


**I-70 West Operations Plan  
Operations Strategy Charrettes**

April 26<sup>th</sup> & 27<sup>th</sup>, 2016



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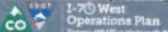
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**Meeting Goals & Introductions**

- Identify appropriate measures of effectiveness
- Identify potential viable operational strategies to be further evaluated



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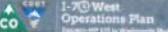
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**Agenda**

- Study overview
- Operational improvements overview & best practices
- Stakeholder input to inform technical charrette
- **BREAK/INTERACTIVE MAP ACTIVITY**
- Technical Review
  - Existing conditions
  - Deployed/unimplemented strategies
- Brainstorm operational strategies
- Identify strategies for further evaluation
- Next Steps



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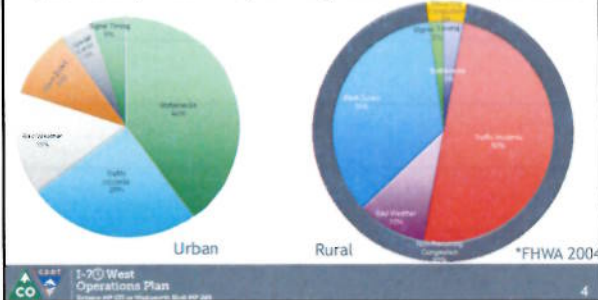
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### Why Create an Operations Plan?

- Meet FHWA request for a plan for I-70 Mountain Corridor
- Create list of strategies to address both recurring and non-recurring congestion
- Coordinate and prioritize strategies with regards to other corridor improvements




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### Project Overview

- Build upon previous recommendations
  - I-70 Mountain Corridor Mobility and Operations Assessment, 2011
  - I-70 Programmatic Environmental Impact Statement (PEIS), 2011
  - FHWA Coordinated Freeway and Arterial Operations Handbook, 2006
- Inventory and evaluate
  - Existing and planned strategies and projects
- Analyze existing conditions data
  - Identify problems and underlying reasons
- Develop and evaluate alternatives
  - Technical and Operational Solutions
- Recommend implementation plan




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### Project Overview

- Study Target Area
  - Copper Mountain to Twin Tunnels (MP 195 to MP 242)
- Secondary Focus Areas
  - Vail to Golden (MP 176 to MP 195 & MP 242 to MP 259)
- Future Studies
  - Dotsero to Wadsworth Blvd (MP 133 to MP 195 & MP 259 to MP 269)




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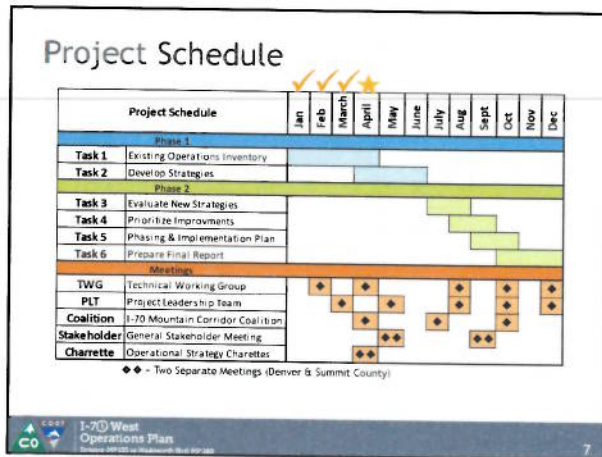
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### Project Goals & Objectives

- **Goals**
  - Improve corridor mobility
  - Improve corridor safety
  - Improve corridor reliability & level-of-service
- **Objectives**
  - Inventory existing operational strategies
  - Build off recommendations of previous corridor studies
  - Identify viable operational strategies
  - Develop comprehensive implementation plan

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### Operational Improvement

- Strategy or treatment that seeks to improve:
  - Congestion, Safety, Reliability/ Predictability, & Throughput
  - **Without Construction of New Roadway Capacity**
- Operational Improvement Examples:
  - Enhanced Incident Detection and Response
  - Dynamic Ramp Metering
  - Enhanced Traveler Information
  - Strategic Chain-up Assistance

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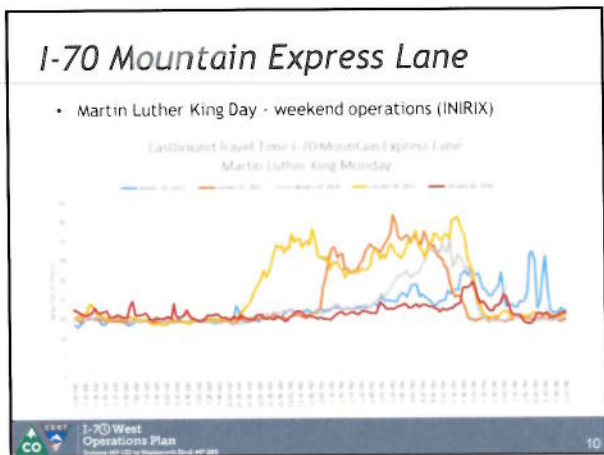
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- ### State of the Practice
- Subject Matter Experts
- David Ungemah
    - Managed lanes, TDM, pricing topics
  - Scott Shogan
    - Traffic management, modeling, connected / automated vehicles
  - Diego Carroll
    - Managed lanes, ITS, lane control systems, arterial systems
  - Les Jacobson
    - Flow metering, ATM, shoulder utilization
- I-70 West Operations Plan  
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### Managed Lanes & Pricing

- Commonalities between strategies
  - Provide options to congested conditions
  - Regulate demand for highway travel
  - Use market signals (incentives / disincentives)
- Current deployment on I-70
  - EB Mountain Express Lane

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12

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### Managed Lanes Practice

- I-70 Mountain Express Lane is only facility of its kind in US
  - HOV / Managed Lanes typically urbanized, commuter corridors
  - Shoulder lane operates only under certain conditions
  - Lack of breakdown shoulder
- Studies Have Considered
  - Extending and expanding shoulder lane (2014)
  - Constructing new reversible lanes (2013)
  - Contraflow lanes via "zipper" truck (2010)



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### Managed Lanes Practice

- State of the Practice
  - Limited special use lane procedures in tourism-heavy corridors
  - Use of exterior shoulder for all traffic
    - Route 3 (Boston to Cape Cod)
  - HOV lanes
    - Long Island Expressway to Hamptons
    - US 101 to Monterey
- Managed Lanes Possibilities
  - Re-evaluate zipper lane approach
  - Contraflow priority lane conversion on EB climb to Eisenhower
  - Dynamic lane evaluation
  - Special use queue bypass for metering



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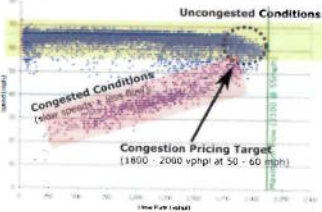
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### Congestion Pricing Practice

- Congestion pricing rationale
  - Generates revenue to build preferred options in corridor
  - Meters traffic, which provides efficiency and self-rationing
- I-70 Mountain Express Lanes currently deploys congestion pricing principles
  - Price decreases and increases with overall corridor traffic to maintain performance within express lane



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## Congestion Pricing Practice

- State of the Practice
  - Limited use of congestion pricing outside of express lanes
    - Restrictions in Federal Law
  - More extensive use of static tolls to tourist destinations (Pikes Peak, Maine Turnpike, Whistler Ski Resort, Prince William Sound, etc.)
- Congestion Pricing Possibilities
  - Variably price tunnels on corridor
    - Twin Tunnels
    - Eisenhower / Johnson Tunnels
  - Variably price entrance ramps to I-70 during peak periods



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## Connected Vehicles



- Opportunities for safety and mobility solutions through CV in the near term, but stronger in the mid- to long-term
- Different types of connectivity:
  - Vehicle-to-“Cloud” (cellular connectivity to internet directly from vehicle)
  - Indirect/tethered connectivity (via smart device)
  - Vehicle-to-Vehicle (V2V)/ Vehicle-to-Infrastructure (V2I) using DSRC or other communications media/standards

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## Role for CV Technologies

- Mandate for DSRC in vehicles not likely required until 2019, many more years to achieve significant fleet penetration
- Current application focused on:
  - Fleet deployments (e.g. maintenance fleet)
  - Stand alone mobile applications
  - Agency partnership with private mobile application providers



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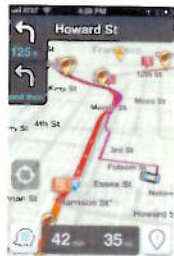
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### Applications for Mobile

- Enhance existing mobility applications using real-time data published from CDOT/local agencies:
  - Work zones
  - Road weather
  - Tunnel operational conditions
  - Weather-related closures
- Develop stand-alone or enhance warning capabilities of mobile applications
  - Back-of-queue warning
  - Reduced speed zones
  - Spot weather warnings
  - Curve speed warnings




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### V2V/V2I Applications

- Enhanced road weather (vehicles as micro-weather probes)
- Cooperative adaptive cruise control
- Gang plow operation support
- Truck platooning
- Speed harmonization
- V2V safety applications




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### Variable Speed Limits on Freeways

- **Location:** I-80; Parleys Canyon, Utah; Mountainous terrain
- **Purpose:** Promote *reasonable and safe speeds*; Minimize speed differentials
- **Design:** 15 signs; 4 zones (2 WB/2 EB; upper/lower canyon zones)
- **Technology:** LED signs
- **Activated:** January 2014
- **Cost:** \$700K (\$40K/sign; driven by power/comms)




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### Variable Speed Limits on Freeways

- **Software:** Custom UDOT software which creates a record of speed limit decisions (creates an engineering report)
- **Protocol:**
  - ✓ Event trigger: when requested by DOT or law enforcement
  - ✓ Decision: Event activated based on engineering study that considers 85<sup>th</sup> %ile speed, weather trend/forecast (updated every 1-3 hrs), shed feedback, and chain restrictions




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### Variable Speed Limits on Freeways

- **Results (Anecdotal):**
  - ✓ First event Jan. 6, 2014 (~100 events per year)
  - ✓ Not enough data to assess crashes (see MT/WA results)
  - ✓ Positive public and agency feedback
  - ✓ Complaints about brightness (or dimness) of the signs
  - ✓ Speeds reasonable, except when event driven by specific location in a zone
  - ✓ Would like to consider automation




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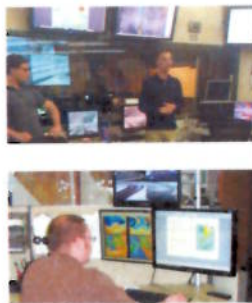
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### Weather Operations/RWIS

- **Location:** Utah statewide
- **Need:** Atmospheric models perform poorly in complex terrain (next slide)
- **Activated:** 2002 Winter Olympics
- **Description:** UDOT TOC staff meteorologists provide year-round/area-specific weather forecasts
- **Purpose:** Assist DOT operations, maintenance, and construction
- **PPP:** 9 contractor meteorologists; 1/3 TOC / 2/3 Others = + DOT coverage
- **Cost:** 11:1 BCR for labor & materials




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### Weather Operations/RWIS

- Total Economic Impact: \$66.36 million\*
  - ✓ Wages & Salaries: \$42.81 million
  - ✓ Retail Sales: \$18.26 million
  - ✓ Federal Taxes: \$3.32 million
  - ✓ State/Local Taxes: \$1.98 million
- [1% improvement = \$600K+]



\*Source: American Highway Users Alliance (IHS Global Insight, 2009)

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### Weather Operations/RWIS

- Benefits:
  - ✓ customized forecasts (+accurate/timely forecasts)
  - ✓ access to a forecaster (Direct and to the point, no charts or graphs; saves time, less user error, up to the second information)
  - ✓ advanced warning of storm conditions
  - ✓ better response time
  - ✓ improved planning and scheduling of staff
  - ✓ better use of chemical products
  - ✓ construction/contractor alerts



• More Info: Jeff Williams; JeffWilliams@utah.gov; (801) 887-3735

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### Lessons Learned & Application to I-70

- Metering
- Advanced Traffic Management (ATM)
  - Variable Speed Displays/Limits
  - Dynamic Shoulder Use
  - Lane Use Control



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## Metering

- Most applications are metering ramps in urban areas
- Reasons for success
  - Smooth flow onto freeway
  - Break up Platoons
  - Requires sufficient number of ramps to "control" flow
- Results
  - Reduced collisions
  - Improved travel time & travel time reliability
- Application to I-70 corridor
  - Needs to apply to majority of vehicles entering critical area




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## Variable Speeds in Rural Areas

- Applications
  - Low visibility (fog or dust)
  - Mountain passes
  - Safety
- Results - Snoqualmie Pass
  - Reduced speeds
  - Reduced collisions
- Important considerations
  - Sign visibility
  - Credibility




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## Dynamic Shoulder Use

- US applications mostly urban
- Lessons
  - Shoulder pavement characteristics
  - Importance of bottleneck locations
  - Clear status indication
- Operational issues
  - Assurance of clear shoulder
  - Vehicle clearance




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### Lane Use Control

- Traditionally, overhead and urban
- Rural application
  - Dynamic shoulder use
- Safety improvement
- Limited application
  - Dynamic shoulder use



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31

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### Synergies

- Managed lane approaches with traffic management
  - Couples mobility and safety
- ATM to support traffic incident management
  - Shoulder use under incident conditions
  - Metering and incidents
  - Variable speeds and incidents



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32

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### Considerations

- Improvements past the bottleneck
- Need for enforcement
- Safety or mobility?
- Context
  - "Rural" but heavy, peaked traffic conditions
- Systems and Synergies



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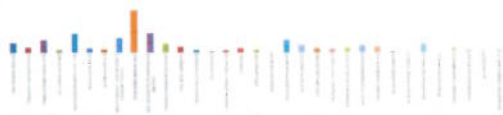
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# Operational Strategy Inventory

## Timeline of studies

- To date 33 substantial studies have been conducted since the Major Investment Study conducted in 1998
- Each study built on the previous and included recommendations for improving I-70 operations
- The timeline shown below and in the handout depicts graphically the studies with the number of associated operational improvements
- There were a number of recommendations that are similar and in some cases the same recommendation in the studies (includes TDM)




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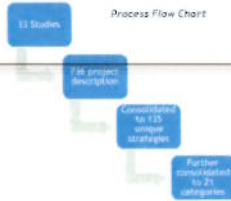
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## How the reports are broken down into a usable data base!

- There were a total so far of about 736 project descriptions with similar concepts for operational improvements
- The handout summarizes and consolidates the 736 project descriptions into 135 unique descriptions called Strategies
- To further consolidate the strategies they were broken down into 20 categories




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## Stakeholder Input

- Level 1 Evaluation Criteria Overview

Criteria	Description	Measure
<b>Mobility Benefits for Passenger Vehicles, Trucks and Commercial Motor Vehicles (Freight)</b>		
Vehicle Throughput	Increased number of vehicles per hour per lane	X
Travel Time Reliability	Reduced travel time variability (standard deviation) of travel time	X
Travel Time Savings	Reduced travel time (minutes) per vehicle per mile	X
Freight Throughput	Increased number of trucks per hour per lane	X
Freight Travel Time Reliability	Reduced travel time variability (standard deviation) of travel time for freight	X
Freight Travel Time Savings	Reduced travel time (minutes) per truck per mile	X
<b>Operational Efficiency for Passenger Vehicles, Trucks and Commercial Motor Vehicles (Freight)</b>		
Vehicle Throughput	Increased number of vehicles per hour per lane	X
Travel Time Reliability	Reduced travel time variability (standard deviation) of travel time	X
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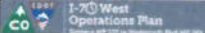
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Stakeholder Input

- *Focus of technical session?*



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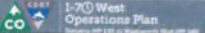
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**Operations Strategy Charrettes  
Technical Review**

April 26<sup>th</sup> & 27<sup>th</sup>, 2016



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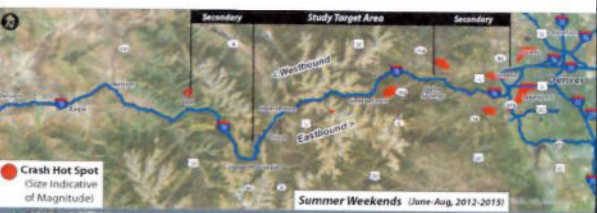
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**Existing Traffic Conditions**

- Crash Density
  - Summer Weekends
  - June-August
  - 2012-2015



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### Existing Traffic Conditions

- Crash Density
  - Winter Weekends
  - December-February
  - 2012-2015



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### Existing Traffic Conditions

- Average Westbound Speed Under Posted Limit
  - Summer Saturday
  - July 18, 2015
  - 6AM - 4PM



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### Existing Traffic Conditions

- Average Eastbound Speed Under Posted Limit
  - Summer Sunday
  - July 19, 2015
  - 9AM - 8PM



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### Brainstorming Operational Strategies

- New strategy ...
- New strategy ...

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September 2015 - February 2016

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### Identify Strategies for Further Consideration

- New strategy ...
- New strategy ...

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September 2015 - February 2016

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### Next Steps

- Following charrette:
  - Collate comments on strategies
  - Evaluate strategies using Level 1 criteria
- Working towards Final I-70 Operational Plan which will include:
  - Inventory of existing operational strategies
  - Prioritized list of new operational strategies
  - Description of evaluation process
  - Phased Implementation plan
- Next I-70 Coalition Meeting: July 14<sup>th</sup>
- Look for Next Stakeholders Meetings in June & September, 2016
- Concurrent Efforts:
  - FASTLANE Grant Application: Truck Parking Management Info. System
  - RoadX
  - Statewide TDM Plan

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September 2015 - February 2016

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