advanced or not. Justification should consider potential environmental impacts.			
Control Strategy	**Strategy Viable?**	**Justification**	**Strategy to be Advanced?**
Two-way Stop-Controlled			
All-way Stop-Controlled			
Signalized Control			
Roundabout			
Median U-Turn			
Restricted Crossing U-Turn (RCUT) Signalized			
Restricted Crossing U-Turn (RCUT) Unsignalized			
Jughandle			
Displaced Left-Turn			
Continuous Green Tee			
Quadrant Roadway			
Other			

Resolution				
To be filled out by PennDOT District Traffic Engineer or designee only				
Project Determination				
Comments				
PE or Designee Name		Signature		Date

Stage 2: Initial Control Strategy Assessment

Pennsylvania Department of Transportation

Intersection Control Evaluation (ICE) Form

Stage 2: Initial Control Strategy Assessment

To fulfill the requirements of Stage 2 (Intersection Control Strategy) of PennDOT's ICE procedures, complete the following form and append all supporting documentation. Completed forms can be submitted to the District Traffic Engineer (DTE) for the project's location.

Project Information			
Project Name		Project ICE Reference Number	
Submitted By	Agency/Company	Email	
List all viable intersection control strategies identified in Phase 1 (Screening):			

Operational Analysis

Summarize the results of the peak hour analysis performed for each control strategy. Select analysis year based on guidance in the ICE procedures document.

Overall Intersection Performance

Opening Year

Control Strategy	Analysis Year / Peak Hour				Peak Hour Analyzed			
	LOS	V/C	Delay (sec.)	All queues accommodated?	LOS	V/C	Delay (sec.)	All queues accommodate

Design Year

Control Strategy	Analysis Year / Peak Hour				Peak Hour Analyzed			
	LOS	V/C	Delay (sec.)	All queues accommodated?	LOS	V/C	Delay (sec.)	All queues accommodate

Provide any additional discussion necessary regarding the results of the operational analysis:

Stage 2: Initial Control Strategy Assessment

Costs

Remaining cognizant of the current level of detail of each control strategy's conceptual design, provide a cost estimate for each. You may want to account for preliminary engineering, required right-of-way acquisitions, construction, and a contingency.

Control Strategy	Cost ($)	Estimate Includes:	Control Strategy	Cost ($)	Estimate Includes:

Safety Performance

Apply the PennDOT HSM Analysis Tool and provide the "Safety B/C" ratio provided by the tool's output. You may wish to append the complete output to this form. For intersection types not accommodated in the tool, manually apply crash modification factors detailed in the ICE policy document or qualitatively describe safety impacts.

Control Strategy	Anticipated Impact on Safety Performance	Predicted Total Crashes	Predicted Fatal & Injury Crashes	Safety B/C

Multimodal Accommodations

Note the existing/anticipated level of pedestrian/bicyclist activity at the study intersection during the peak hours of the typical day.

	AM Peak Hour		PM Peak Hour	
	Major Street	Minor Street	Major Street	Minor Street
# of pedestrian crossings (both approaches,				
# of bicyclists (both approaches, if app.):				

Summarize the ability of each viable control strategy to accommodate the existing/anticipated level of:

Control Strategy	Pedestrians and Bicycles	Transit Services	Freight Needs

Stage 2: Initial Control Strategy Assessment

Stage 3: Detailed control strategy assessment

Pennsylvania Department of Transportation

Intersection Control Evaluation (ICE) Form

Stage 3: Detailed Control Strategy Assessment

To fulfill the requirements of Stage 3 (Detailed Control Strategy Assessment) of PennDOT's ICE procedures, complete the following form and append all supporting documentation, which may include detailed design plans of each control strategy analyzed. Completed forms can be submitted to the District Traffic Engineer (DTE) for the project's location.

Project Information			
Project Name		Project ICE Reference Number	
Submitted By	Agency/Company	Email	
List all viable intersection control strategies identified at the end of Phase 2 (Initial Control Strategy Assessment):			

Additional Analysis	
What issues and/or findings to date have led to a control strategy **NOT** being selected in Stage 2?	
Category	**Description of Issues/Findings**
Describe specific evaluation activities undertaken in Stage 3 analysis to identify a preferred control strategy and discuss the findings:	
Category	**Description of Additional (Stage 3) Analysis**

Public Input/Feedback	
If not discussed as a part of the preceding section, summarize public input received or stakeholder considerations regarding the control strategies:	

Stage 3: Detailed control strategy assessment

Control Strategy Evaluation		
Provide a brief justification as to why each of the following was either selected or not selected after conducting the additional analysis. ICE Stage 3 activities should result in a single control		
Control Strategy	**trol Strategy Selec**	**Justification**

Resolution			
To be filled out by PennDOT District Traffic Engineer or designee only			
Project Determination			
Comments			
DTE or Designee Name:		Signature	Date

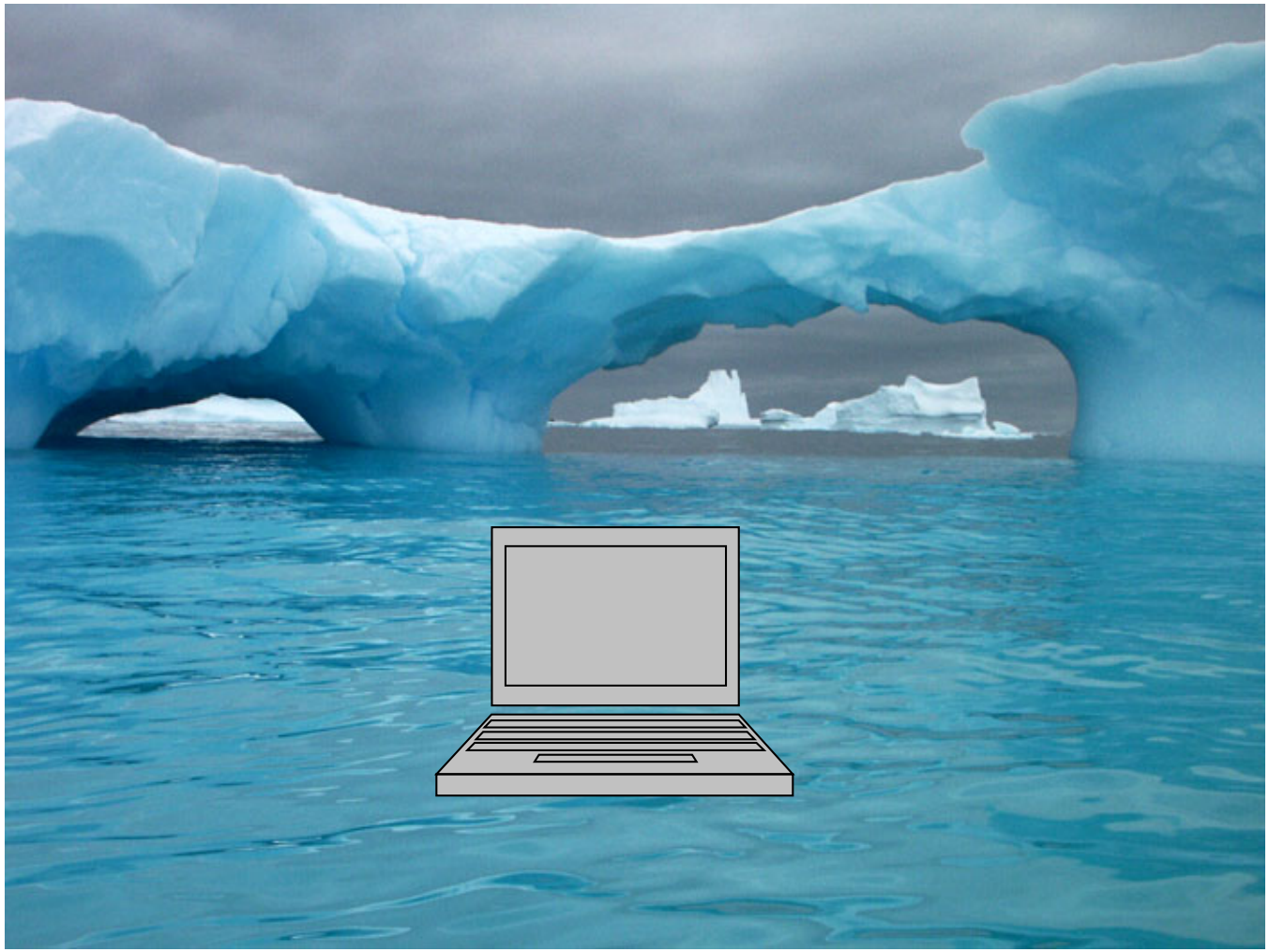
Case Studies

- **1 – HOP for new roadway serving residential development along 2-lane roadway**
  - Signal not warranted
  - ROW and utility impacts with roundabout
  - TWSC selected in Stage 1
- **2 – Skewed TWSC intersection with operations and safety issues**
  - Signal and single-lane roundabout considered
  - Roundabout selected in Stage 2 for safety benefits and local government support
- **3 – Urban signalized intersection operating at LOS F**
  - Left turn lanes and permissive protected phasing added by prohibiting on-street parking near intersection
  - Determined in Stage 1 – other control strategies not feasible in urban environment
- **4 – Rural signalized intersection with capacity issues**
  - Multi-lane roundabout and signal with auxiliary through lanes considered
  - Multi-lane roundabout selected in Stage 2
- **5 – Urban signalized intersection with capacity and safety issues**
  - Restricted Crossing U-Turn and Median U-Turn considered; widening with conventional traffic signal not viable
  - Median U-Turn selected in Stage 3 at considerable stakeholder input

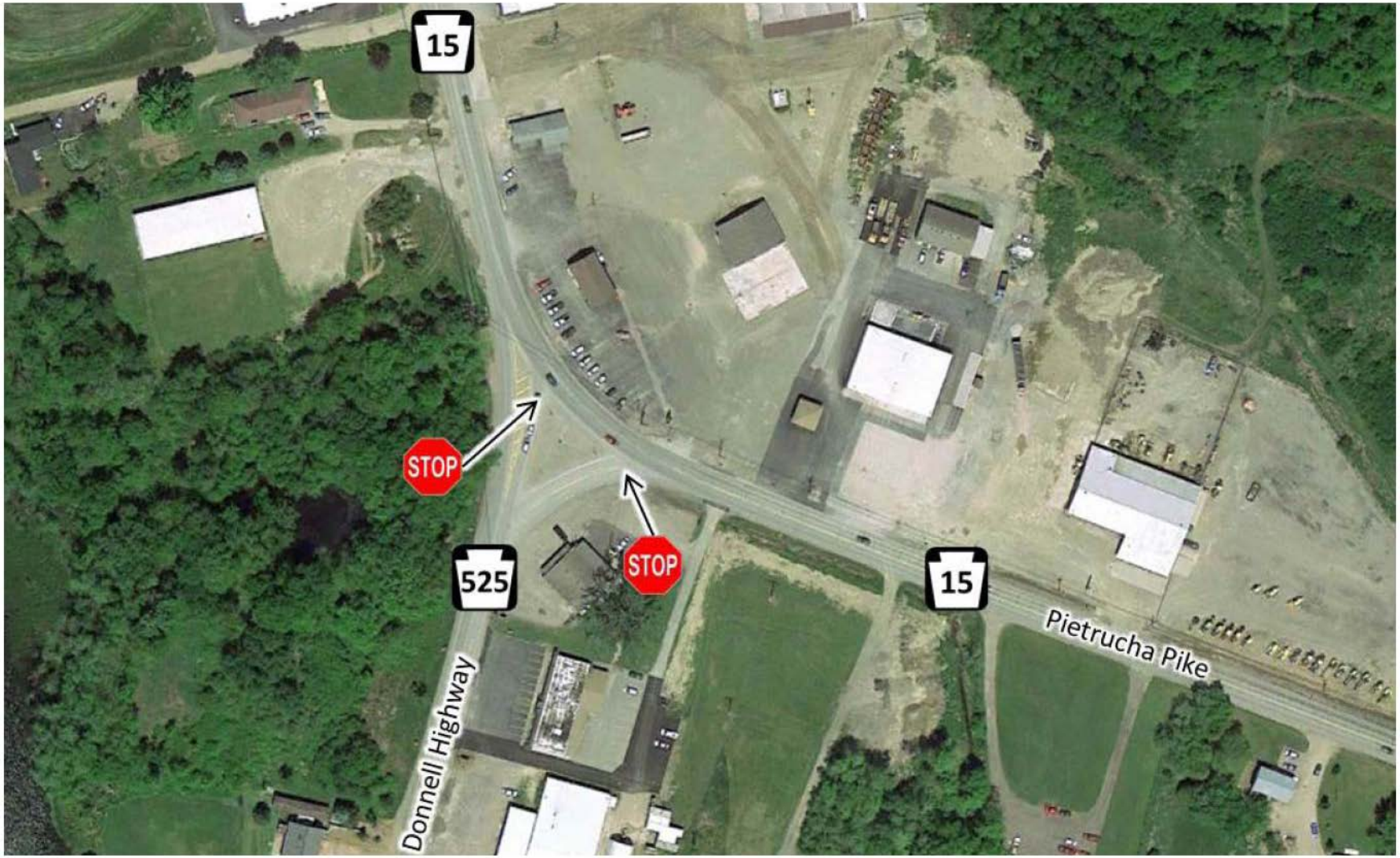
PennDOT ICE Tool

- **Stage 2 tool for financial analysis of intersection alternatives**
- **Based on the NCHRP 3-110 Life Cycle Cost Estimation Tool (LCCET)**
  - Macro-powered Excel spreadsheet
- **Needed inputs for life-cycle cost analysis**
  - Safety – PennDOT HSM Tool and built-in CMFs for alternative intersections
  - Vehicular delay – SYNCHRO, VISSIM, HCS, SIDRA, etc.
  - Design, construction, right-of-way, and operating costs
- **Conducts benefit-cost / net present value analysis**
- **Designed to be quick and easy to use – hour(s) not day(s)**
  - Limit data inputs to readily available or computable values
- **Flexible enough to accommodate most common alternative intersections**

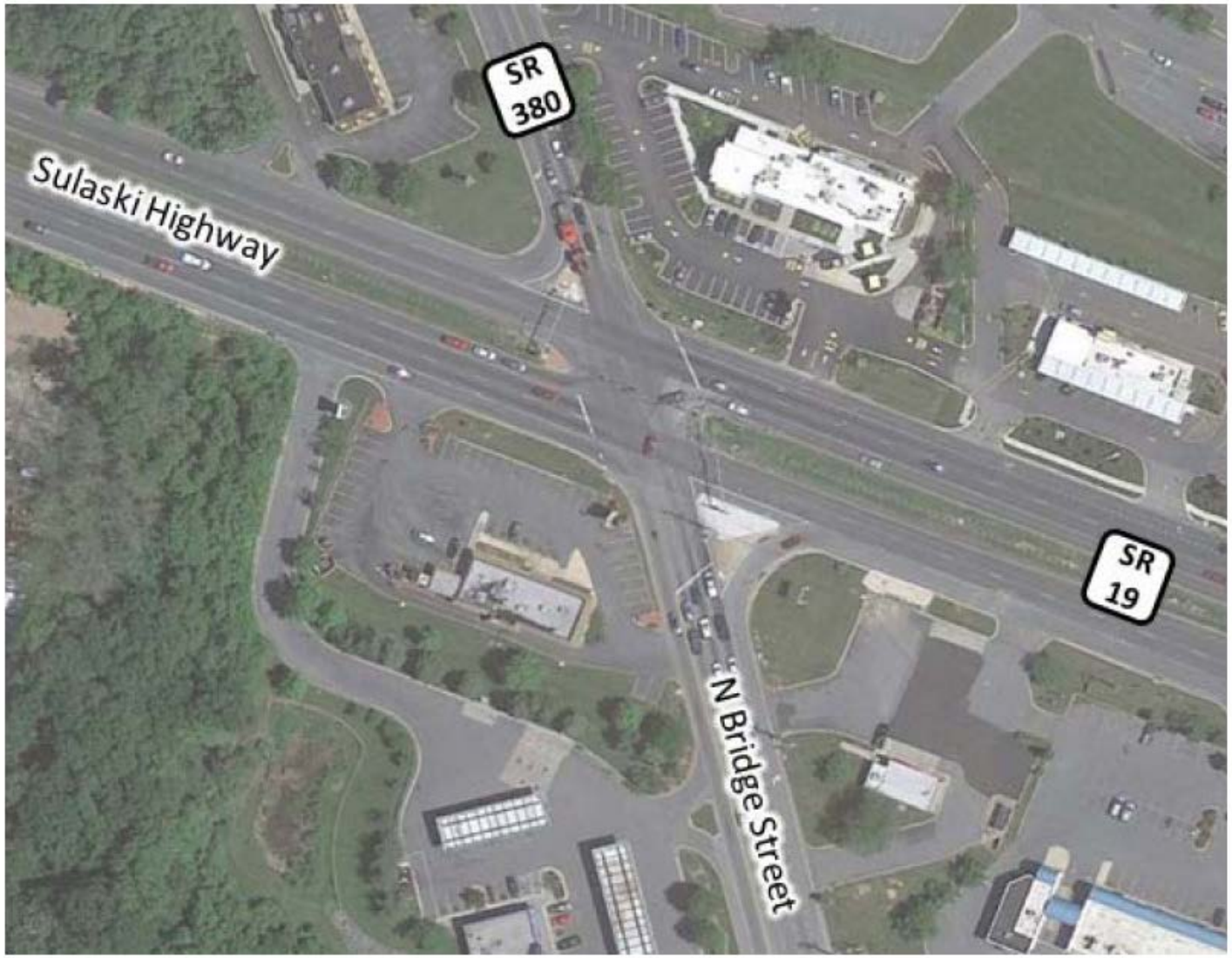
Tool Demonstrations



ICE Tool Demonstration – Case Study 2



CAP-X Demonstration – Case Study 5



PennDOT ICE Tool Summary

- **What does the PennDOT ICE Tool tell you?**
  - Comparatively evaluates intersection control strategies to provide the Benefit/Cost or Net Present Value of each.

- **What are the primary information elements needed to perform the PennDOT ICE Tool Analysis?**
  - Operations analysis – delay
  - Safety analysis – crashes per year
  - Implementation costs – construction, design, ROW

- **What does the PennDOT ICE tool does *not* tell you?**
  - The control strategy to be recommended, as other factors need to be considered.

ICE Implementation

- **Strike-off letter anticipated in late January 2018**
  - ICE policy will be effective immediately for PS&E projects not yet scoped
  - Encouraged for PS&E projects in preliminary design and other PennDOT projects
- **Full implementation anticipated July 2018**
  - PS&E projects not yet scoped
  - Other PennDOT projects (new signals, other capacity improvements, safety improvements, etc.)
  - HOP Applications

Questions & Discussion

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