Keith Koeppen, P.E.

Caltrans, District 2

2022

Controlled Helter-Skelter

Definitions/Acronyms

ATMS – Advanced Traffic Management System

AVMS – Advanced Variable Message Sign, aka Model 710 CMS

CCB – Change Control Board

CCO – Contract Change Order

CCTV – Close Circuit Television

CMS – Changeable Message Sign

CT - Caltrans

DMS – Dynamic Message Sign

EMS – Extinguishable Message Sign

HDPE – High Density Polyethylene

IP – Internet Protocol

IRIS – Intelligent Roadway Information System

ITS – Intelligent Transportation Systems

M2M – Machine to Machine

NTCIP – National Transportation Communications for ITS Protocol

RWIS – Roadside Weather Information System

SMFO – Single Mode Fiber Optic

TEES – Transportation Electrical Equipment Specifications

TMC – Transportation Management Center

VMS – Variable Message Sign

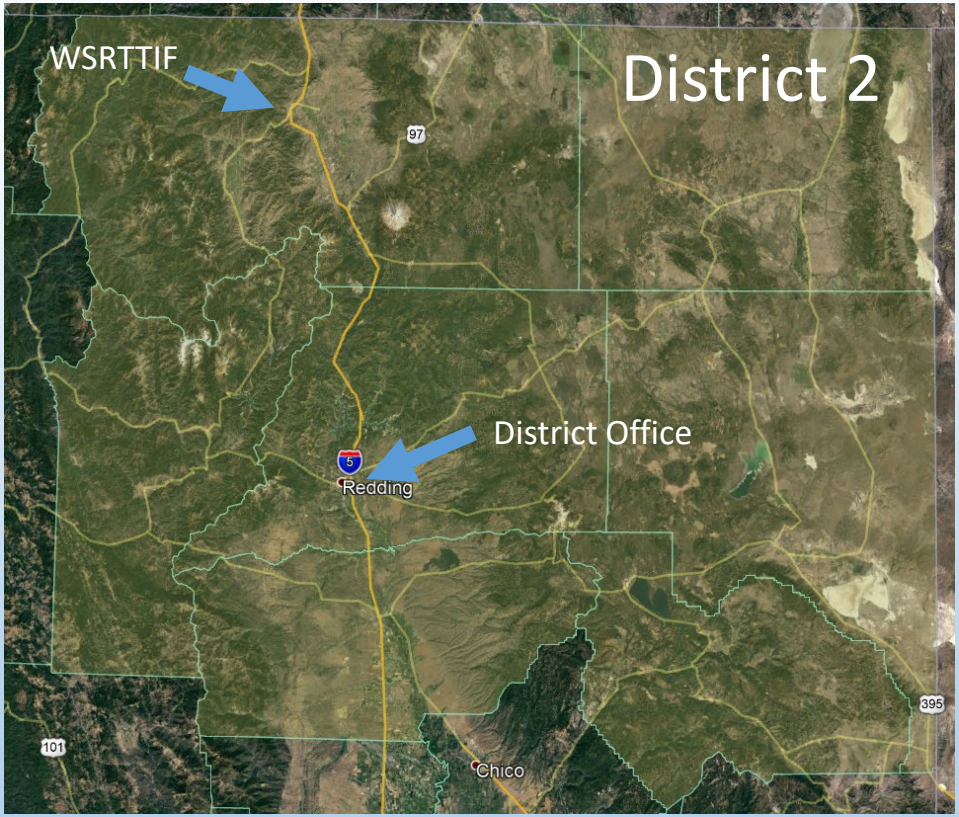
VPH – Vehicles per hour

WAN – Wide Area Network

WSRTTIF – Western States Rural Transportation Technology Implementers Forum

Background

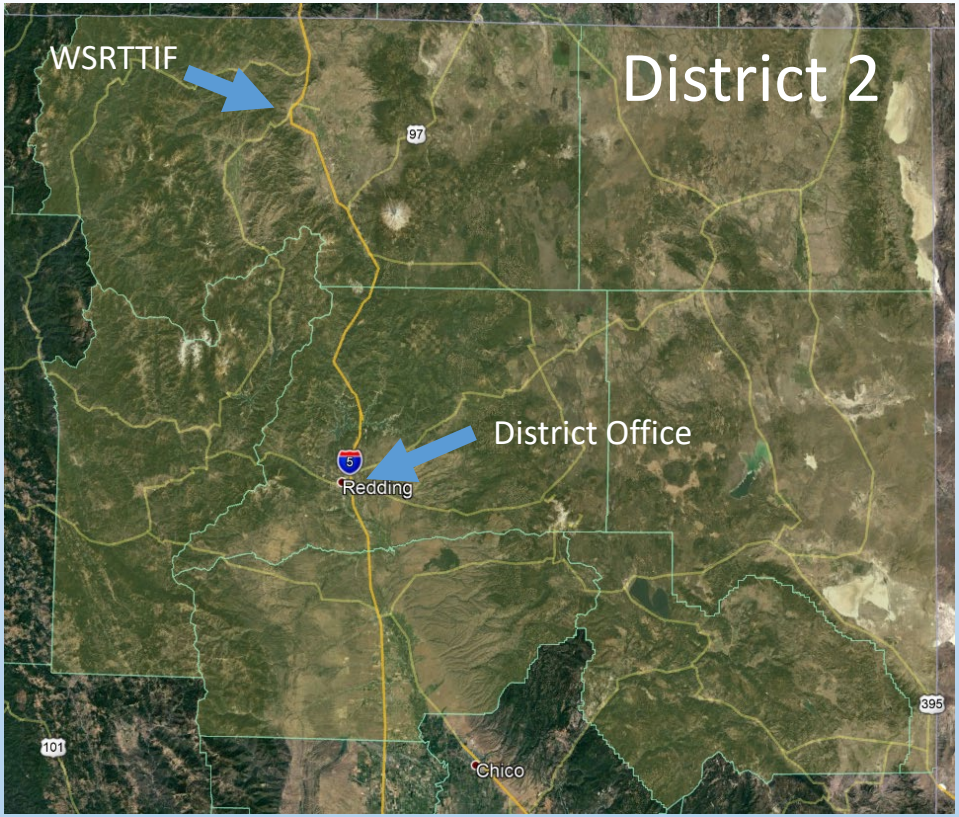
District 2



Background

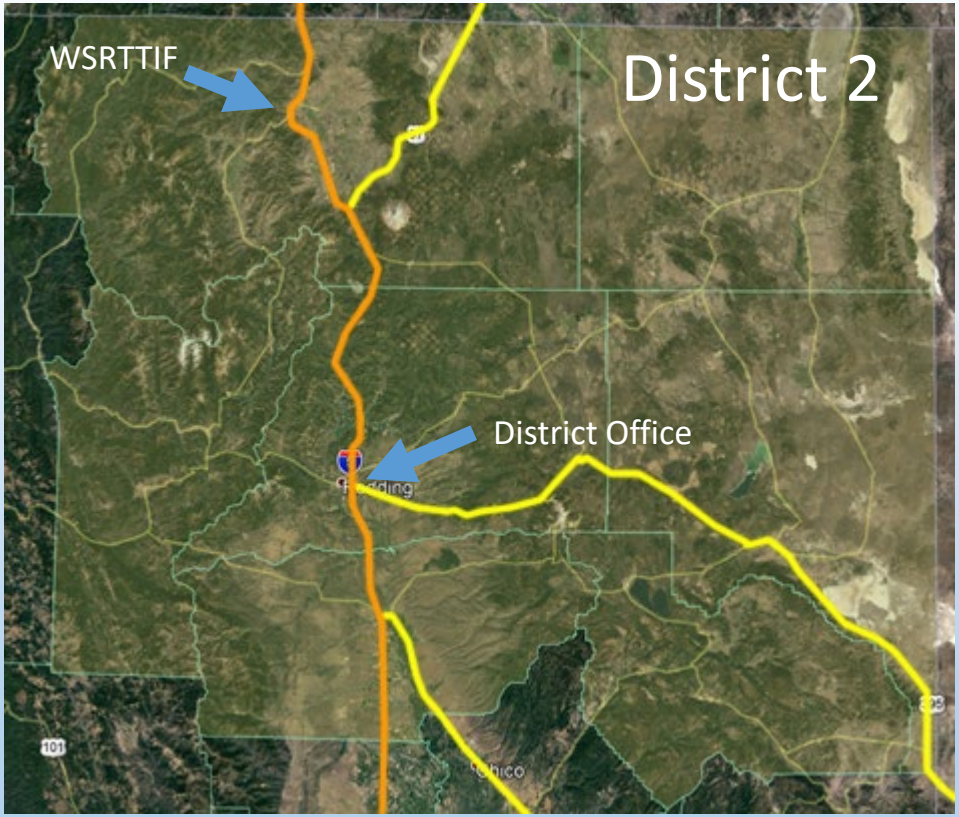
District 2

- Very Rural District
- Winter Operations
  - 33 passes/summits
  - 172 chain control signs



Background
District 2

- Very Rural District
- Winter Operations
  - 33 passes/summits
  - 172 chain control signs
- Interstate 5
  - Major North/South freight corridor



Background

Sacramento River Canyon

- Sacramento River Canyon
  - Funneling Effect – Most traffic north and sound will traverse the canyon
  - Divided Interstate with Median barrier
  - Steep canyon walls
  - Follows the Sacramento River to the Headwaters in Mt. Shasta
  - Subject to significant snow fall in winter
  - Approx. 40 miles long

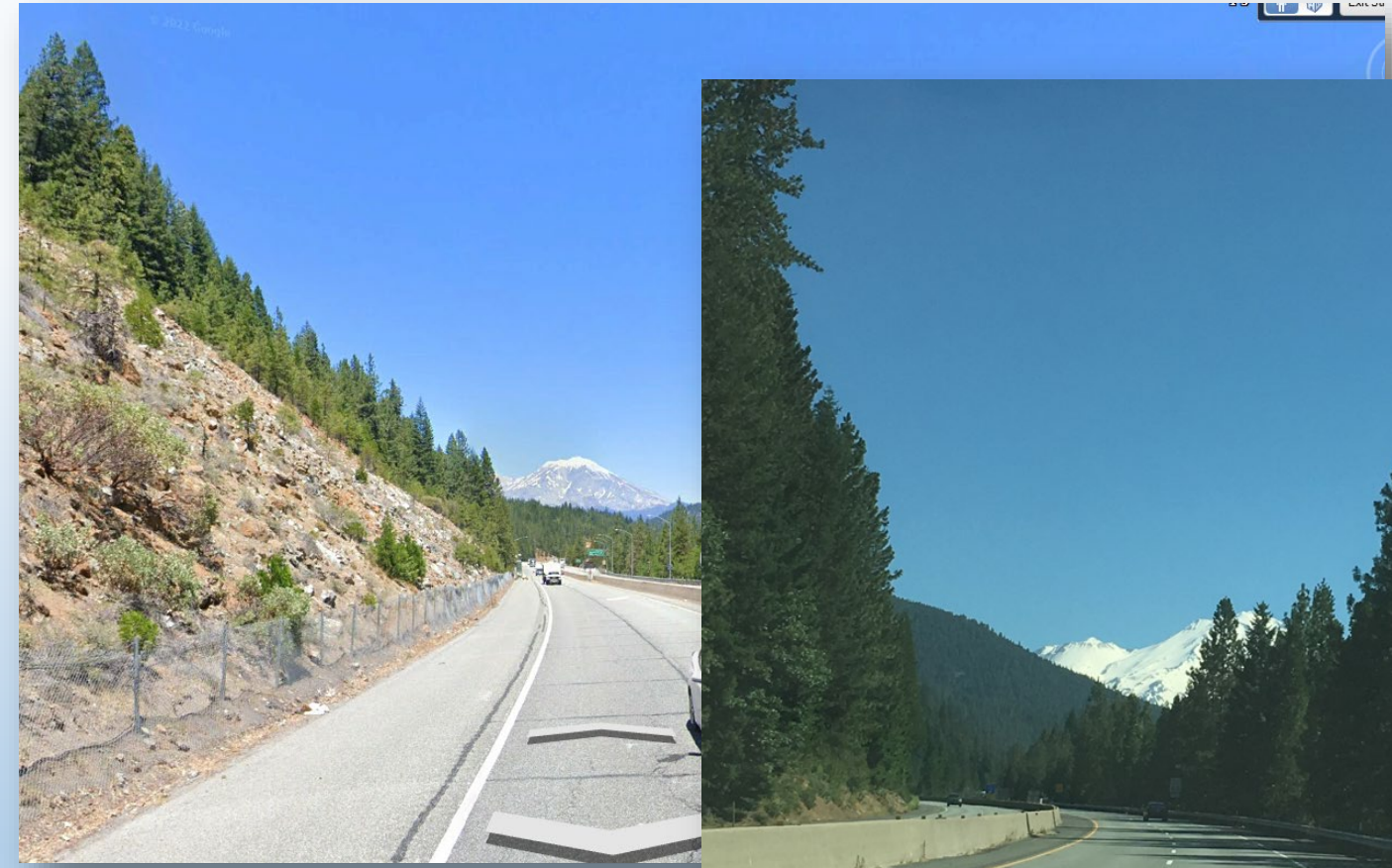
Background

Sacramento River Canyon

Street View? Can we do better?

Background

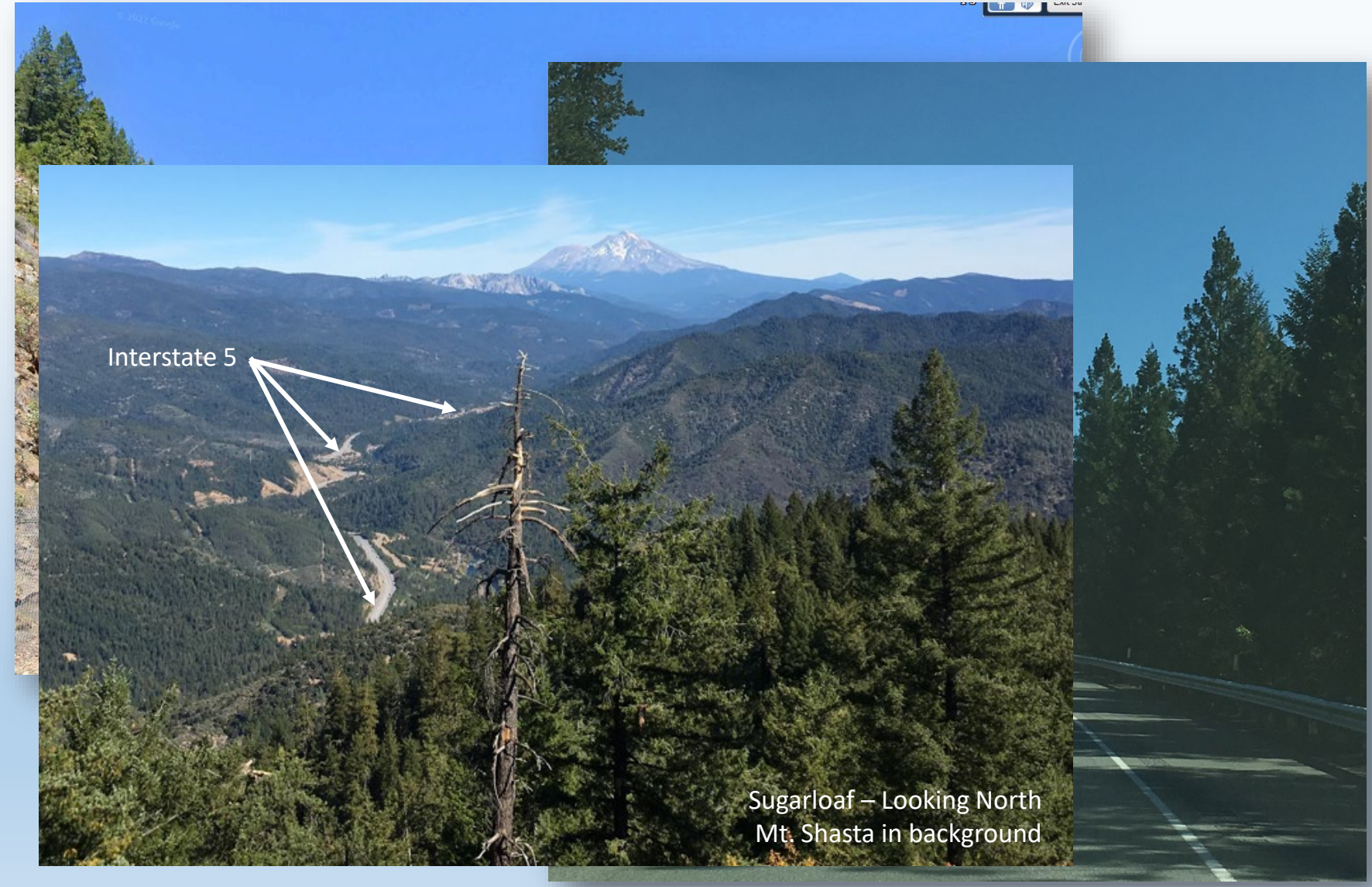
Sacramento River Canyon



Interstate 5 Castella – Looking North
Mt. Shasta in background

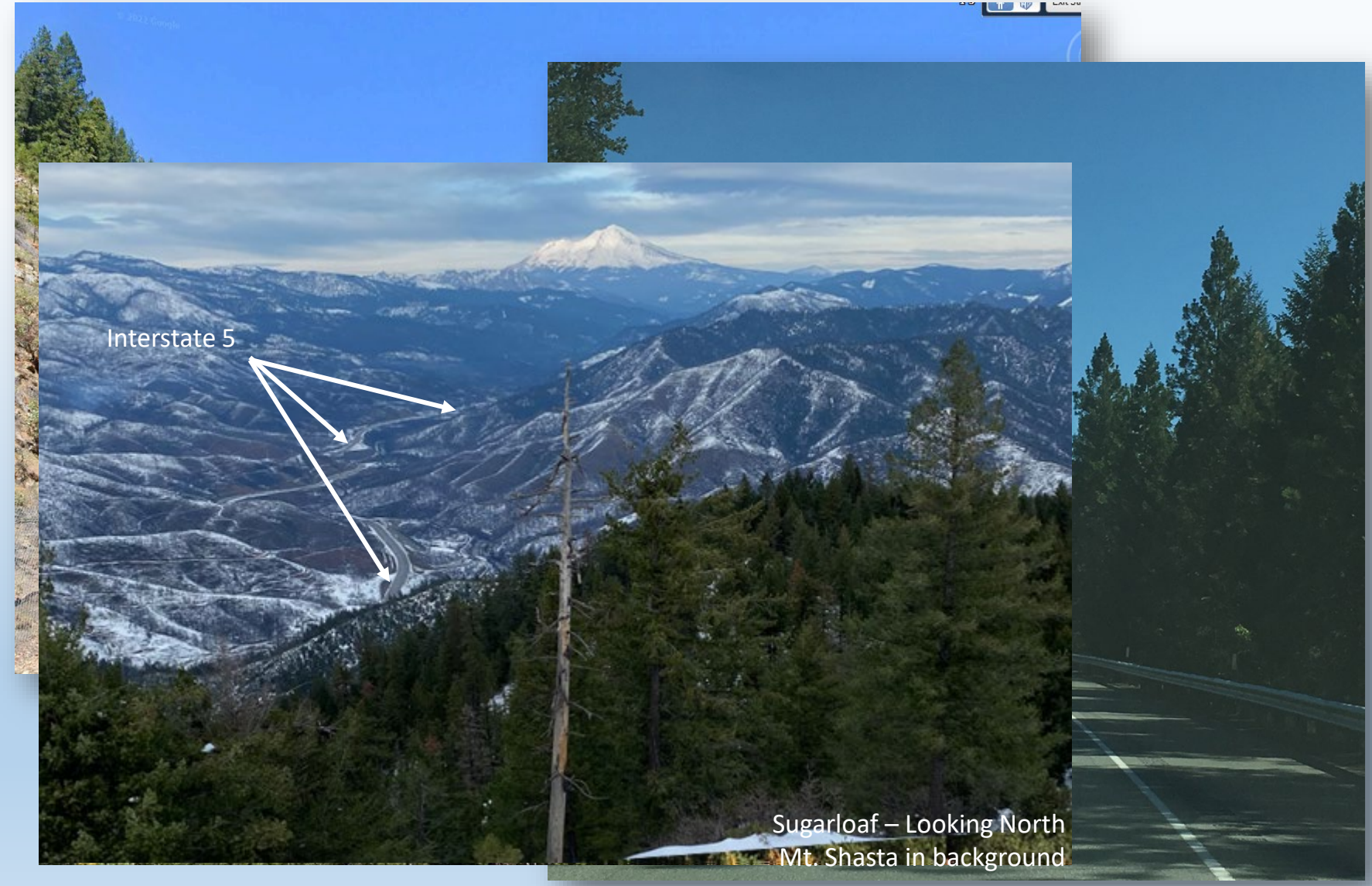
Background

Sacramento River Canyon



Background

Sacramento River Canyon



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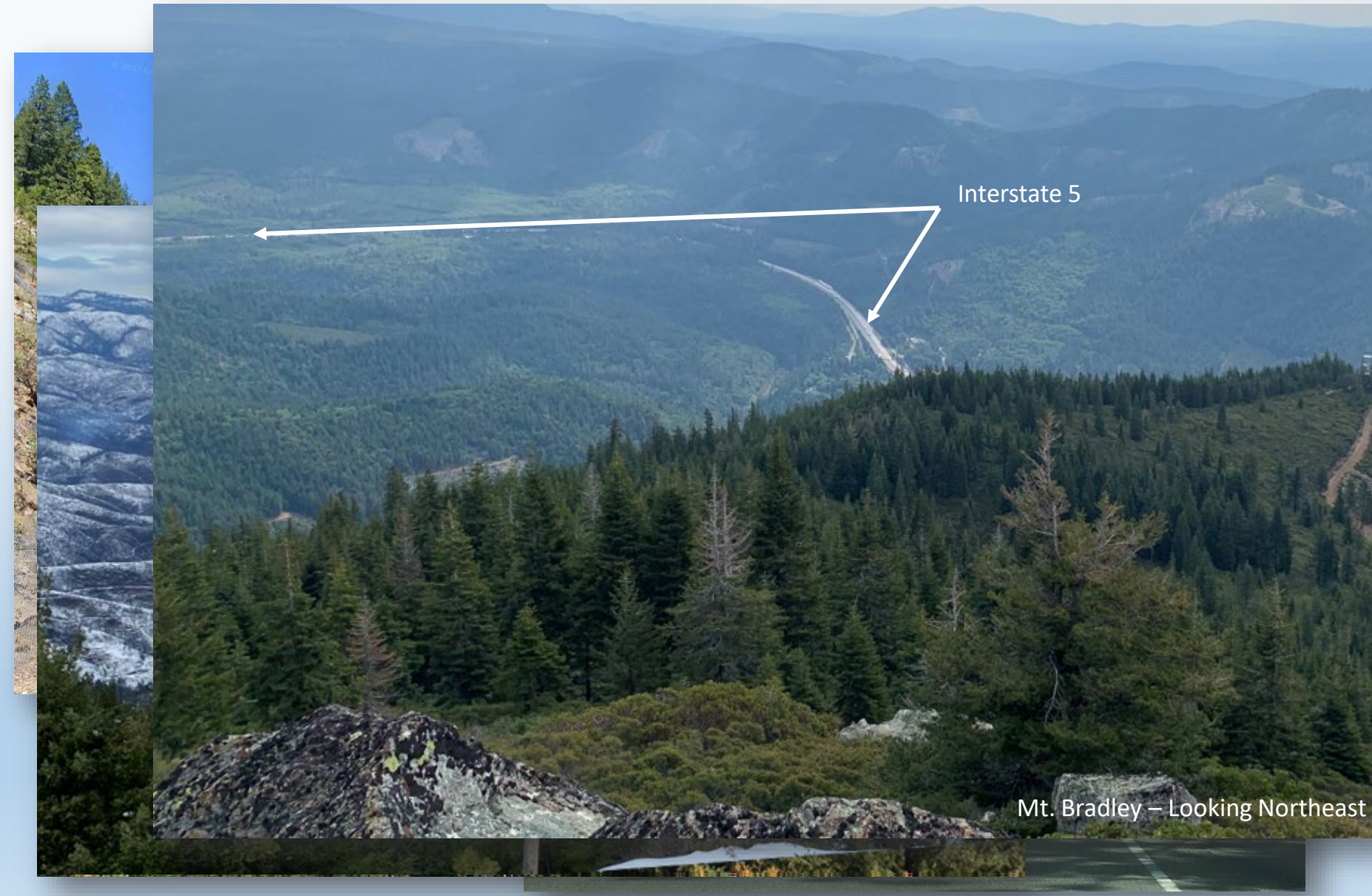

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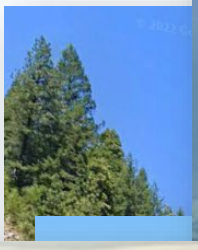
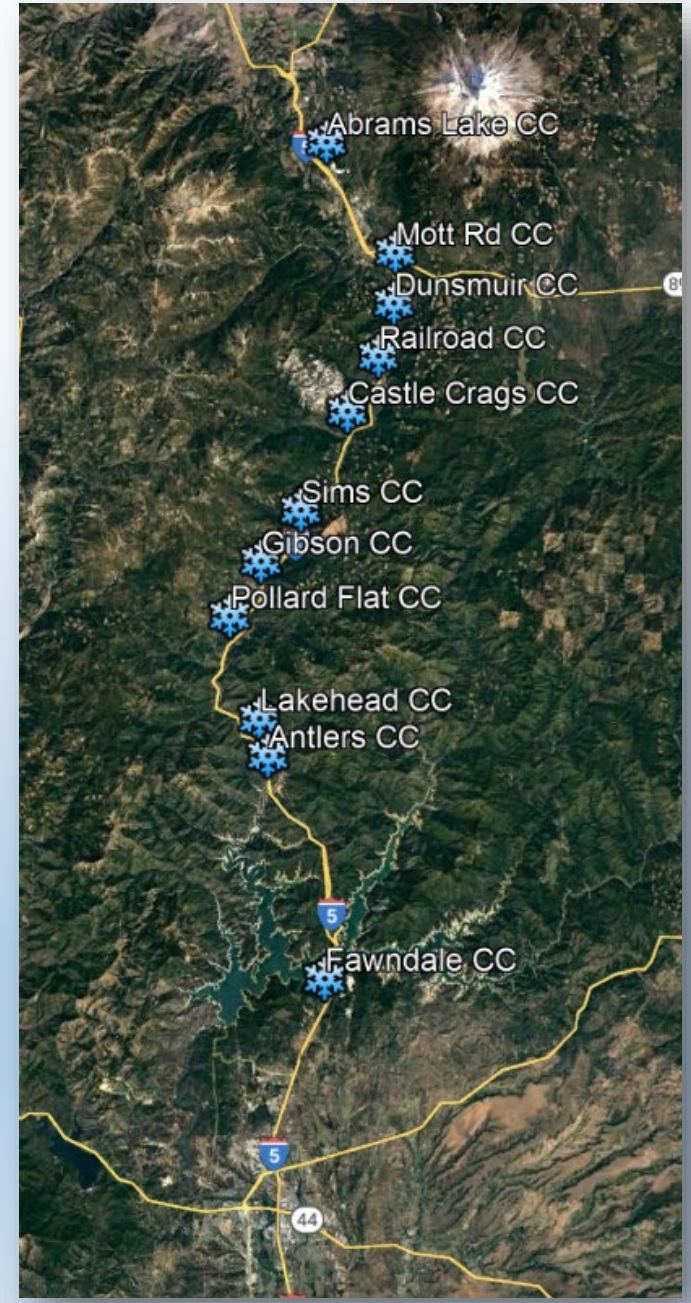


Sugarloaf – Looking East
Mt. Lassen in background

Background

Chain Control Locations



- Chain Control Locations
  - 8 chain control signs / chain on locations
  - 3 watch sign location (non-restrictive)

Background

Chain Control Signage

- Chain Control Locations
  - 8 chain control signs / chain on locations
  - 3 watch sign location (non-restrictive)
- Chain Control Watch Signs
  - Advises motorist of winter driving conditions
  - ***Advisory***

Background

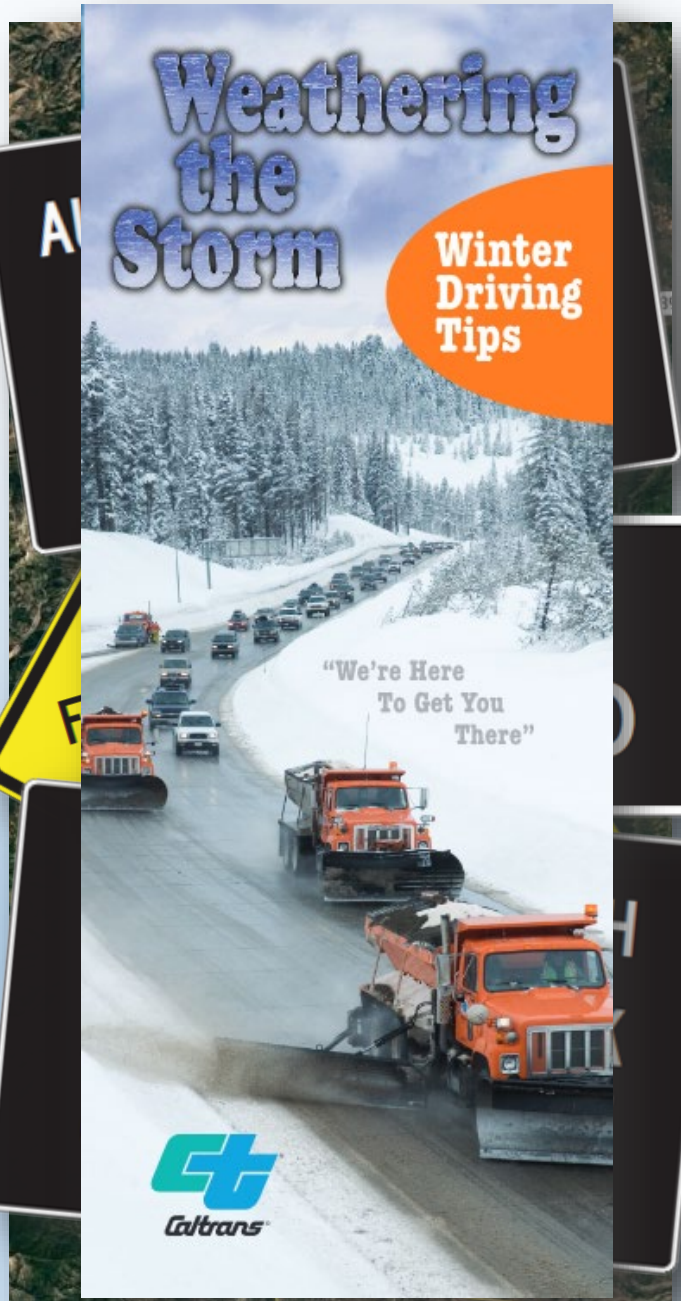
Chain Control Signage

- Chain Control Locations
  - 8 chain control signs / chain on locations
  - 3 watch sign location (non-restrictive)
- Chain Control Watch Signs
  - Advises motorist of winter driving conditions
  - ***Advisory***
- Chain Control Signs
  - Informs motorist of current chain control restrictions and requirements
  - ***Regulatory***

Background

Chain Control Levels

- Chain Control Levels (District 2)
  - **R-0** – No Restrictions
  - **R-1** (Modified) – Trucks and vehicles pulling trailers require chains, traction devices or snow tires on the drive axle of all vehicles except four wheel or all wheel drive vehicles
  - **R-1** – Chains, traction devices or snow tires are required on the drive axle of all vehicles except four wheel or all wheel drive vehicles
  - **R-2** – Chains or traction devices are required on all vehicles except four wheel / all wheel drive vehicles with snow treaded tires on all wheels



Background

Chain Control Levels

- Chain Control Levels (District 2) (con't)
  - **Truck Hold (TH)** – All truck trailer combinations are being held at the chain **check point** due to accidents or weather-related conditions
  - **Truck Screening (TS)** – All trucks must stop at the chain **check point**, Caltrans is currently screening for chains. Drivers must have maximum chains in their possession in order to proceed. Trucks without chains will be turned around. Permit loads are prohibited over the summit
  - **Vehicle Metering (VM)** – Traffic control is in effect to meter vehicles at the chain **check point** in order to reduce traffic congestion in the mountain areas
  - **Road Closed (RS)** – Road Closed

Background

Chain Control Levels

- Chain Control Levels (District 2) (con't)
  - **Truck Hold (TH)** – All truck trailer combinations are being held at the chain **check point** due to accidents or weather-related conditions
  - **Truck Screening (TS)** – All trucks must stop at the chain **check point**, Caltrans is curr… ng for chains. Dri… n … out … roads are … the summit
  - **Vehicle Metering (VM)** – Traffic control is in effect to meter vehicles at the chain **check point** in order to reduce traffic congestion in the mountain areas
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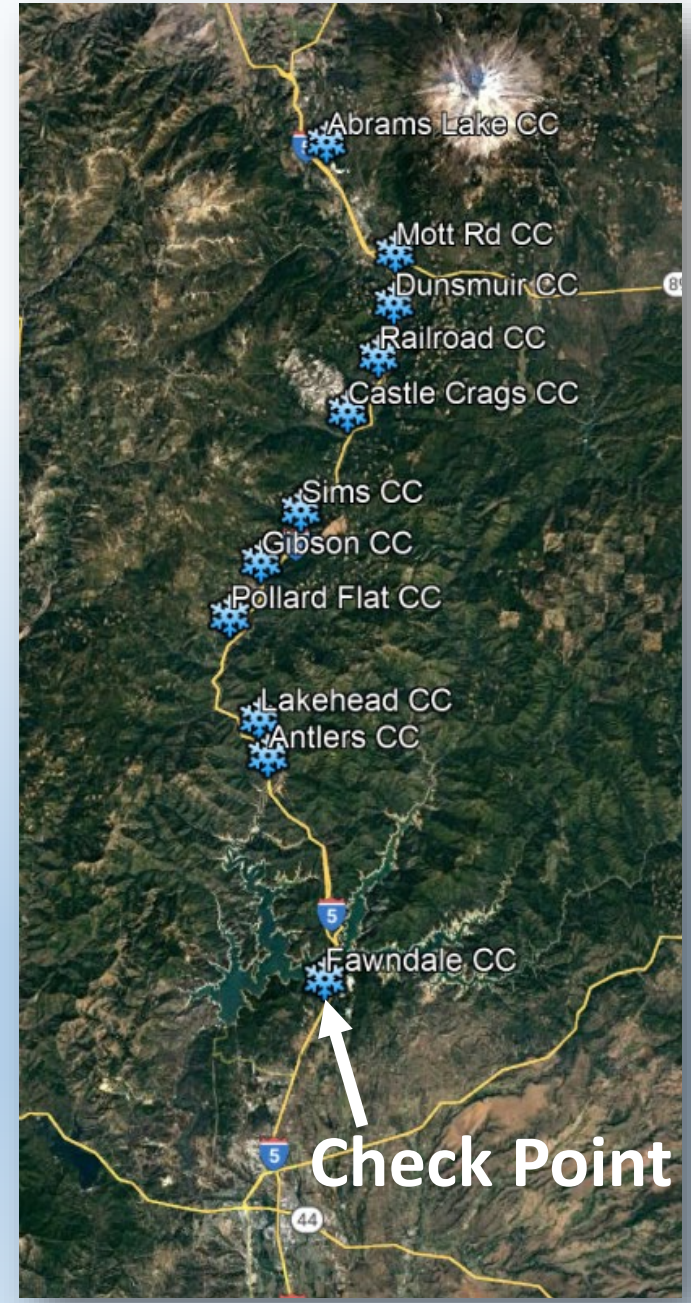
Check Point?

Background

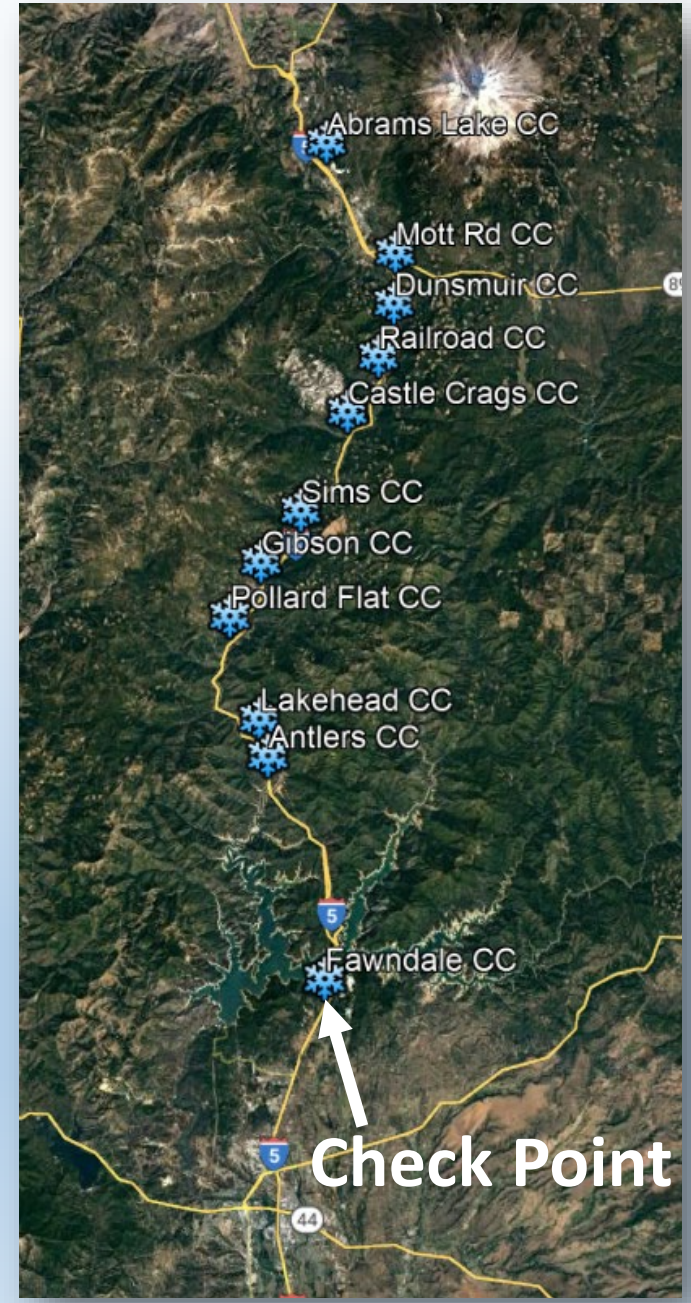
Check Point



- Ensures motorist have proper traction devices before entering the Sacramento River Canyon
- Allows for metering vehicles when chain conditions are active

Background

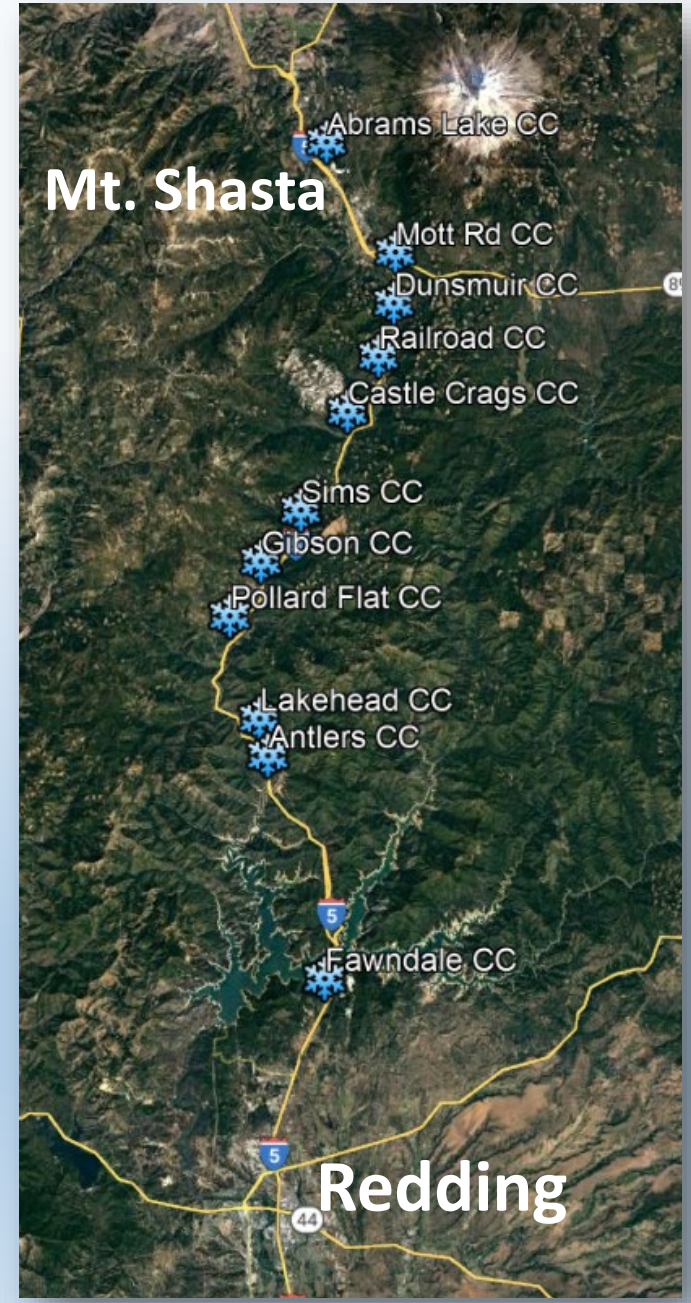
Check Point



- Limited resources to respond
  - Plowing
  - Traffic collisions/spin outs
  - Towing
- Limited resources for motorist
  - Fuel
  - Food
  - Lodging

Background

Check Point



- Limited resources to respond
  - Plowing
  - Traffic collisions/spin outs
  - Towing
- Limited resources for motorist
  - Fuel
  - Food
  - Lodging
- Nearest Major Town Centers
  - Mt. Shasta – 40 miles
  - Redding – 60 miles

Background

So, what's the problem?

- Snow?

Background

So, what's the problem?

- Snow?
- Trucks?

Background

So, what's the problem?

- Snow?
- Trucks?
- Queuing?

Background

So, what's the problem?

- Snow?
- Trucks?
- Queuing?

Background

So, what's the problem?

- Snow?
- Trucks?
- Queuing?
- Enroute Traveler Information?

Background

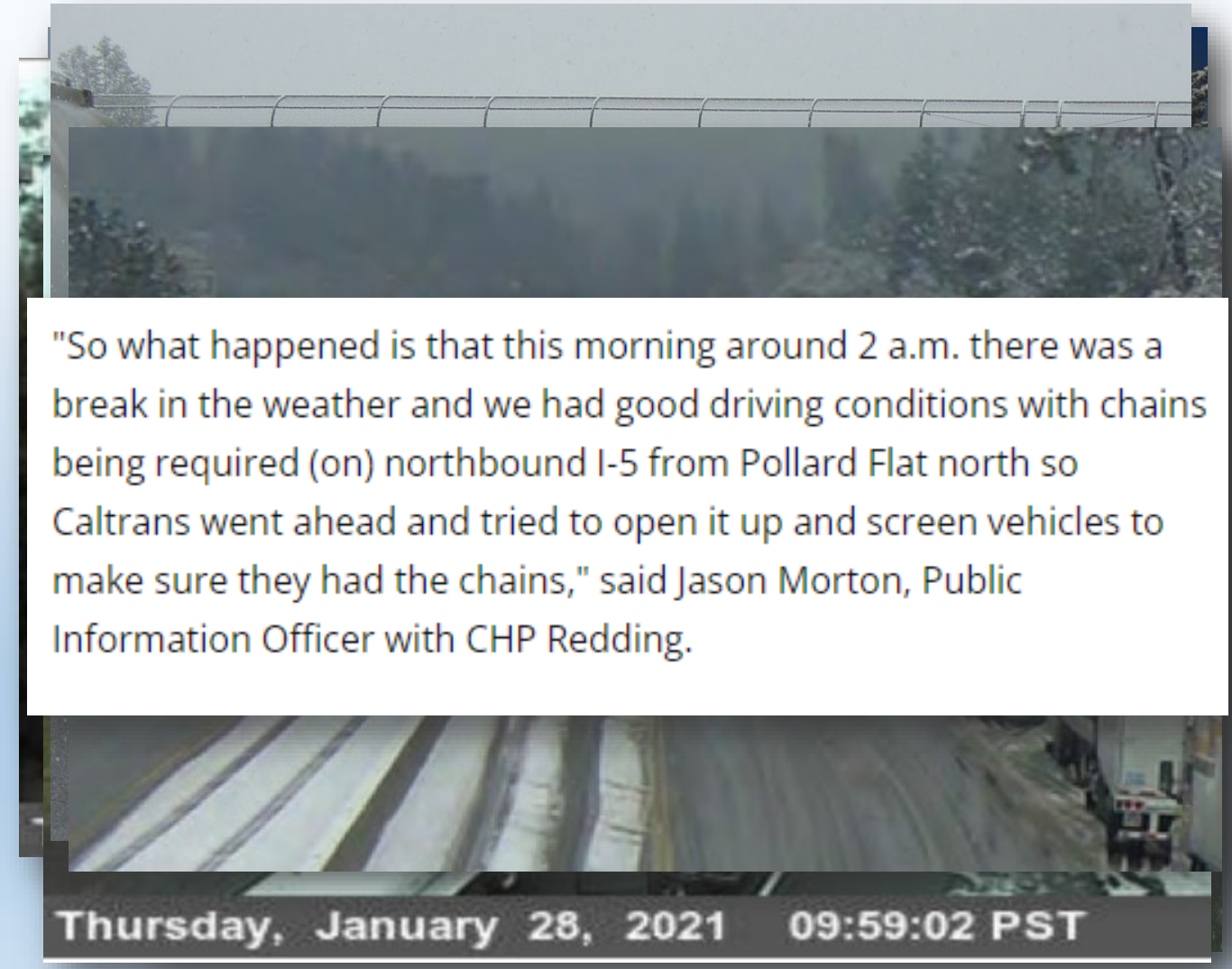
So, what's the problem?

- Snow?
- Trucks?
- Queuing?
- Enroute Traveler Information?
- Not enough lanes?

Background

So, what's the problem?

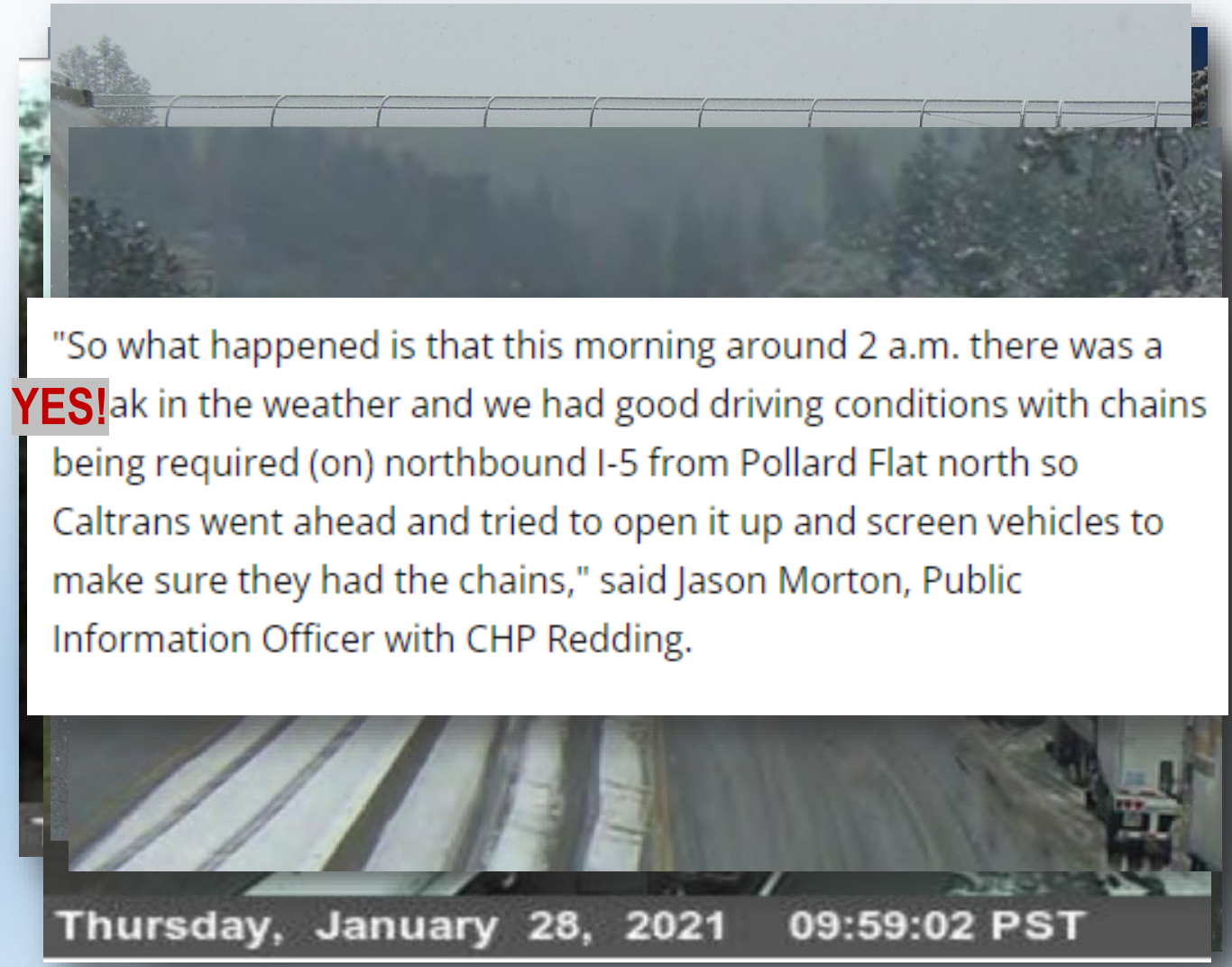
- Snow?
- Trucks?
- Queuing?
- Enroute Traveler Information?
- Not enough lanes?
- Operations?



Background

So, what's the problem?

- Snow? **YES!**
- Trucks? **YES!**
- Queuing? **YES!**
- Enroute Traveler Information? **YES!**
- Not enough lanes? **YES!**
- Operations? **YES!**



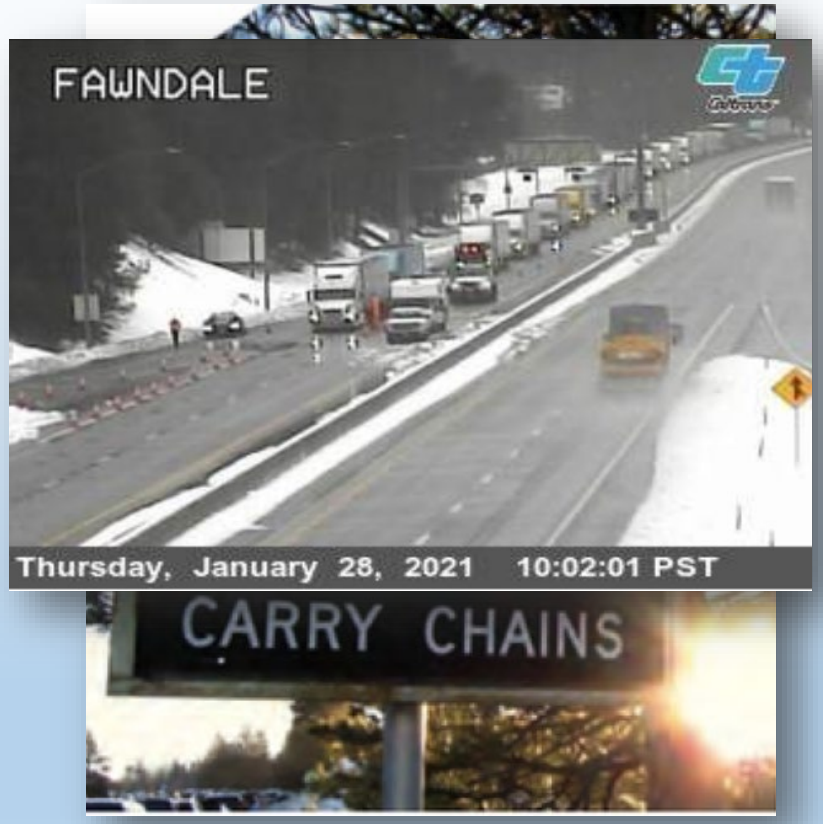
Background

So, what's the problem?

- Queuing Impacts
  - Vehicles not needing to be screen
  - First Responders
  - Snow removal operations
  - Communities
  - Traffic Hazards
    - Parking on Shoulders
    - Parking on On/Off Ramps

Background

So, what's the problem?



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- Queuing extends several miles
  - Screening location

Background

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  - Screening location
  - 1-mile queue

Background

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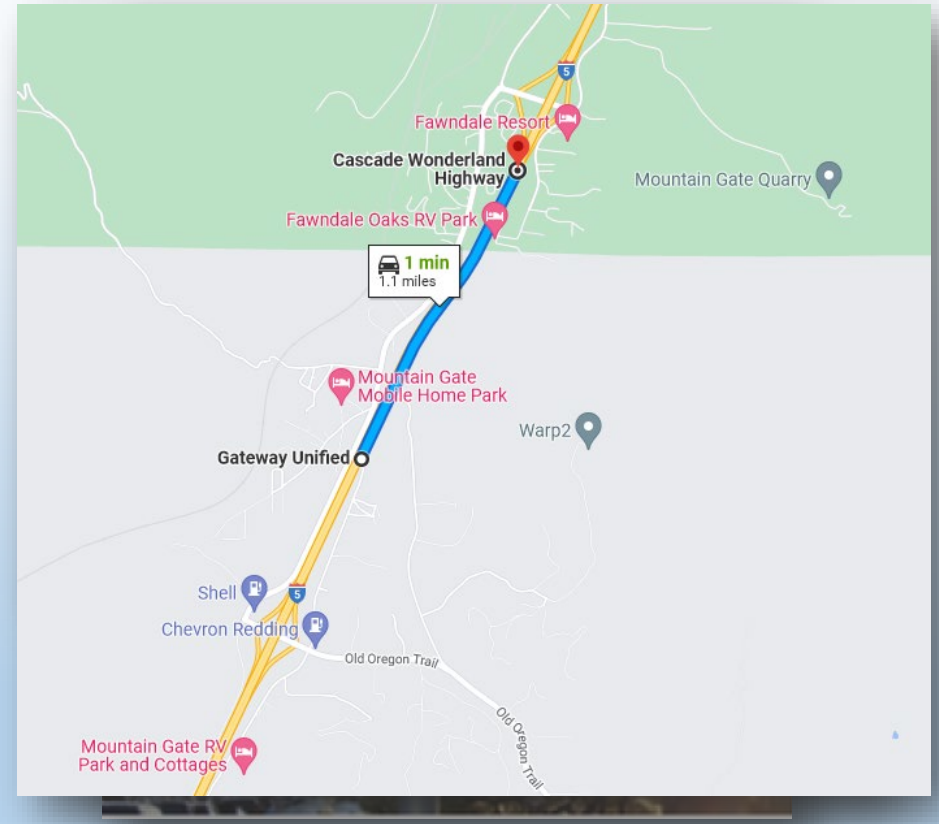

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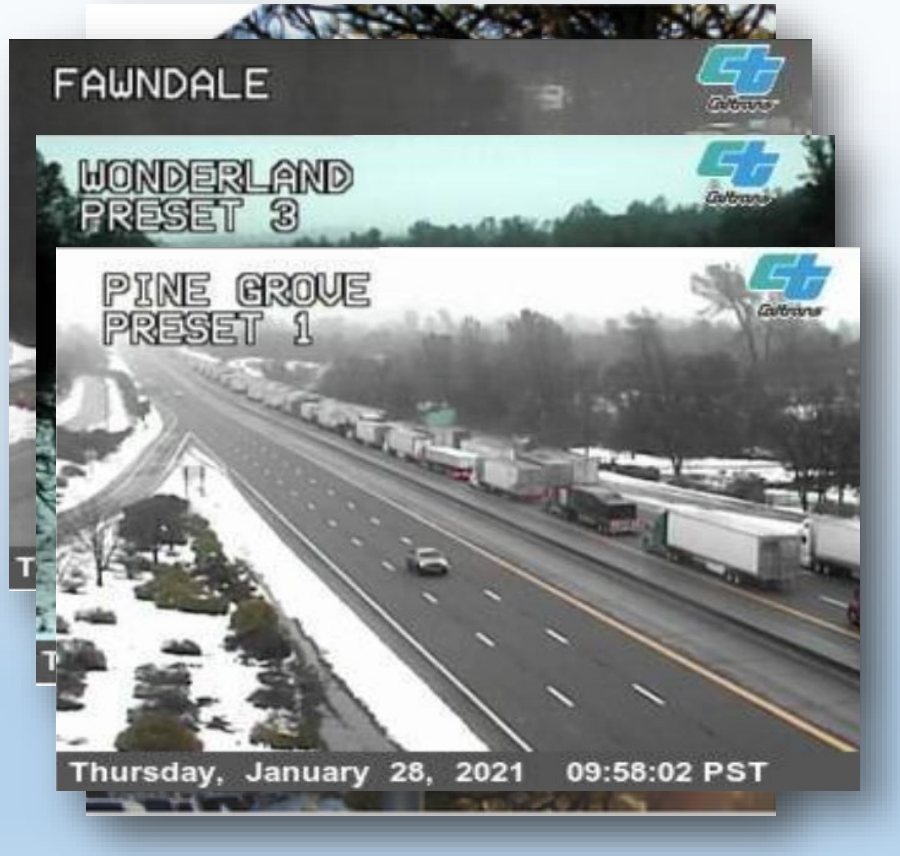

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  - 1-mile queue
  - 5-mile queue

Background

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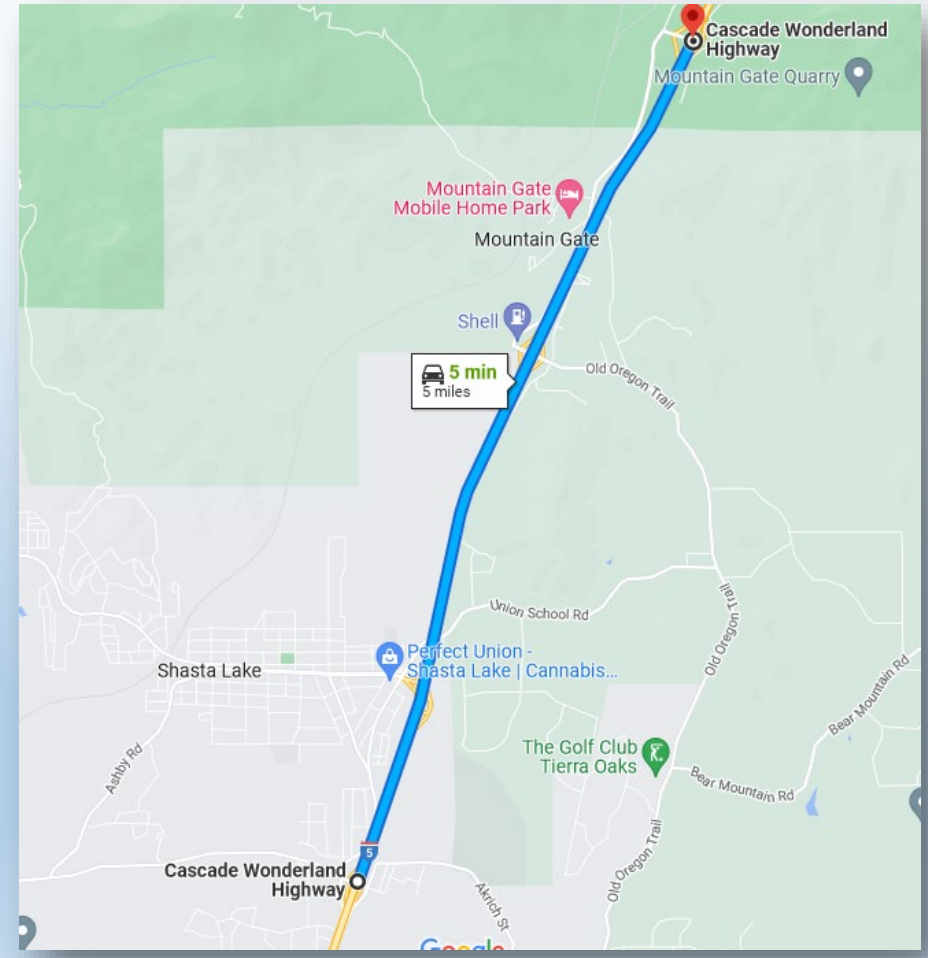

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  - 5-mile queue

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  - Communities
  - Traffic Hazards
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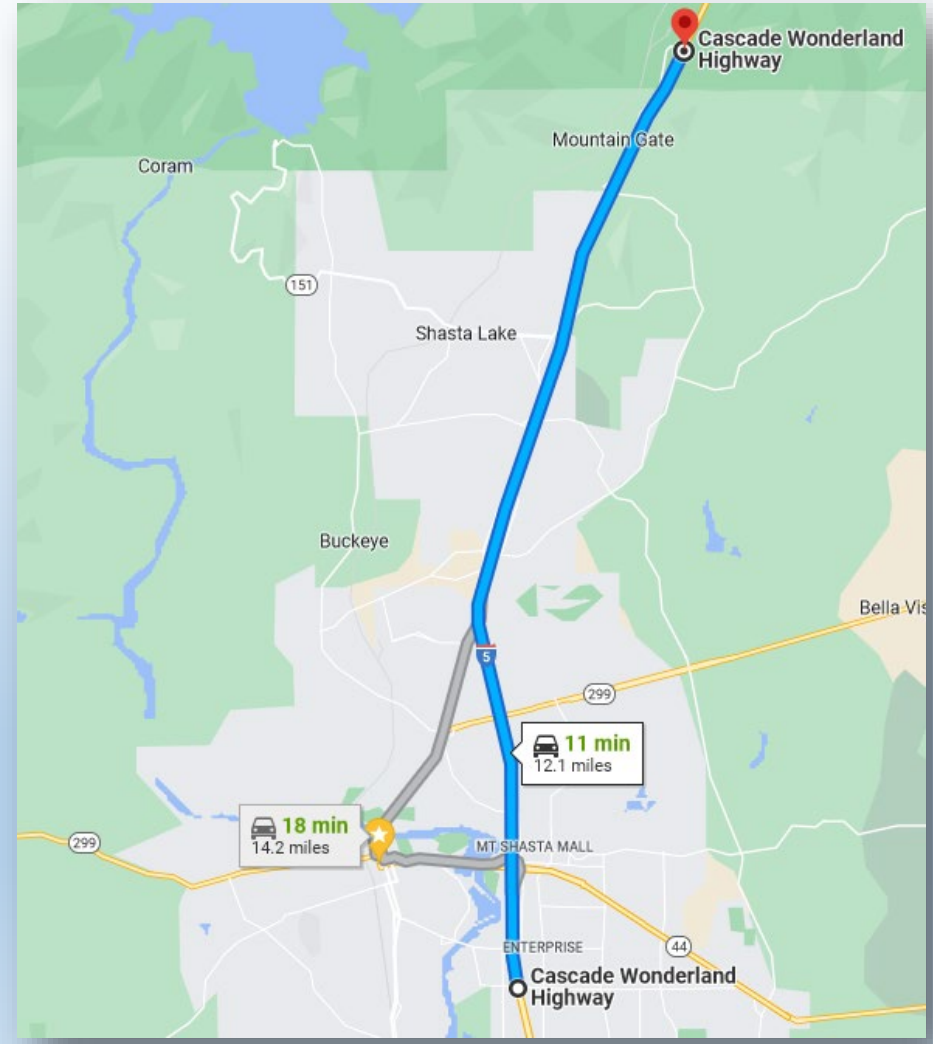
    - Parking on On/Off Ramps
- Queuing extends several miles
  - Screening location
  - 1-mile queue
  - 5-mile queue
  - 12-mile queue

Background

So, what's the problem?



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- Queuing extends several miles
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  - 1-mile queue
  - 5-mile queue
  - 12-mile queue

Background

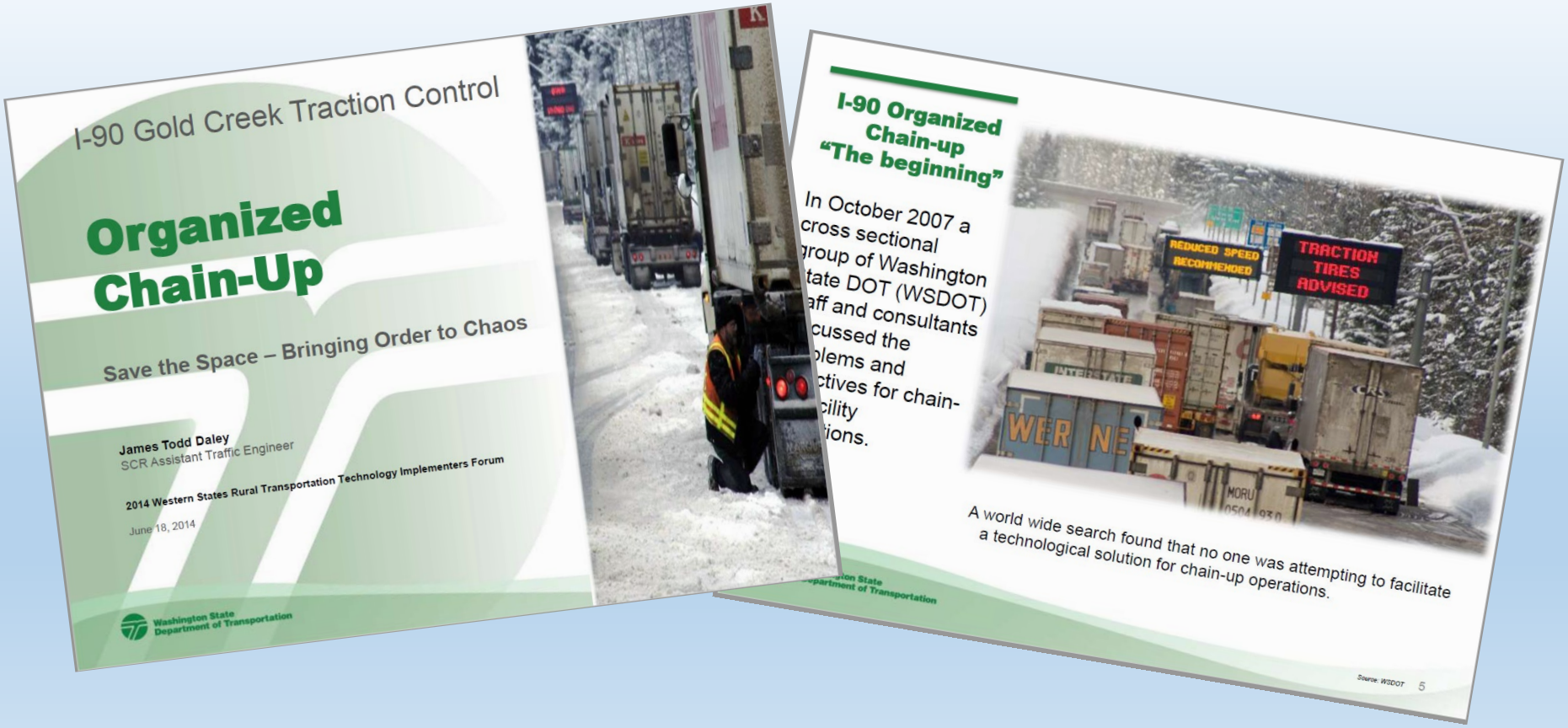
Look Familiar?

*WSDOT I-90 Snoqualmie Pass

Background

WSDOT I-90 Snoqualmie Pass

- WSDOT Previous Presentation at WSRTTIF (2014)
- Compare / Contrast



Corridor Issues

Similarities

- Backup/Congestion
- Truck “parking” waiting for conditions to improve
- Lane striping hardly visible during heavy snow
- Shoulder areas become an extra “lane”
- Services are limited within the corridor

Differences

- Chain requirements not always required at check point (CT)
- Issue location relative to the corridor
  - CT – Before the start of the corridor
  - WA – Middle of the corridor
- Maintenance Crews physically meter/check chains (CT)
- Motorist are turned around at check point (CT)

Operations

How it was before / Fawndale Check point

Operations

How it was before / Fawndale Check point

Operations

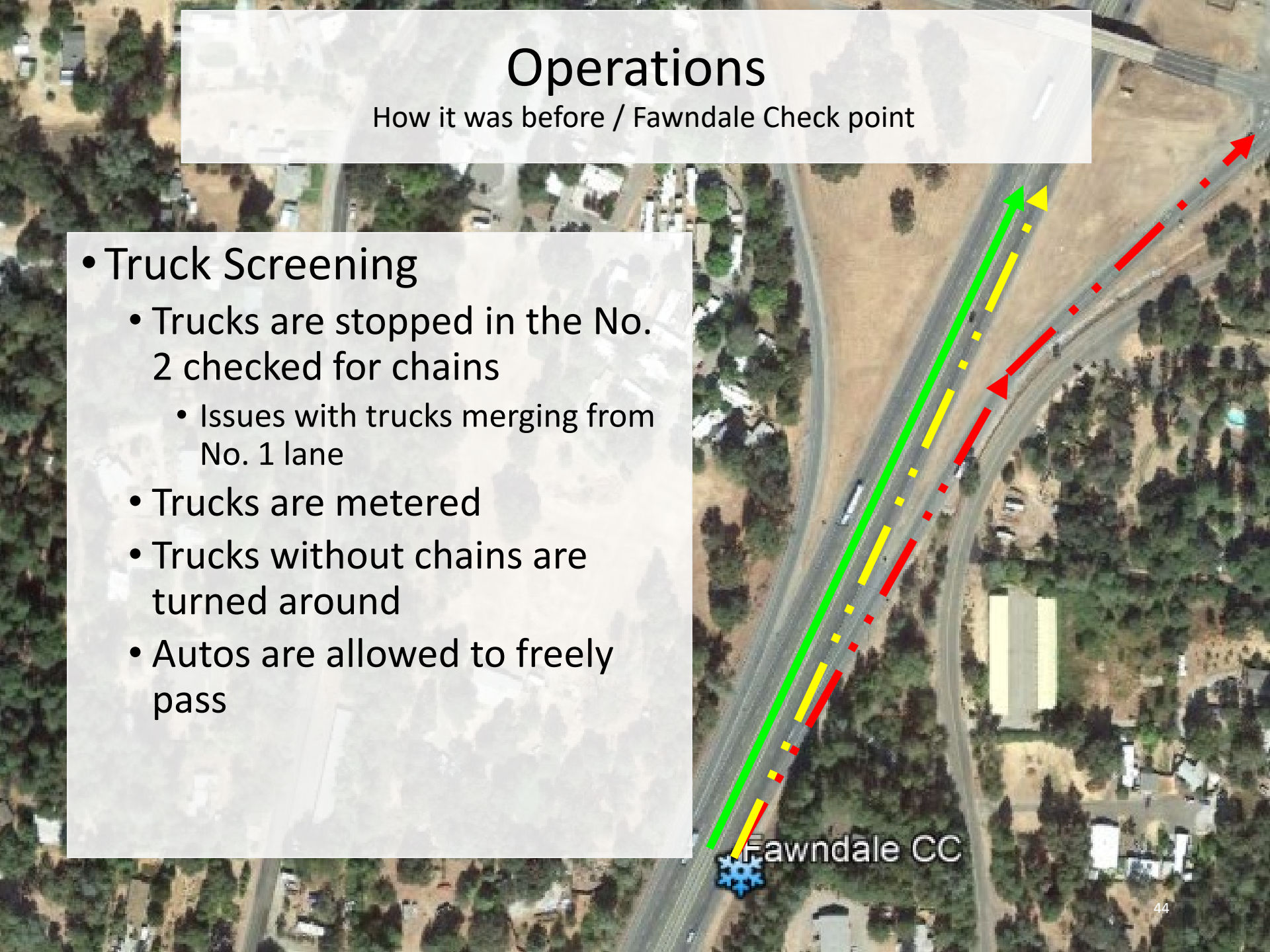
How it was before / Fawndale Check point

- Chain Control Escalation
  - No Restrictions
  - Truck Screening
  - Vehicle Screening
  - Chain Controls
  - Total Closure

Operations

How it was before / Fawndale Check point

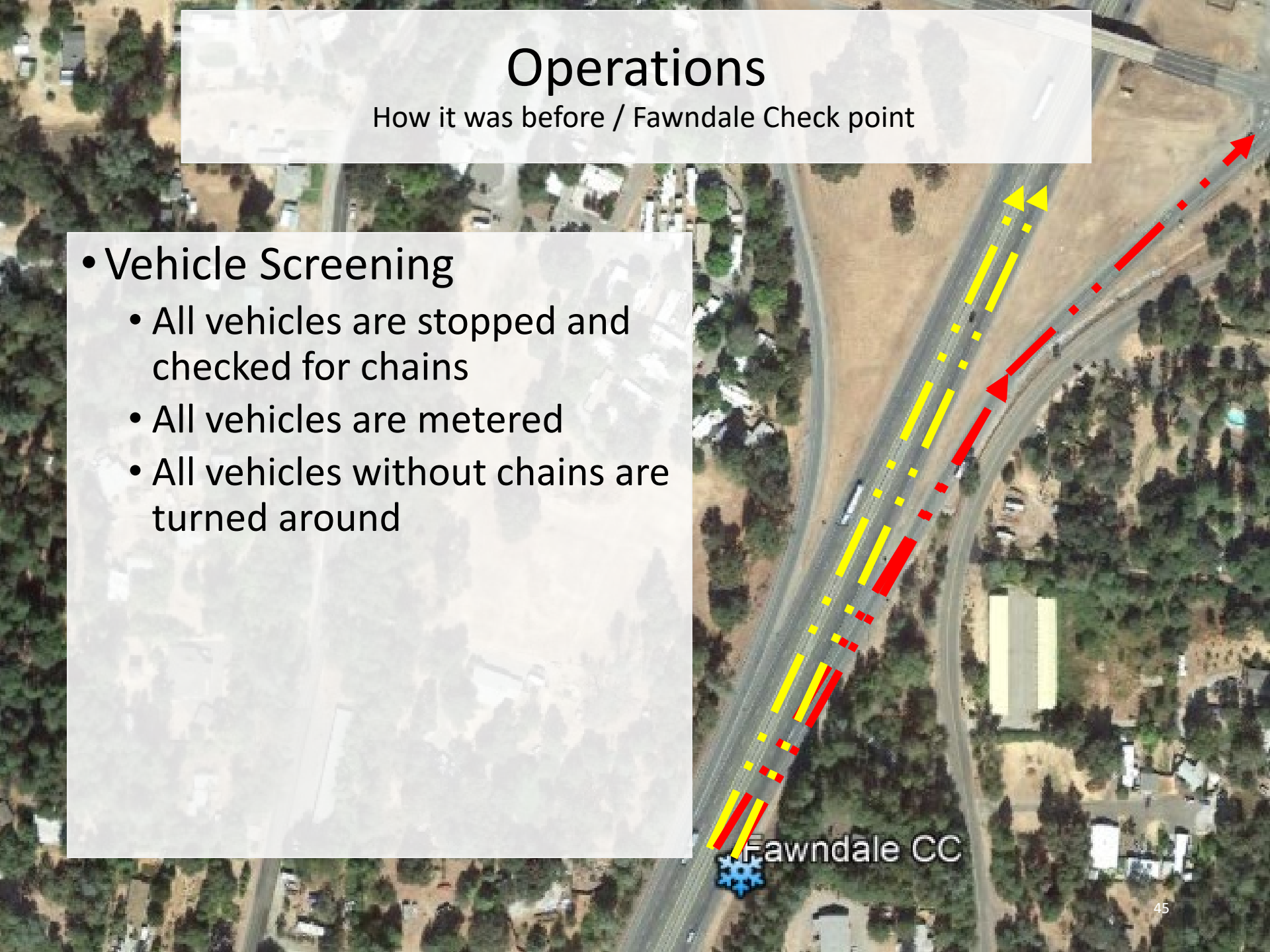
- Truck Screening
  - Trucks are stopped in the No. 2 checked for chains
    - Issues with trucks merging from No. 1 lane
  - Trucks are metered
  - Trucks without chains are turned around
  - Autos are allowed to freely pass



Operations

How it was before / Fawndale Check point

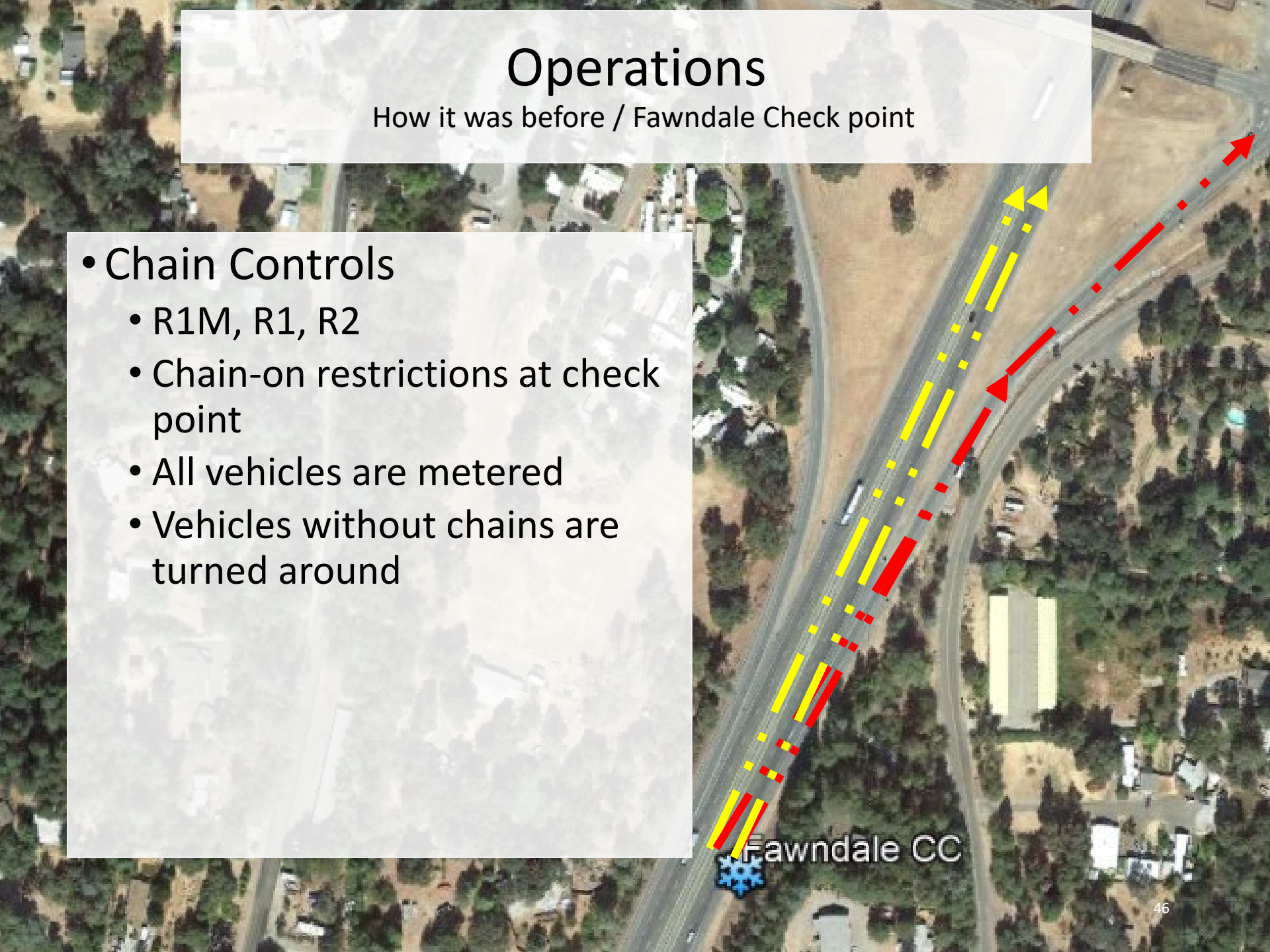
- Vehicle Screening
  - All vehicles are stopped and checked for chains
  - All vehicles are metered
  - All vehicles without chains are turned around



Operations

How it was before / Fawndale Check point

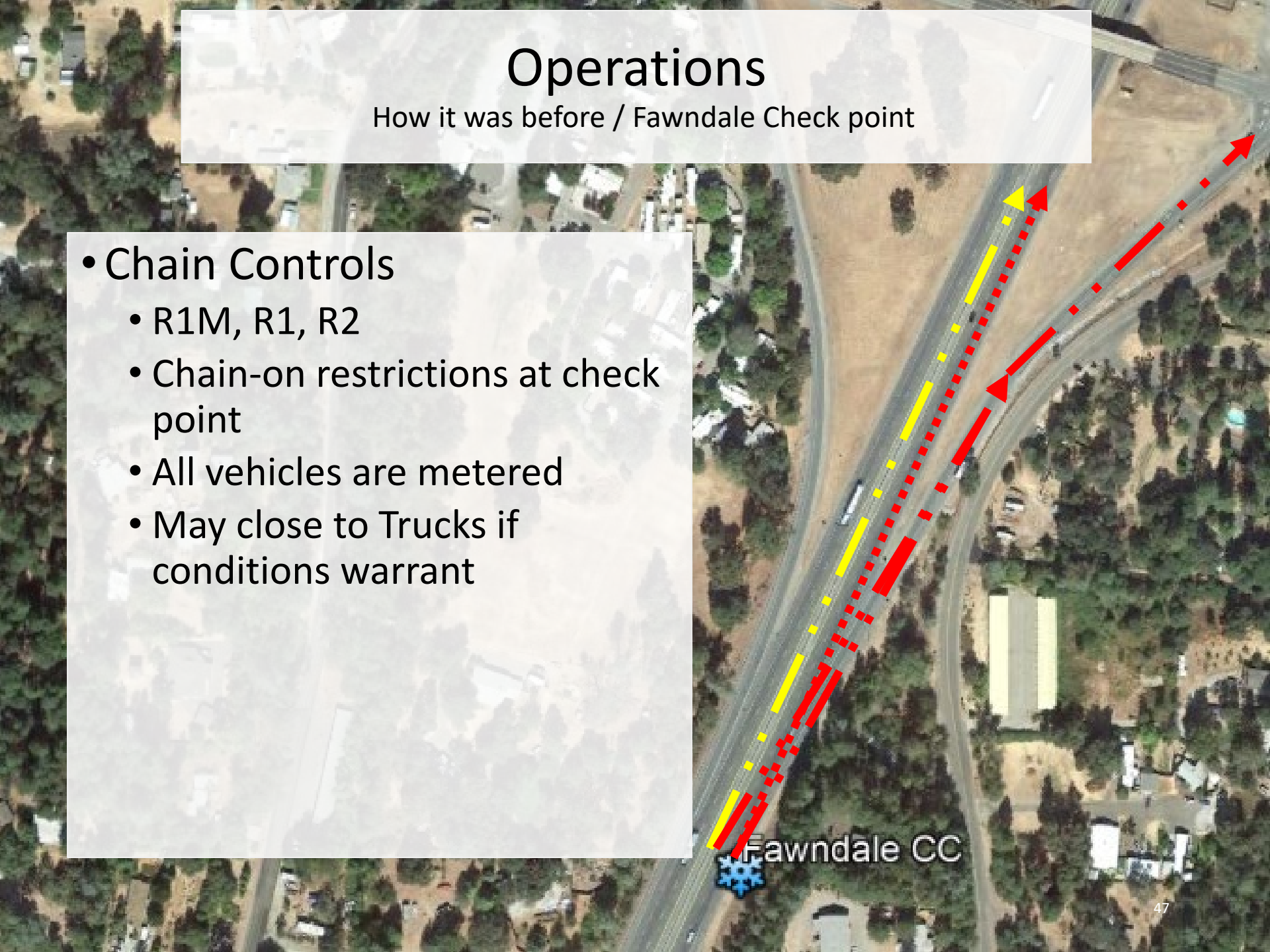
- Chain Controls
  - R1M, R1, R2
  - Chain-on restrictions at check point
  - All vehicles are metered
  - Vehicles without chains are turned around



Operations

How it was before / Fawndale Check point

- Chain Controls
  - R1M, R1, R2
  - Chain-on restrictions at check point
  - All vehicles are metered
  - May close to Trucks if conditions warrant



Operations

How it was before / Fawndale Check point

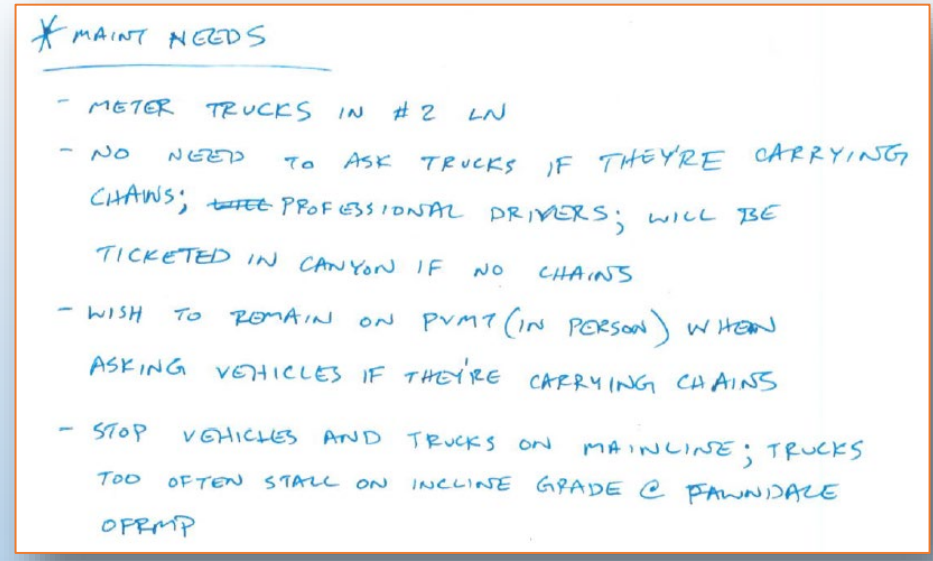
- Total Closure
  - Interstate is closed
  - All vehicles are turned around


TRAFFIC
BACKUP

Need for Improvement

Needs from Field Maintenance

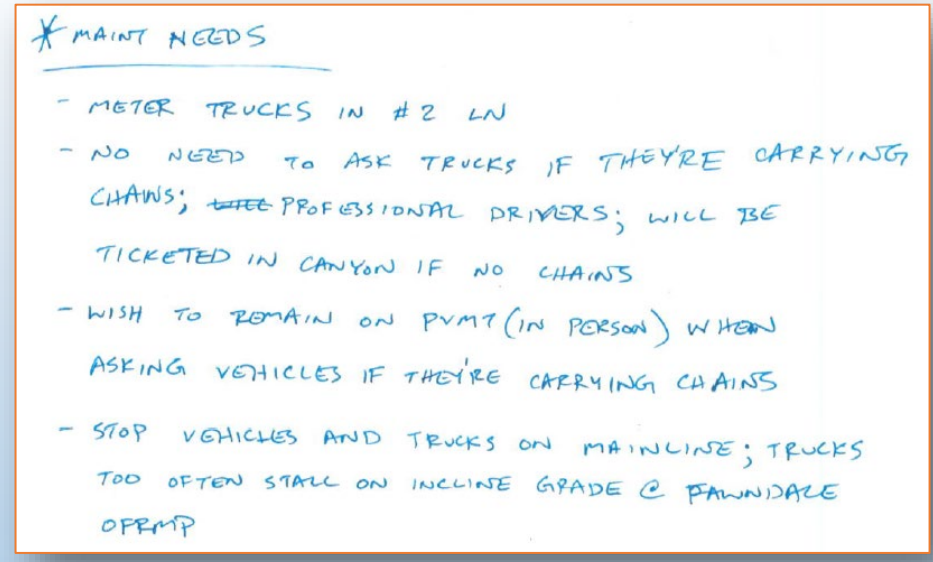
- Need to have Autos in No. 1 lane
- Need to have Trucks in No. 2 lane
- Need to encourage vehicle to use prior exits to turn around
- Need to stop trucks on mainline
  - Off ramp – trucks stall or slip in icy conditions
- Minimize worker exposure (automation)
- Needs to be field controlled by maintenance
- Needs to have simple operation



Need for Improvement

Needs from TMC

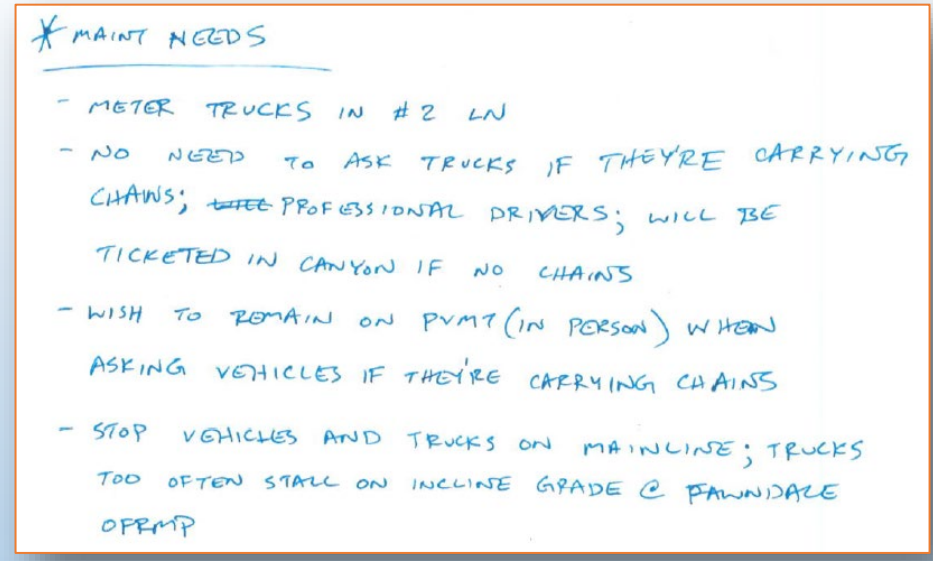
- Need to operate with standard field elements
  - CCTV
  - CMS
  - EMS
- Needs to be visible to TMC Operators
- Needs to provide clear and direct instructions to the traveling public
- Needs be treated as a corridor
  - Several locations



Need for Improvement

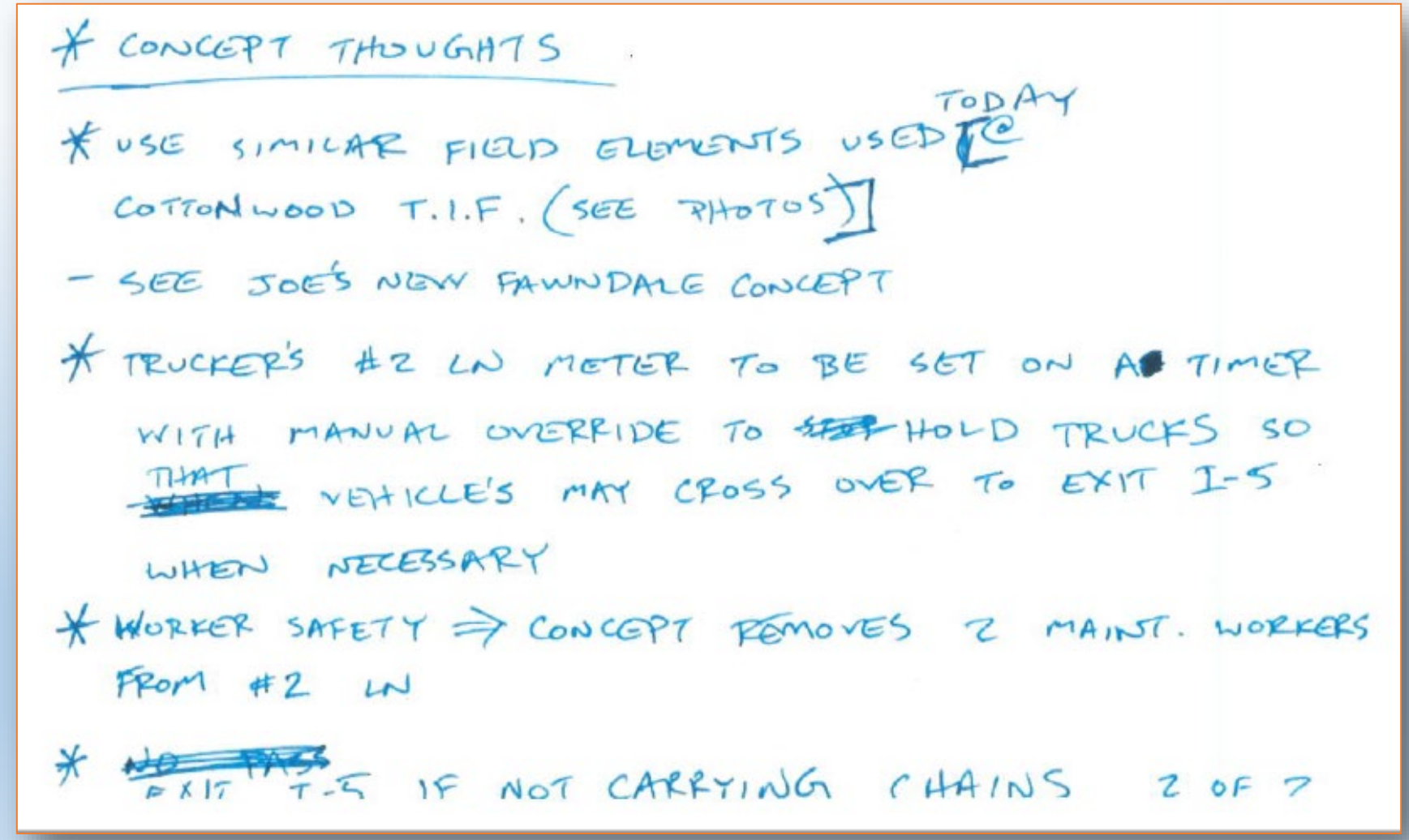
Needs from ITS

- Need to operate with standard field elements
  - CCTV
  - CMS
  - EMS
- Needs to be interconnected with appropriate State-owned infrastructure
  - Roadside Fiber
  - Microwave Backhaul
- Needs to be flexible to adapt to technology changes



Need for Improvement

Early Concept



Need for Improvement

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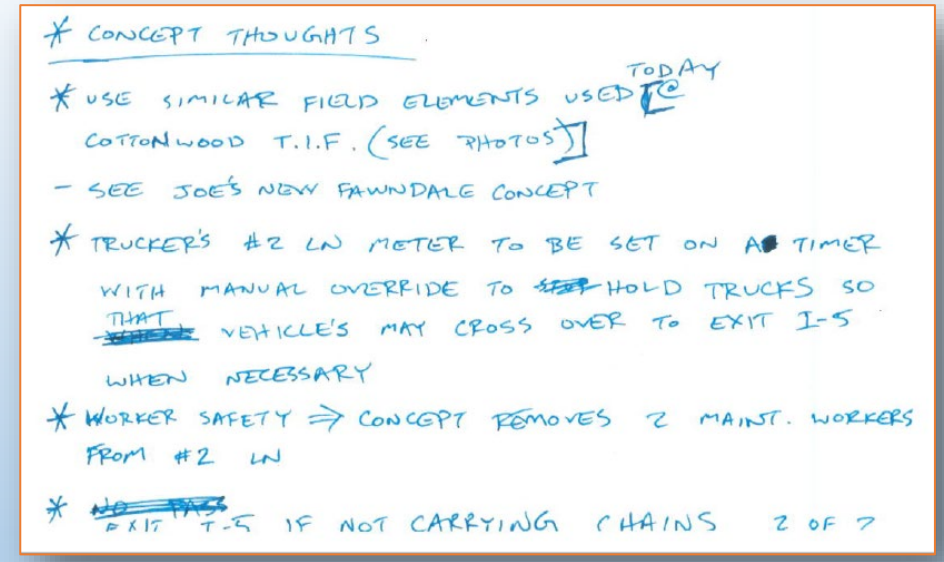
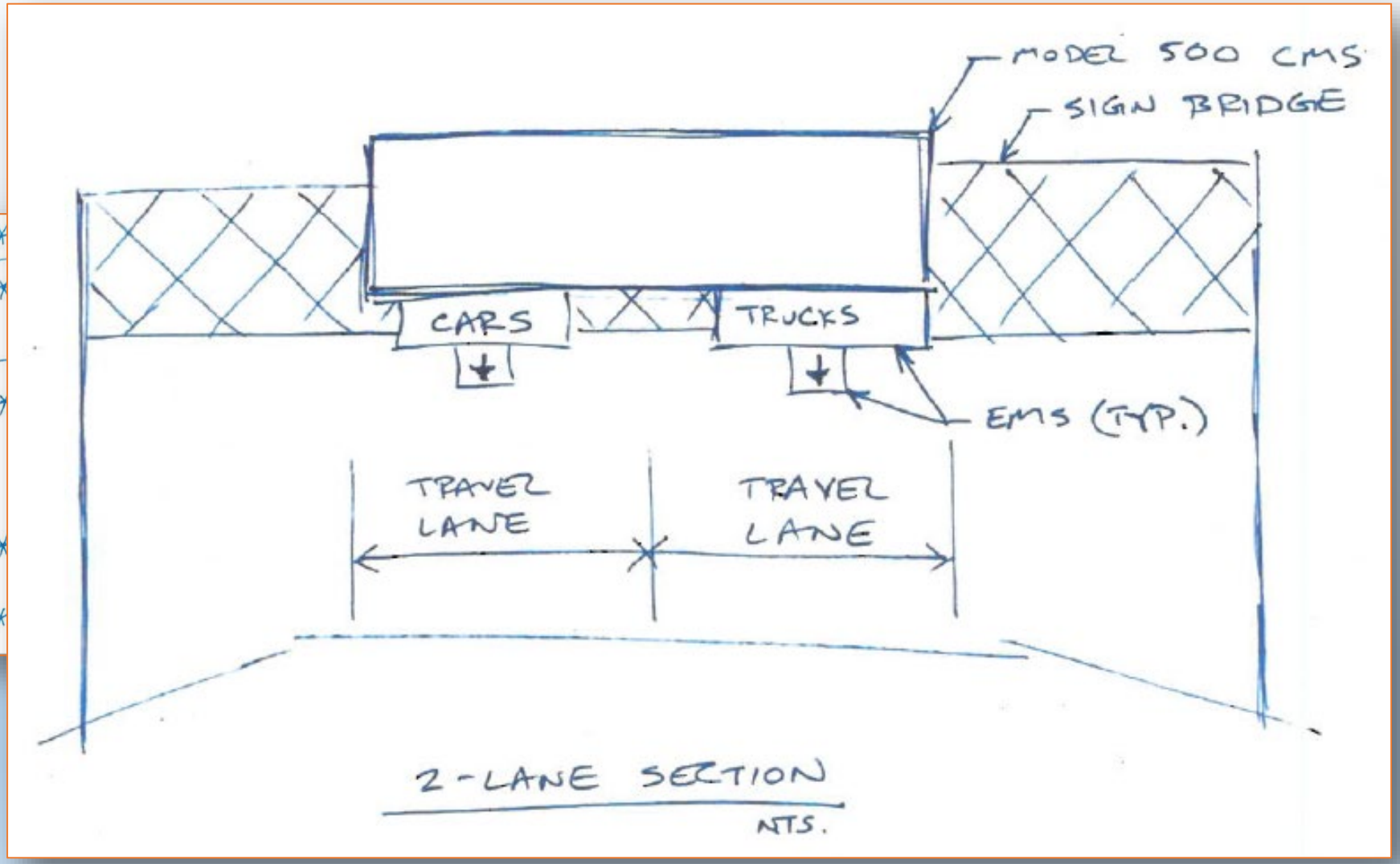


- Using a timer in No. 2 lane for trucks
  - Similar to ramp metering
- Manual override for local crews
- Guard Shack / Command Shack
- Local simple control by maintenance crew
- Use of CMS signs with EMS on signs bridge
- Lane control signs / Directing Vehicles

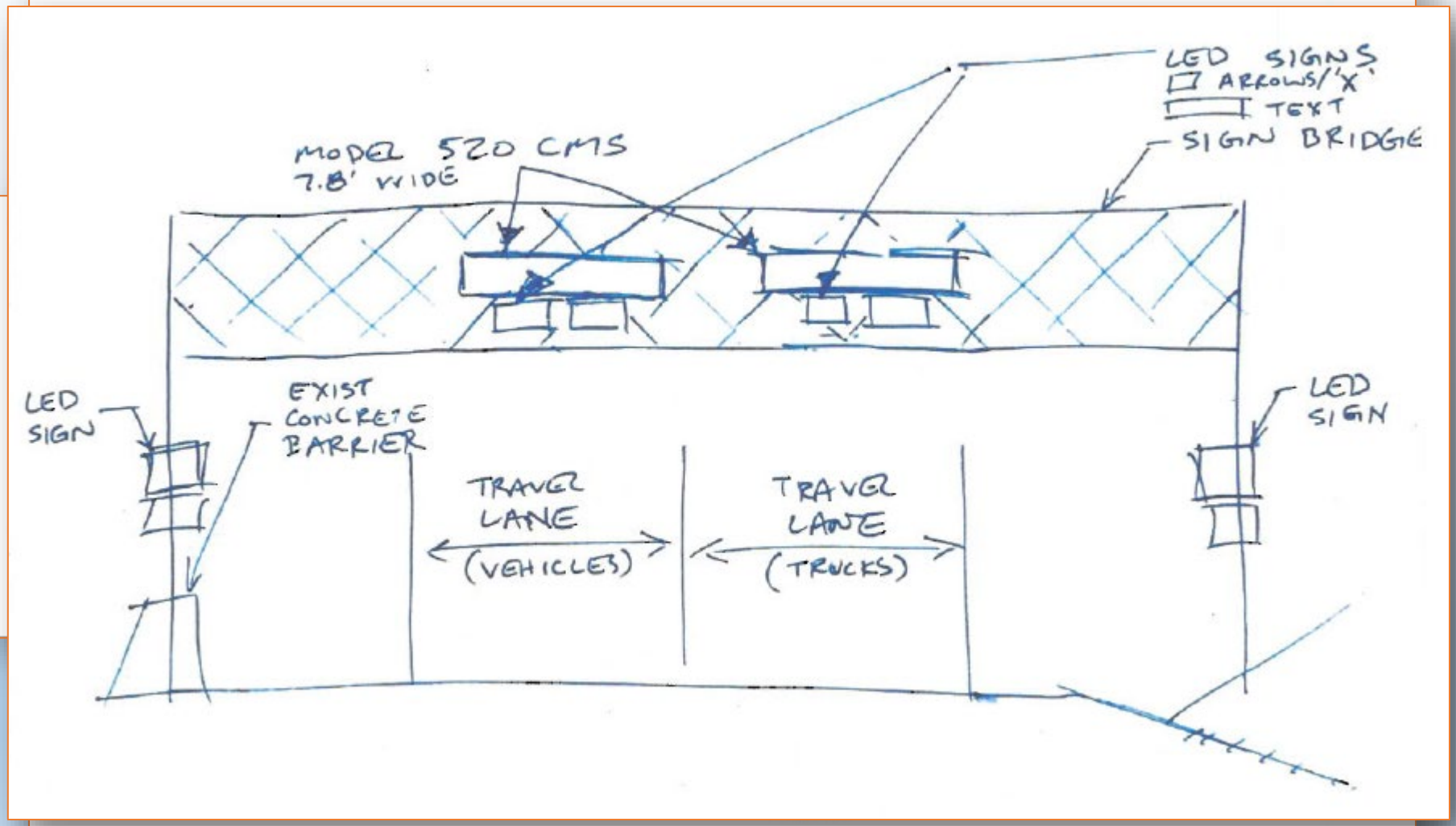
Need for Improvement

Early Concept



Need for Improvement

Early Concept



Design by Committee

Welcome the Design Committee!

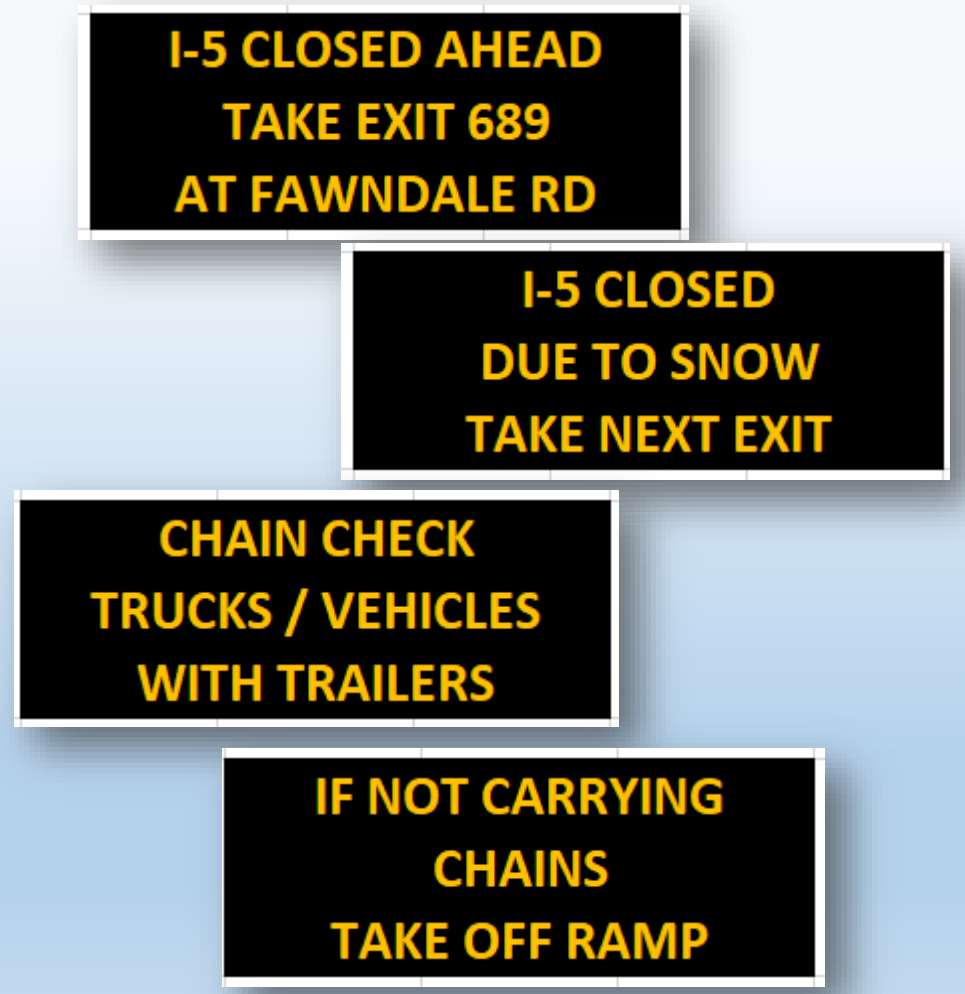
Photo Credit (Mary Ellen Matthews/NBCU Photo Bank/NBCUniversal via Getty Images via Getty Images)

Design by Committee

Sign Messages

- Who determines sign message?

  TMC / Maintenance



Design by Committee

Controlling Elements

- Who determines sign message?

  TMC / Maintenance

- Who determines EMS vs Lane Control vs Blank out? **ITS**

Design by Committee

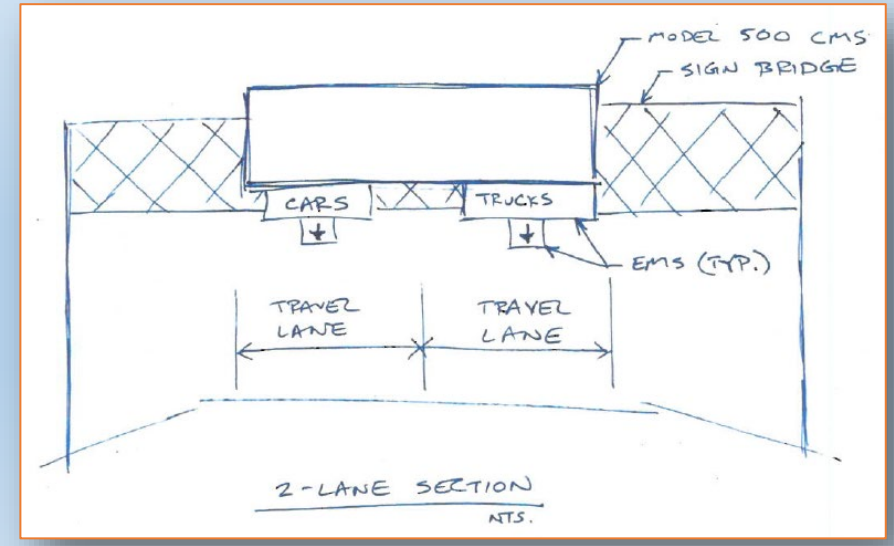
Sign Structure and Layout

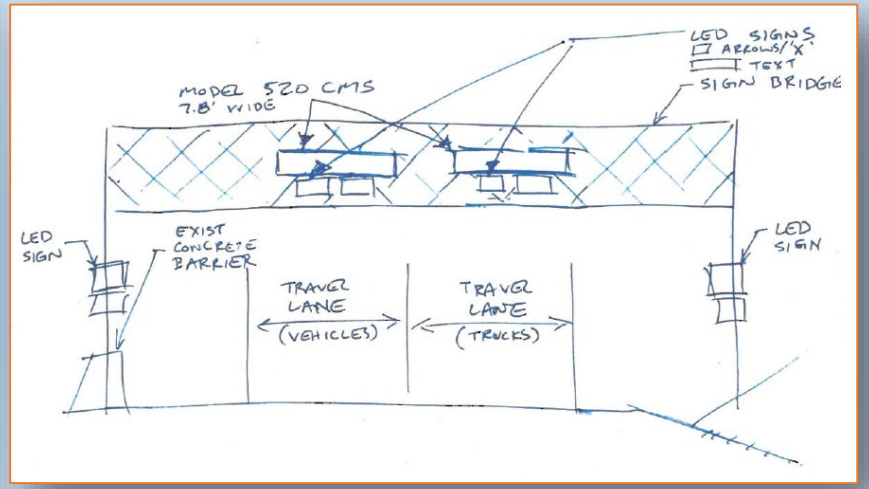
- Who determines sign message?

  TMC / Maintenance

- Who determines EMS vs Lane Control vs Blank out? **ITS**
- Who determines one CMS vs two CMS?

  TMC / ITS





Design by Committee

Regulatory vs Advisory

- Who determines sign message?

  TMC / Maintenance

- Who determines EMS vs Lane Control vs Blank out? **ITS**
- Who determines one CMS vs two CMS?

  TMC / ITS

- Who determines regulatory vs advisory? **Sign Group**

Design by Committee

Locations

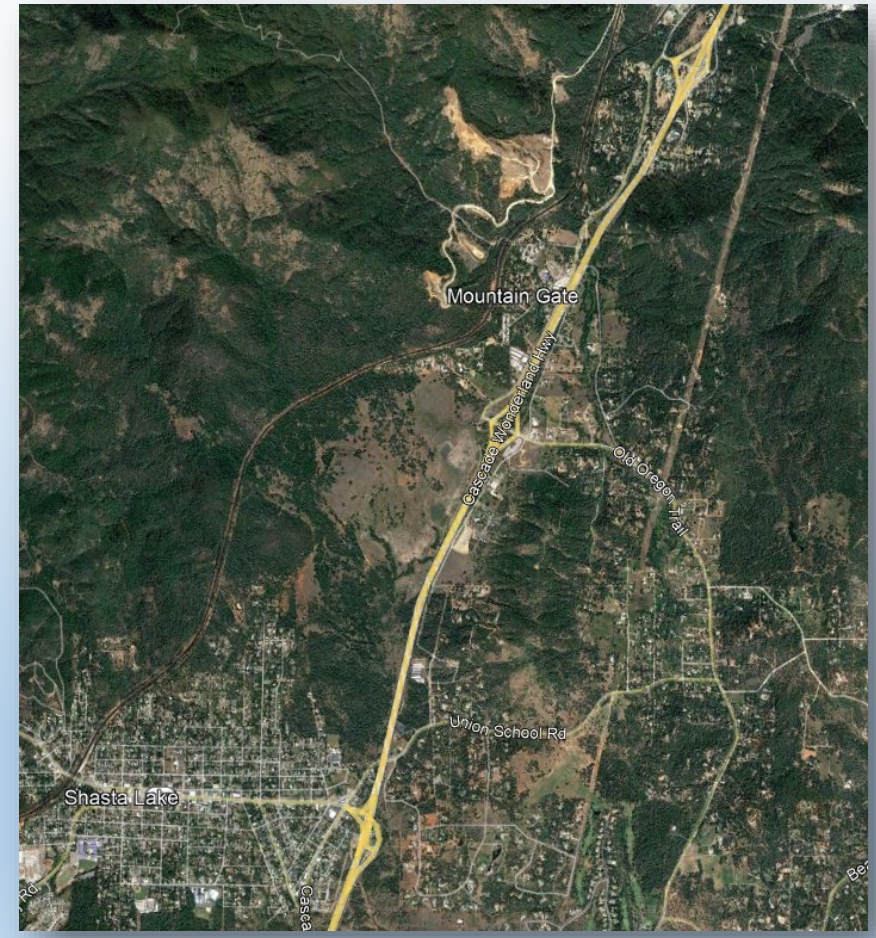
- Who determines sign message?

  TMC / Maintenance

- Who determines EMS vs Lane Control vs Blank out? **ITS**
- Who determines one CMS vs two CMS?

  TMC / ITS

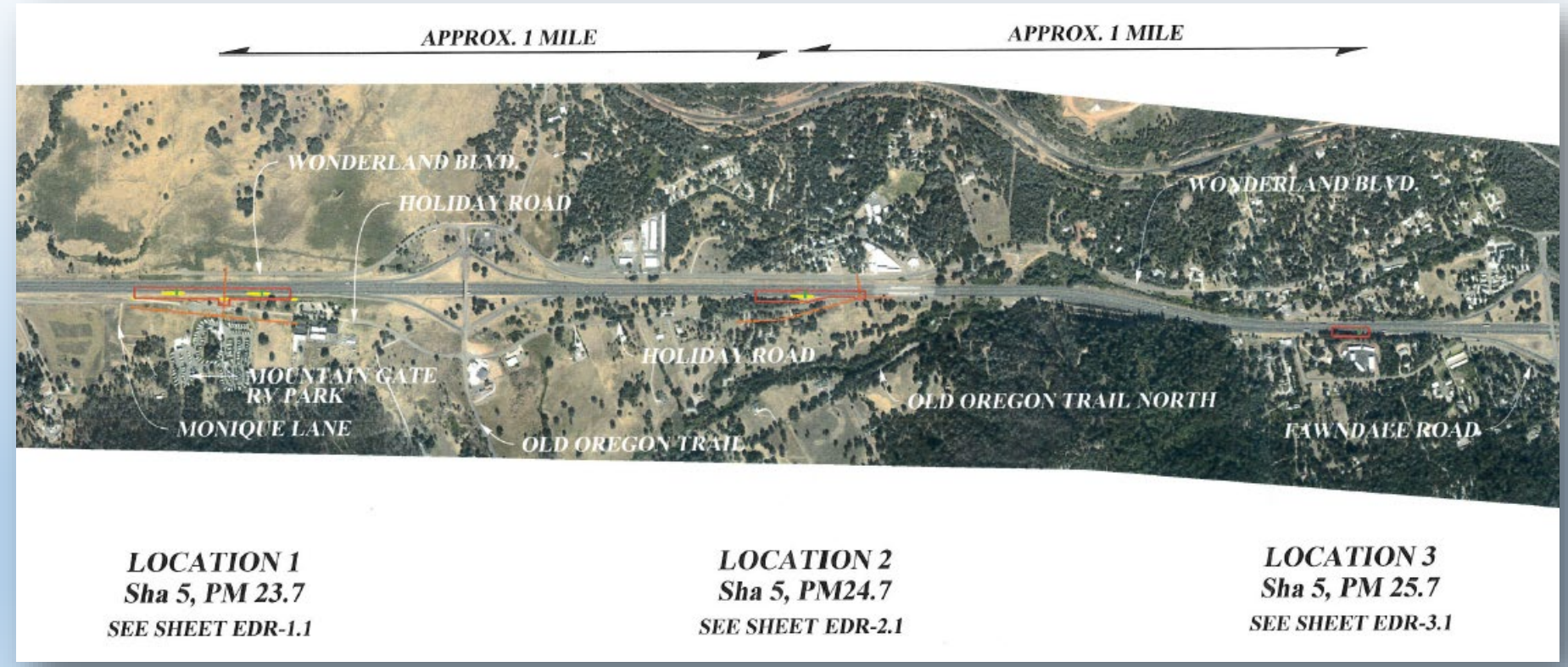
- Who determines regulatory vs advisory? **Sign Group**
- Who determines locations?
  - **TMC (Operations)**
  - **Maintenance (Operations)**
  - **ITS (Communication/Power)**
  - **Design**
  - **Right of Way**



Design by Committee

Locations

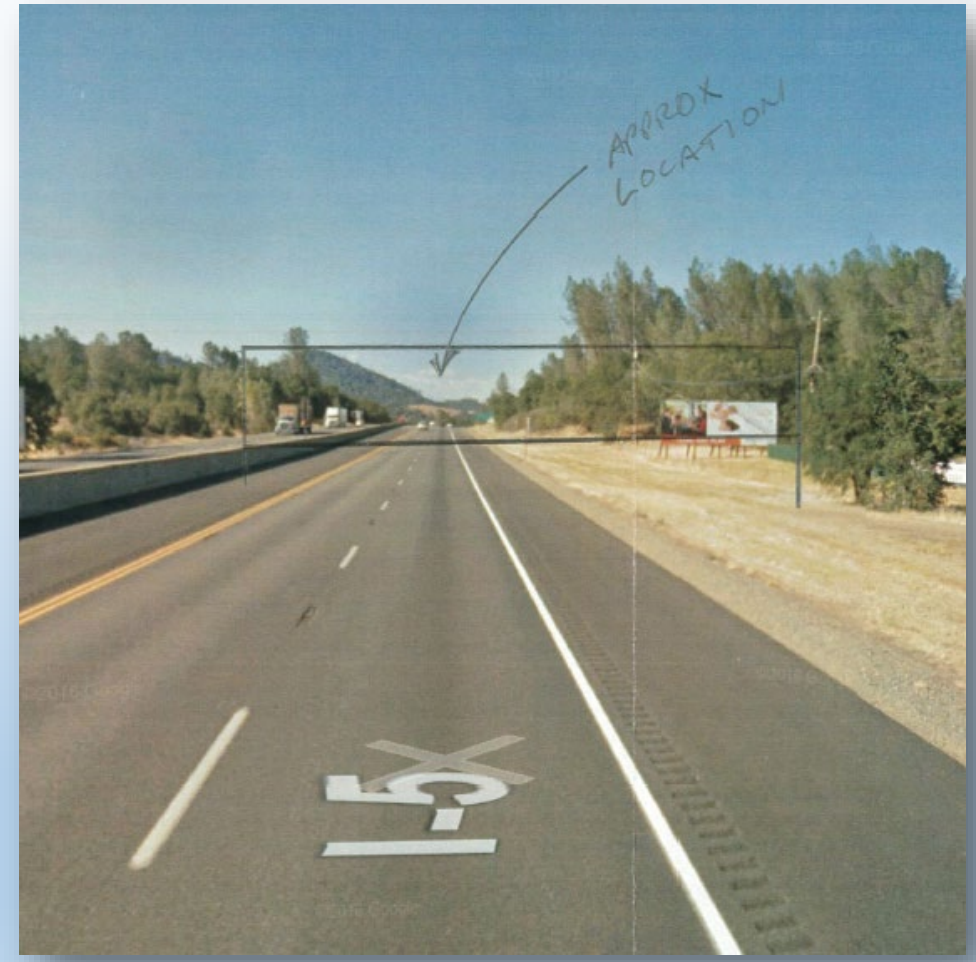
- Proposed locations



Design by Committee

Locations

- Proposed locations
- Location Changes – Viewshed Permit Concerns
  - Location 1 was moved 200’ north to not interfere with billboard



Design by Committee

Locations

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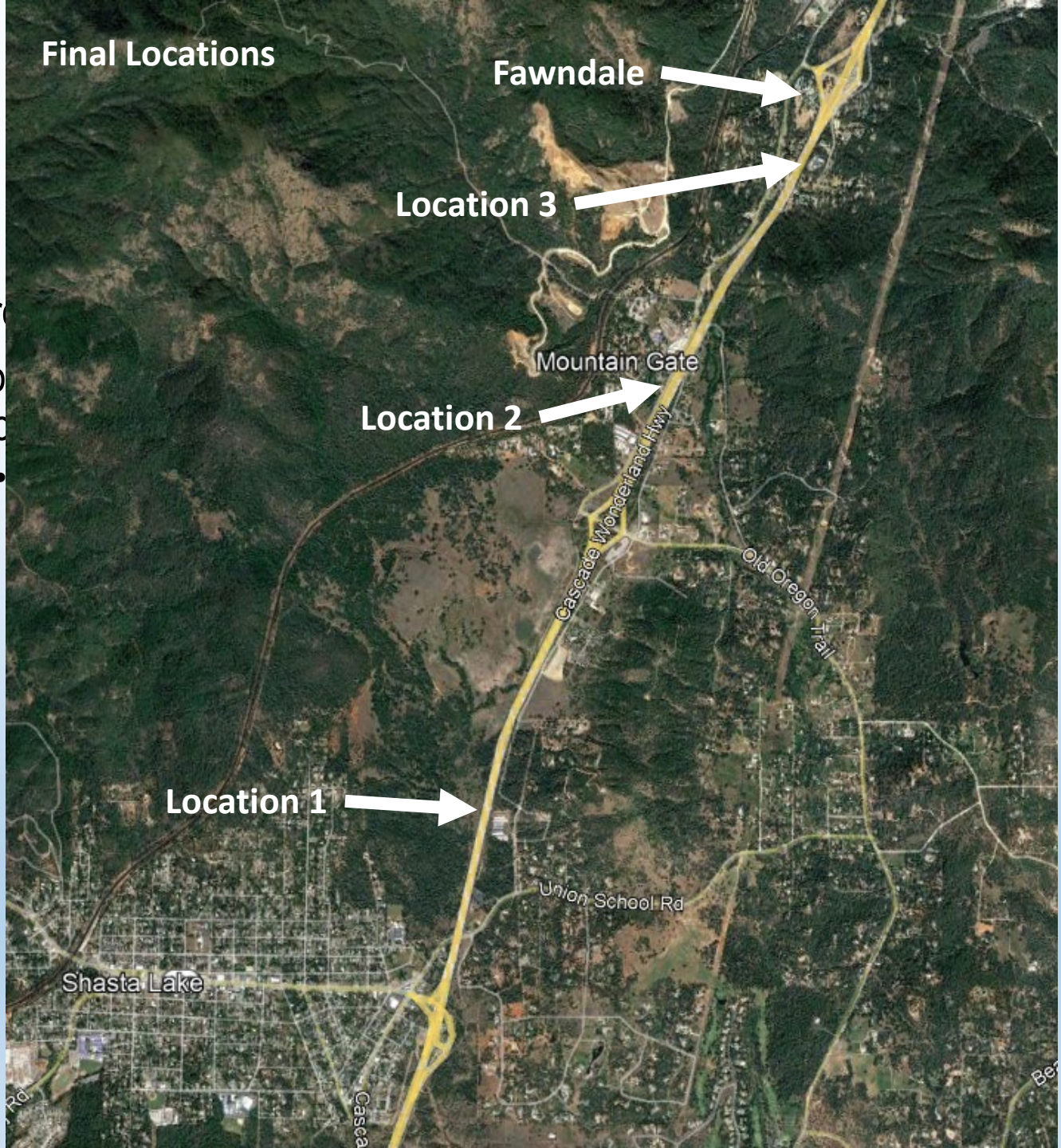
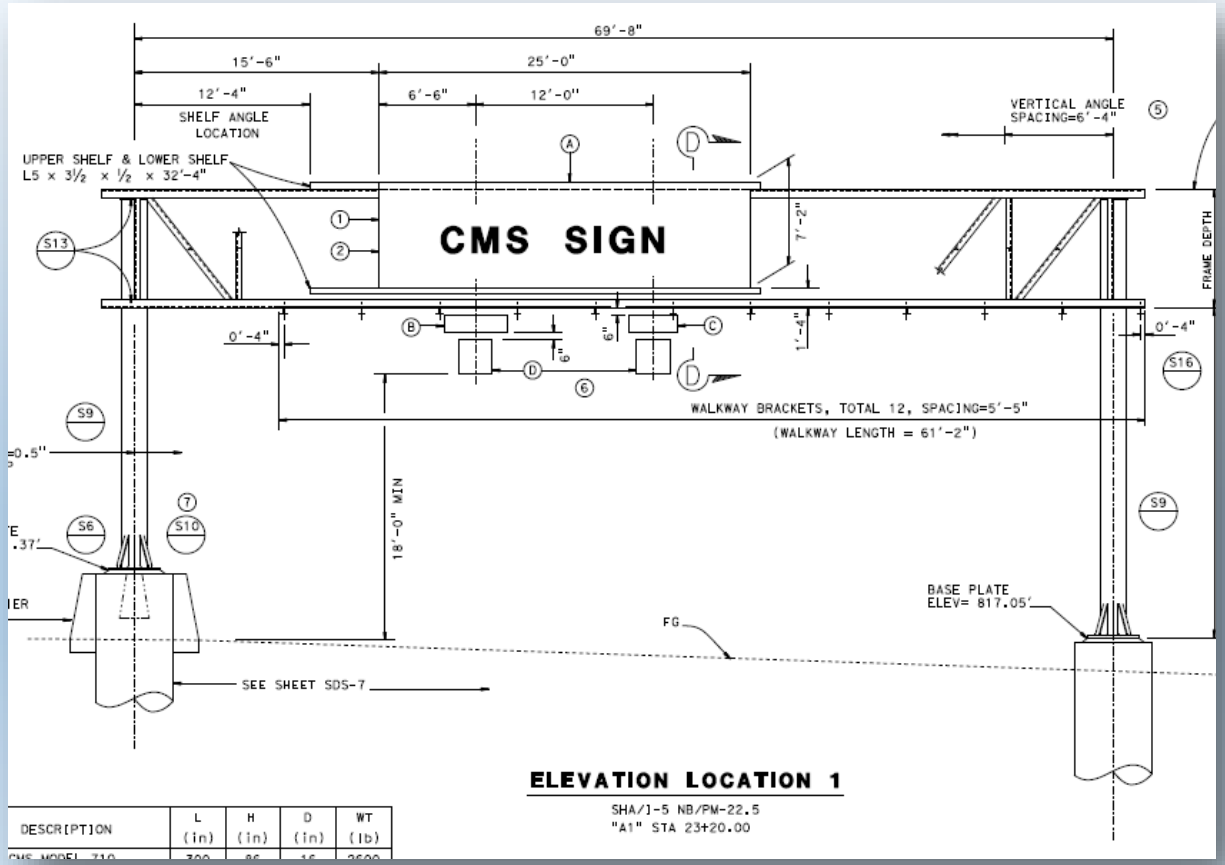
- Pr
- Lo
  Co
  -


Final Locations
Fawndale
Location 3
Mountain Gate
Location 2
Cascade Wonderland Hwy
Old Oregon Trail
Location 1
Union School Rd
Shasta Lake

Design by Committee

Physical Layout

- Proposed locations
- Location Changes – Viewshed Permit Concerns
  - Location 1 was moved to with billboard
- Physical Layout



Project Design

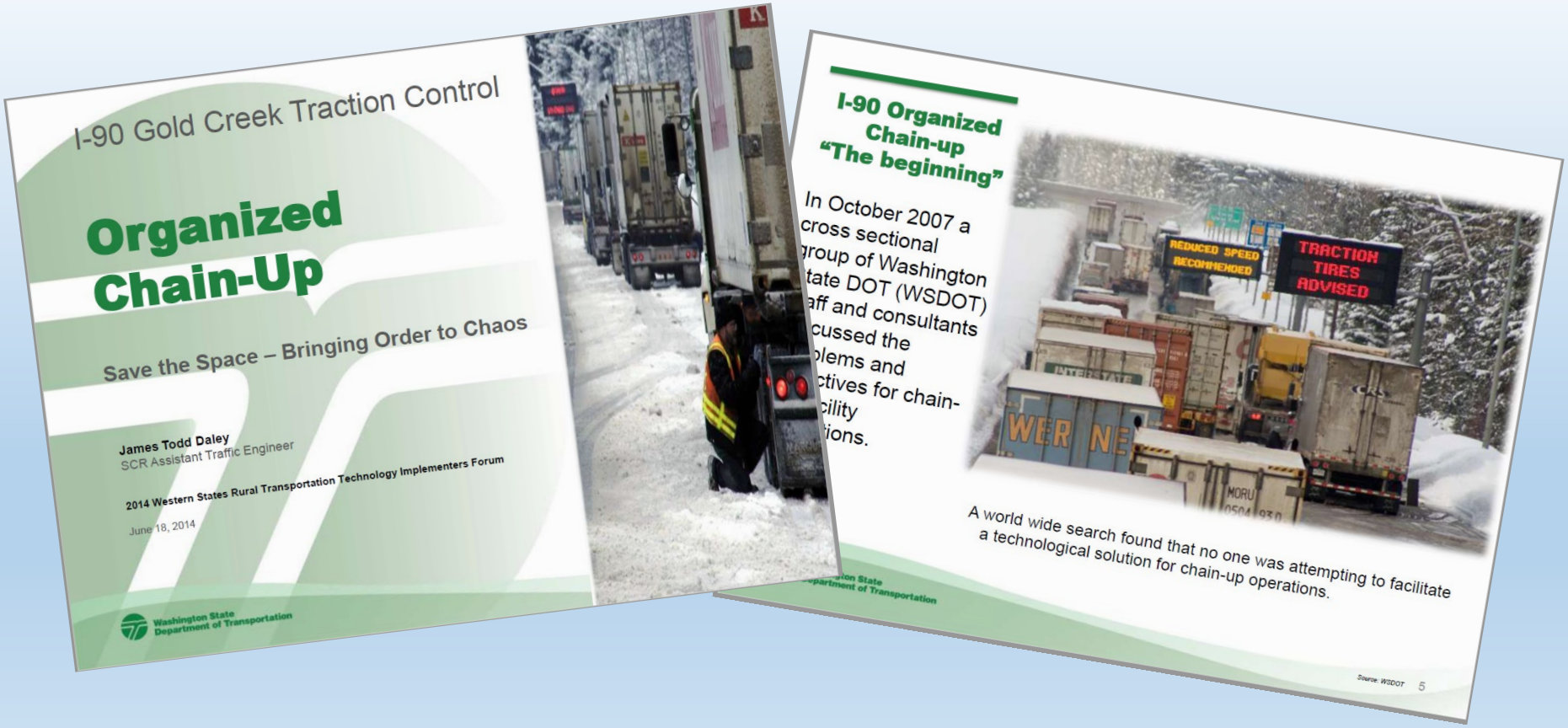
Capital Outlay Design

- Conceptual Design Finished – Now time to have formal design
- Included in District wide worker and public safety project.
  - Enhance safety at 15 chain on areas (not covered in presentation)
    - Paving, Lengthening, Widening, Lighting, Tunable Signs
  - Enhance safety and operations in the Fawndale area (major part of project)
    - Improve work safety by reducing worker exposure to live traffic
    - Meets all the operational needs at Fawndale
    - Provides clear and easily understandable directions to the traveling public
    - Is easily maintained (including low repair costs, use of standard/replaceable long life components, etc)
    - Is easily operated (including pre-programmed 1 button scenario activations that turn all components for that operation)

Project Design

WSDOT vs Caltrans Design

- WSDOT Previous Presentation at WSRTTIF (2014)



Project Design

WSDOT vs Caltrans Designs

I-90 Chain-up Proposed Designs

To help the Chain-up areas several ideas were purposed.

- ✓ Increase the width Chain-up areas
- — Increase the length of the chain up areas
- ✗ Use different colored lights or zones to direct trucks to current open areas
- ✗ Increase enforcement for those who linger longer than they need to
- ✓ Use variable message signs (VMS) to direct chain up operations
- ✓ Use cameras to keep track of what is happening in the area

*WSDOT Organized Chain-Up 2014

Project Design

WSDOT vs Caltrans Designs

WSDOT Design

- Standalone Project
- Geometrics to increase lanes
- 9 VMS/CMS
  - 6 Full Color
  - 3 Amber
- 6 Cameras
- 2 Data Stations
- 1 Meter control

Caltrans Design

- District wide project
  - Heavy emphasis on single location
- Geometrics were not an option
- 3 CMS – Amber
- 2 Camera / 1 Upgraded Camera
- 6 Blank Out Signs (Advisory)
- 6 Lane Control Signs (Regulatory)

*WSDOT Organized Chain-Up 2014

Project Design

WSDOT vs Caltrans Designs

WSDOT Design

- Fiber Optic Communication
  - Entire length of project
  - 48 strand SMFO
- Power
  - Joint trench with utility for power
- 2 VMS per overhead structure
- Primary purpose is to facilitate efficient chain-on activities

Caltrans Design

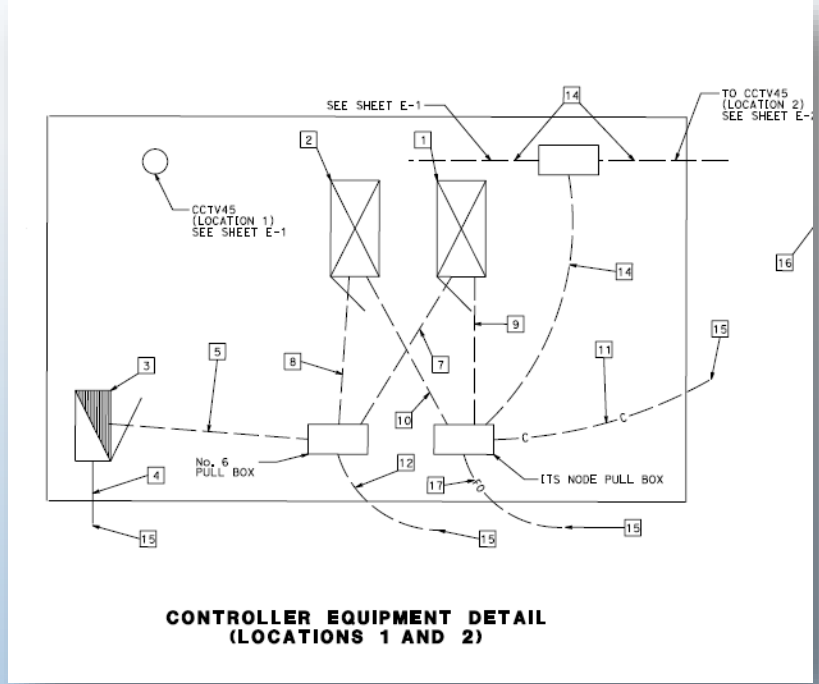
- Fiber Optic Communication
  - Entire length of project
  - 12 strand SMFO
- Power
  - Individual Services – no power conduits entire length of project
- 1 CMS per overhead structure
  - 2 Blank Out Signs per overhead
  - 2 Lane Control Signs per over head
- Primary purpose is to facilitate efficient corridor operations and safety

*WSDOT Organized Chain-Up 2014

Project Design

Electrical

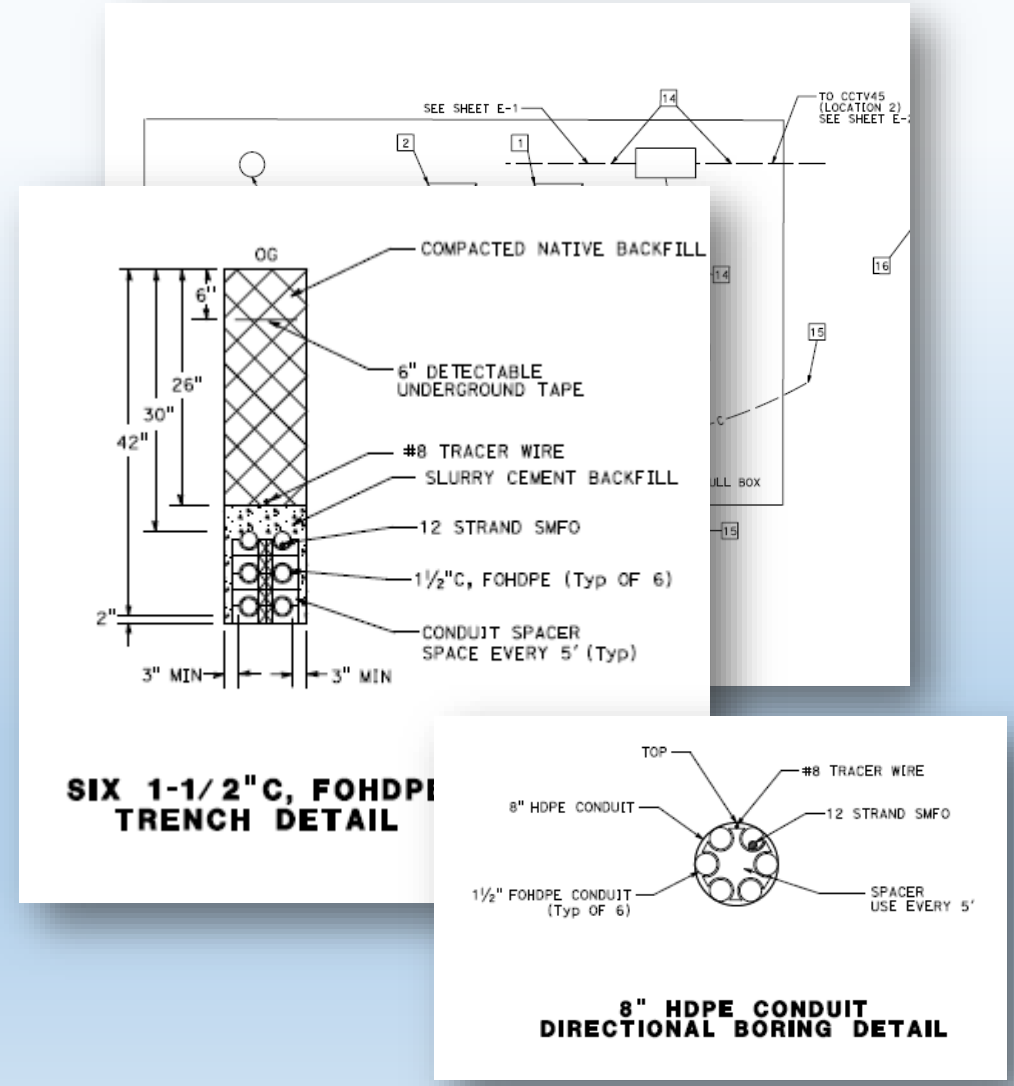
- Requirements for each location
  - Standard Controller Walkway
    - ITS Nodes
  - Power Service
  - Fiber Interconnect



Project Design

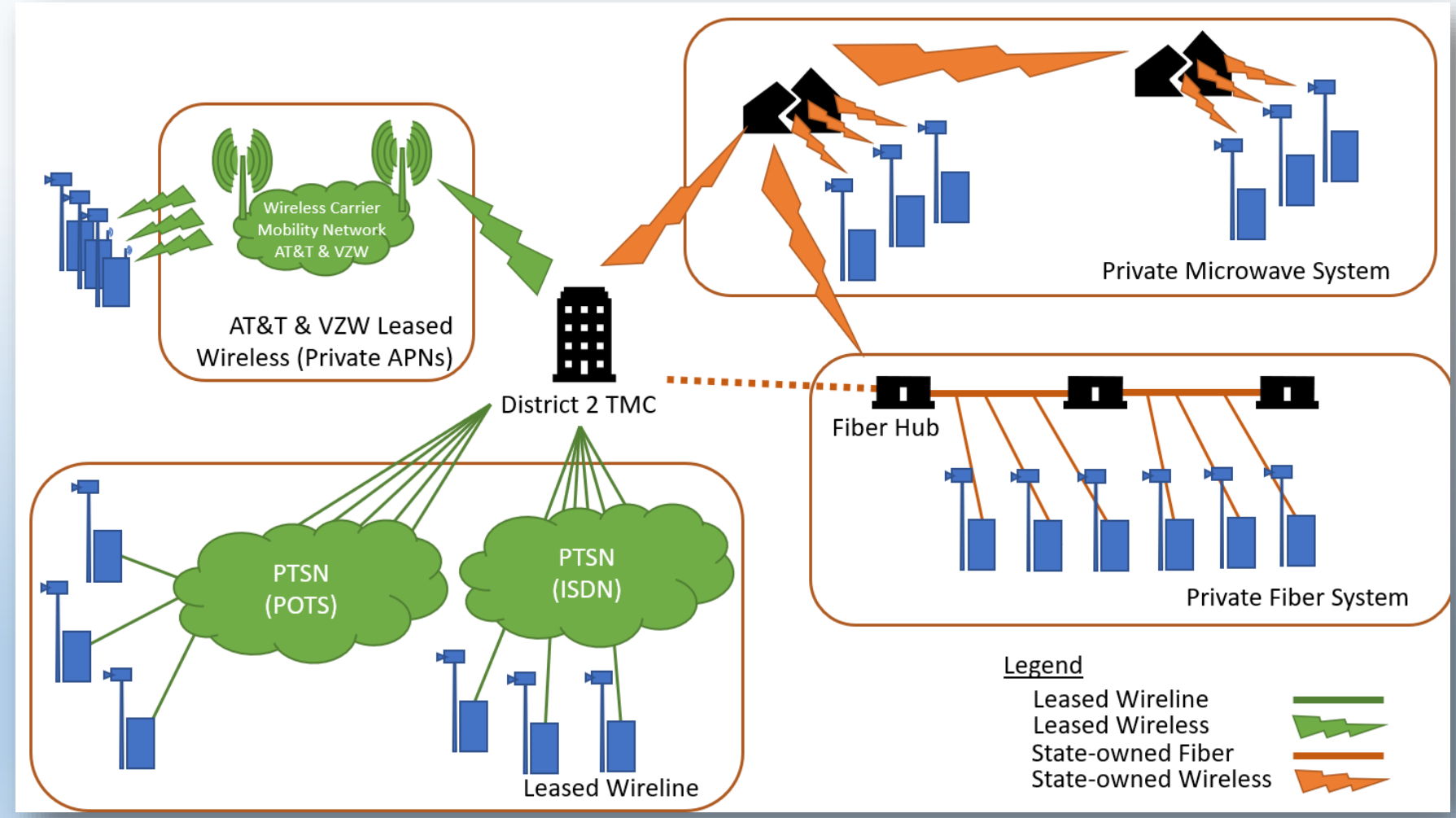
Electrical

- Requirements for each location
  - Standard Controller Walkway
    - ITS Nodes
  - Power Service
  - Fiber Interconnect
- Requirements for Fiber Backbone
  - 6 - 1 ½ HDPE
  - Concrete encased
  - 12 strand SMFO for interconnects
  - Future expansion considered



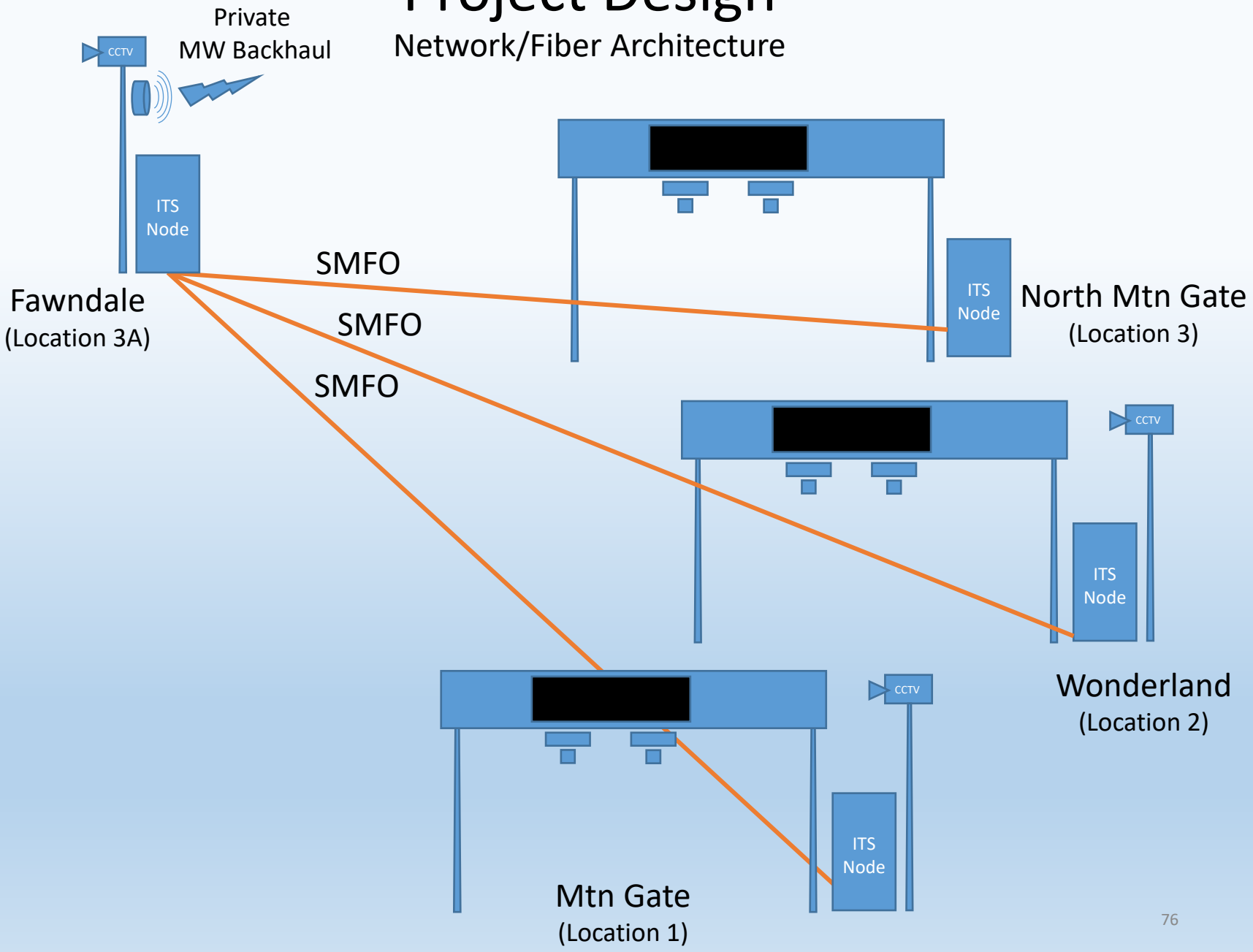
Project Design

Quick Network Architecture Overview



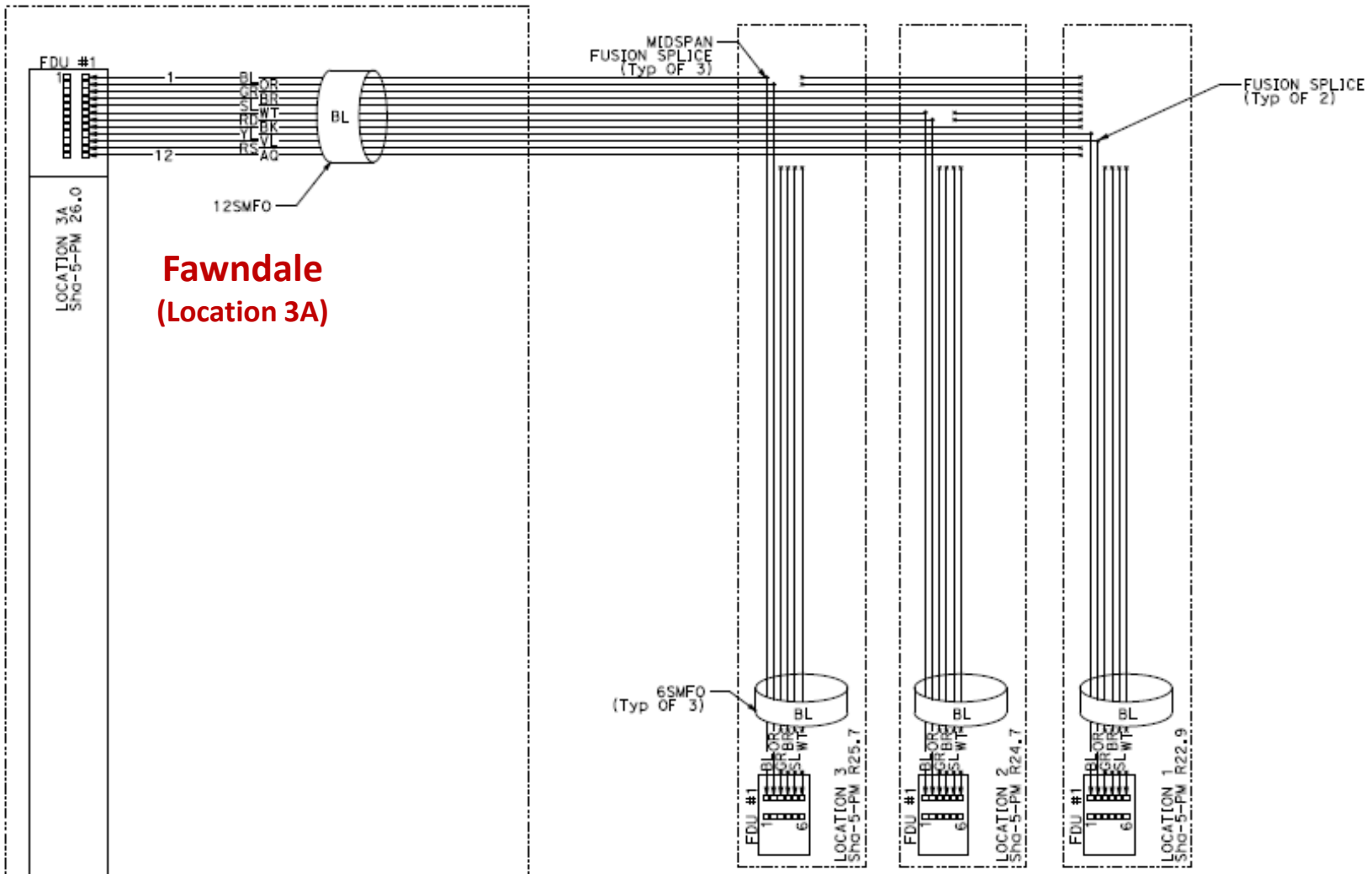
Project Design

Network/Fiber Architecture



Project Design

Network/Fiber Architecture



Project Design

CMS Signs

- Department furnished electronics due to specialty nature of project
- Changeable Message Signs
  - Model 500
    - SignView (Caltrans Proprietary)
    - Being phased out at the start of project

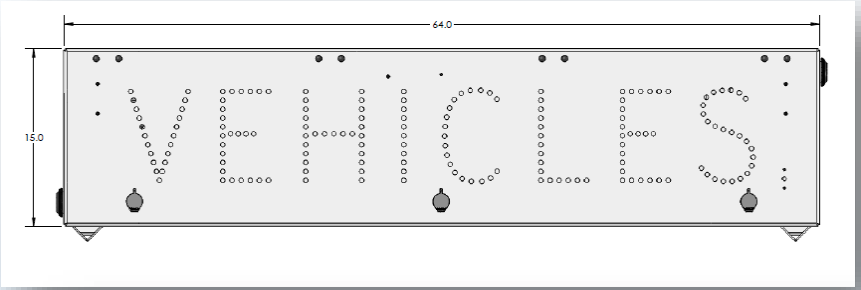
Project Design

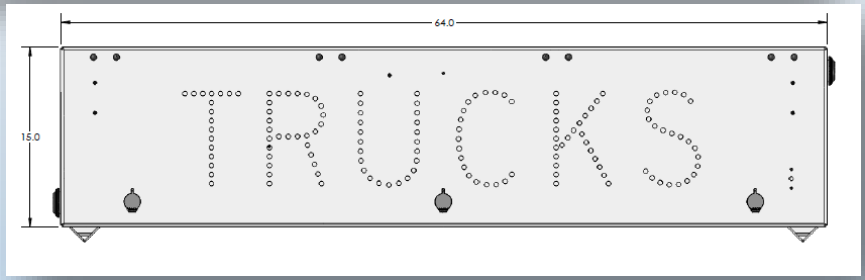
CMS Signs

- Department furnished electronics due to specialty nature of project
- Changeable Message Signs
  - Model 500
    - SignView (Caltrans Proprietary)
    - Being phased out at the start of project
  - Model 700
    - Uses SignView (Caltrans Proprietary)
    - NTCIP Compatible
    - Chosen for future flexibility and integration with systems

Project Design

BOS/LCS Signs

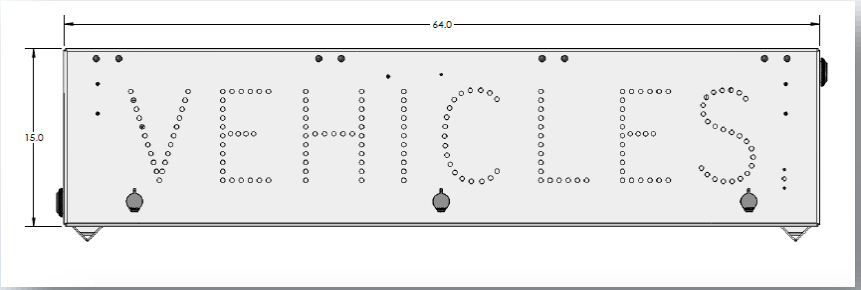


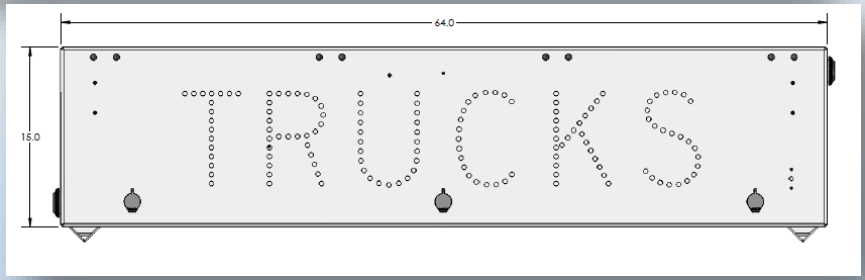


- Department furnished electronics due to specialty nature of project
- Blank Out Signs (BOS)
  - TCP/IP
  - NTCIP Compliant
  - Static text (Vehicles/Trucks)

Project Design

BOS/LCS Signs





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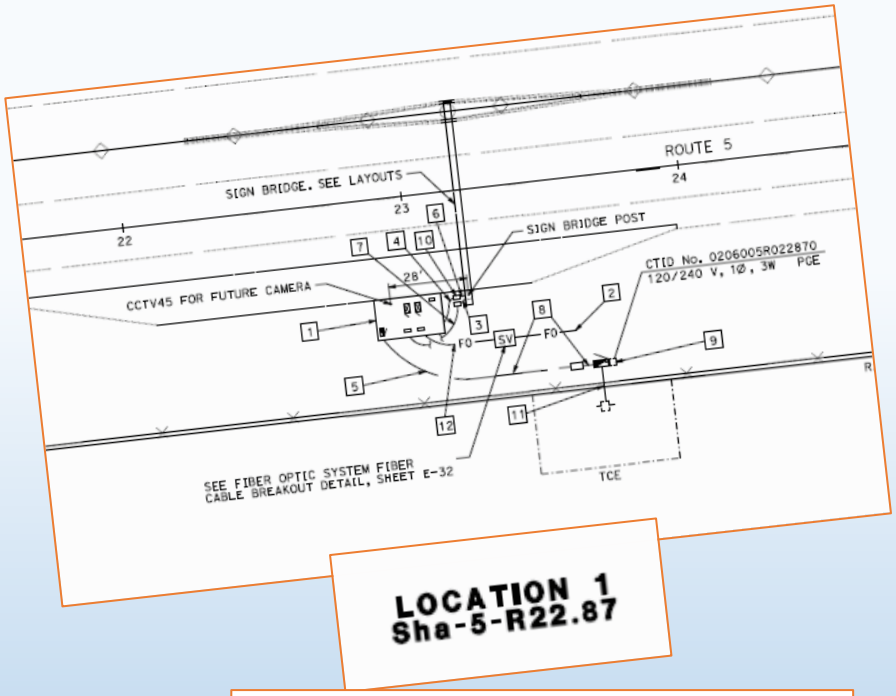
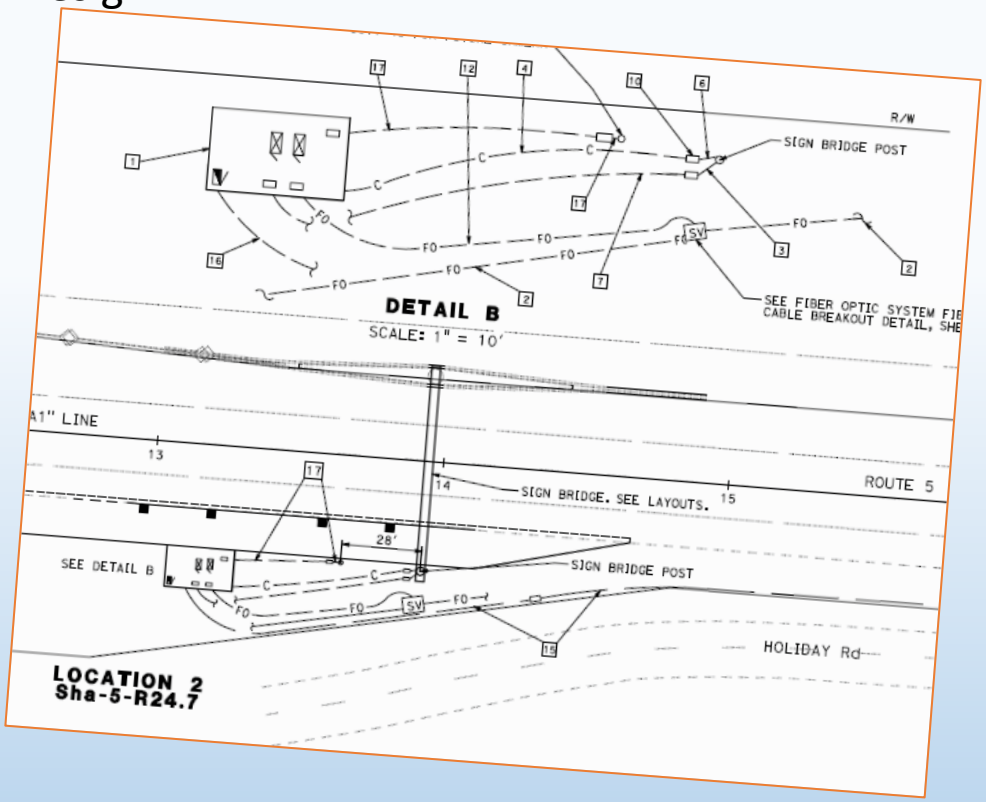
- Blank Out Signs (BOS)
  - TCP/IP
  - NTCIP Compliant
  - Static text (Vehicles/Trucks)
- Lane Control Signs (LCS)
  - TCP/IP
  - NTCIP Compliant
  - Multiple indicators

Project Design

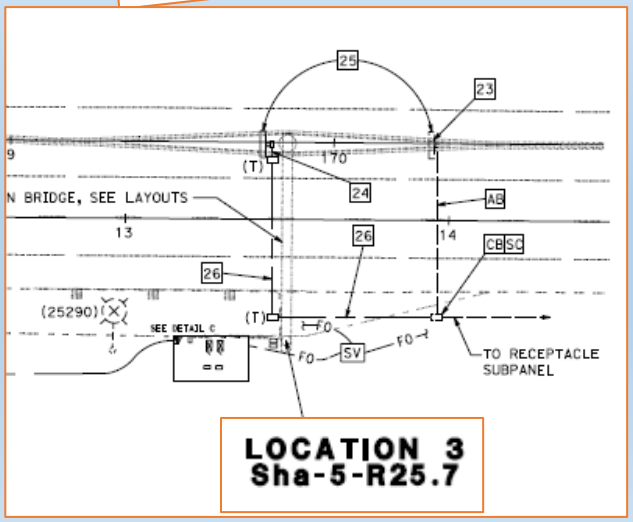
Final Design



LOCATION 1
Sha-5-R22.87



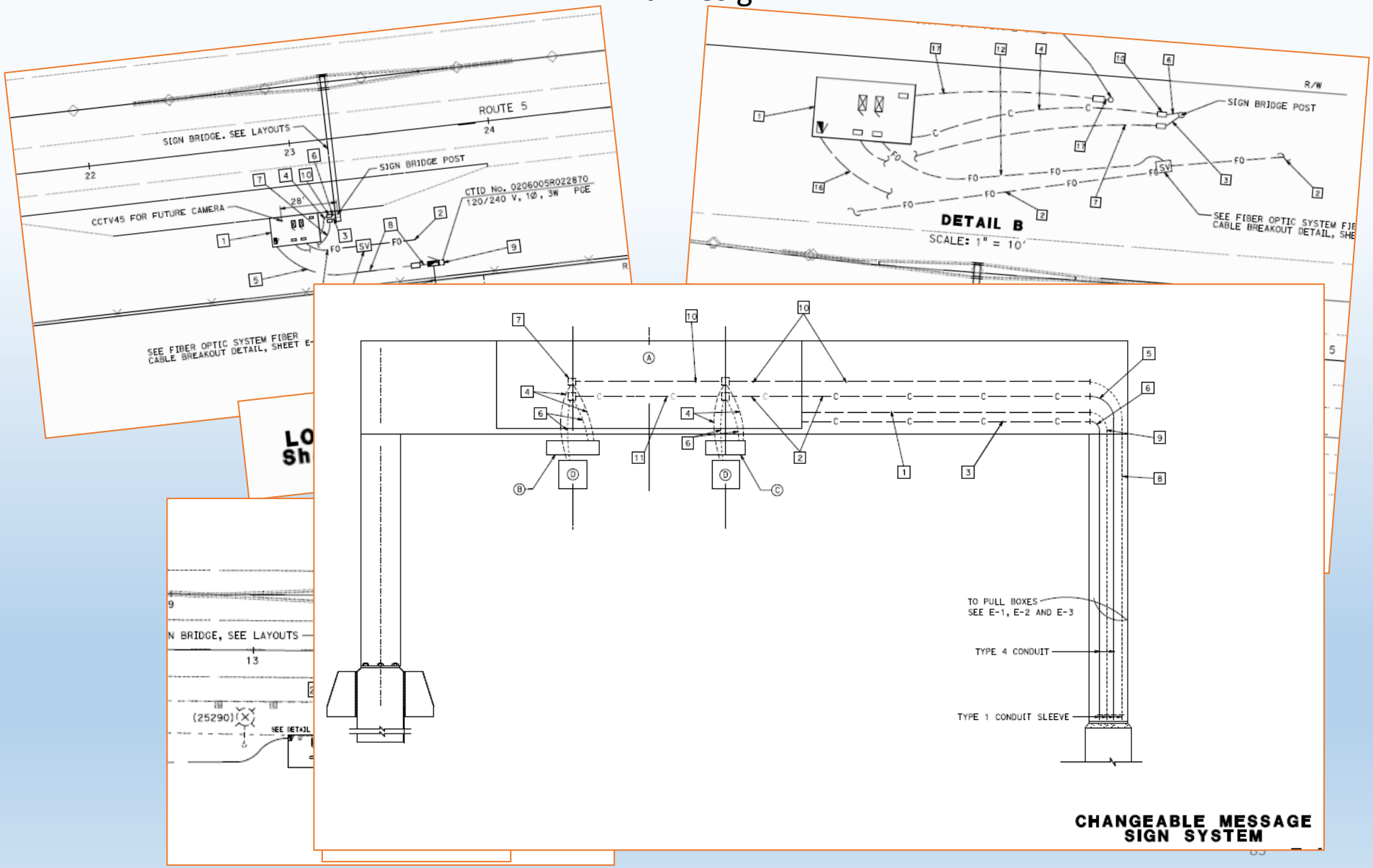
LOCATION 2
Sha-5-R24.7



LOCATION 3
Sha-5-R25.7

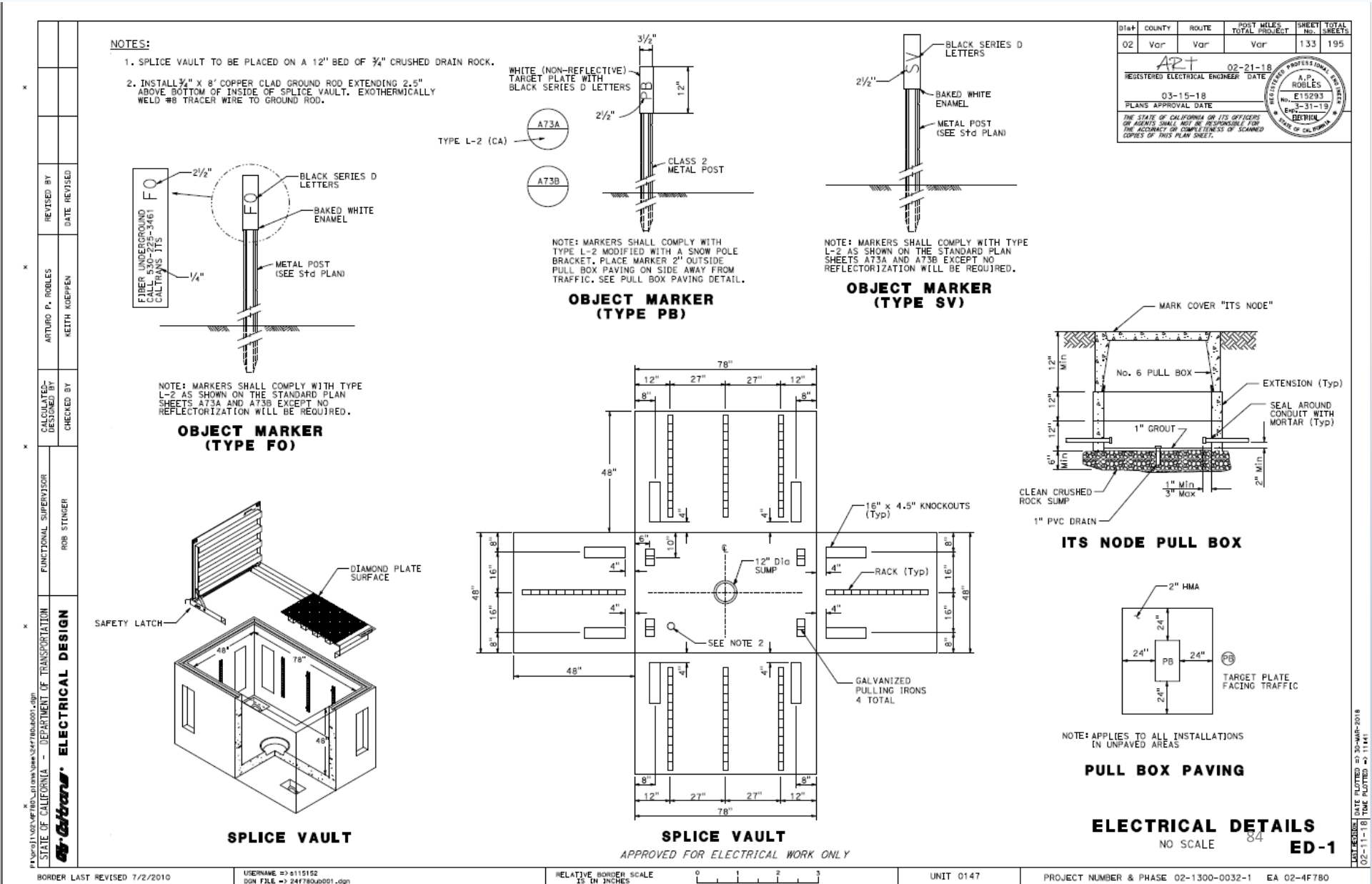
Project Design

Final Design



Project Design

Final Design



Project Design

Final Design

LEGEND (THIS SHEET):

[1] MOUNT TO SV WALL WITH WALL BRACKET PER MANUFACTURER'S RECOMMENDATION AND AS DIRECTED BY ENGINEER.

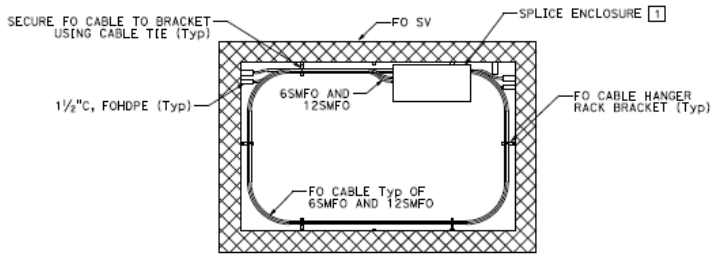
DIst	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
02	Var	Var	Var	136	195

ART 02-21-18
REGISTERED ELECTRICAL ENGINEER DATE

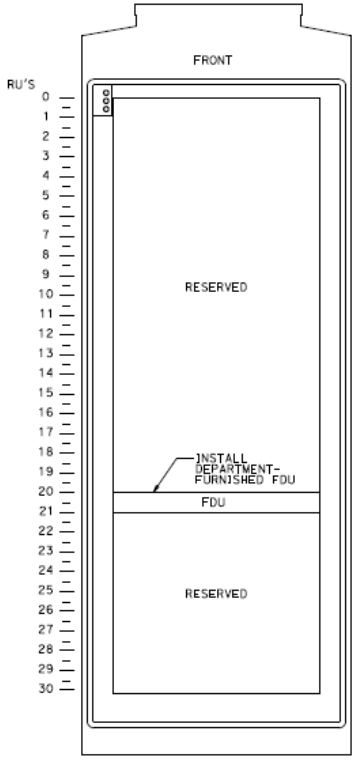
03-15-18
PLANS APPROVAL DATE

A.P. ROBLES No. E15293 Exp. 1-31-19 ELECTRICAL REGISTERED PROFESSIONAL ENGINEER STATE OF CALIFORNIA

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.



12 SMFO TO 6 SMFO MIDSPAN FUSION SPLICE



ITS EQUIPMENT CABINET LAYOUT

ELECTRICAL DETAILS
NO SCALE
ED-4

CALCULATED-DESIGNED BY	FUNCTIONAL SUPERVISOR	REVISED BY	DATE REVISED
ARTURO P. ROBLES	ROB STINGER		
CHECKED BY			
KEITH KOEPPEN			

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
ELECTRICAL DESIGN

P:\proj\1\02\4F780_plans\pee\24f780ud004.dgn

LAST REVISED 02-11-18 DATE PLOTTED => 30-MAR-2018 TIME PLOTTED => 11:41

BORDER LAST REVISED 7/2/2010 | USERNAME => s115152 DGN FILE => 24f780ud004.dgn | RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3 | UNIT 0147 | PROJECT NUMBER & PHASE 02-1300-0032-1 EA 02-4F780

Construction

Major Miles Stone Overview

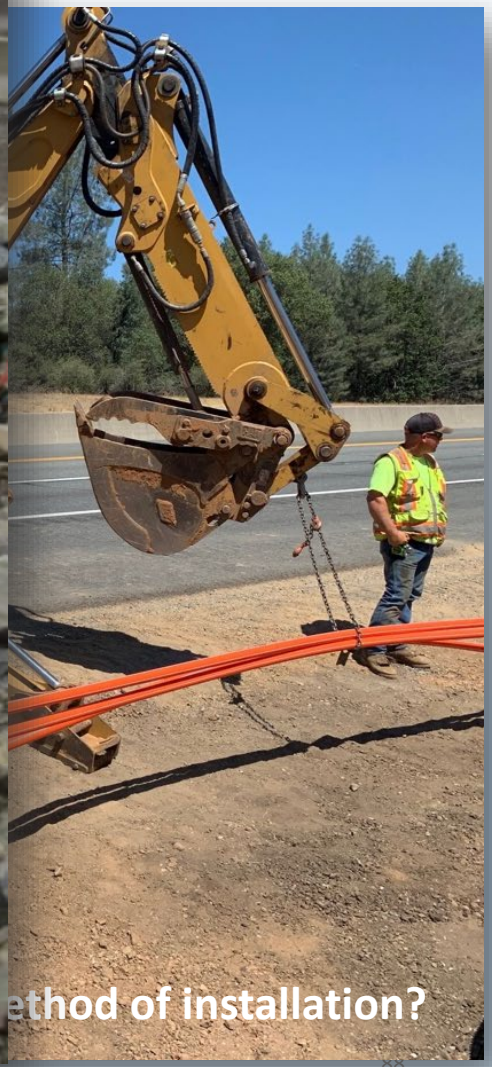
- Construction Started June 2019
- Trenching/Fiber Optic ducting installed July-September 2019
- Sign Structures installed October 2019
- BOS/LCS installed April 2020
- CMS Signed installed April 2020
- Fiber Optic installed in April 2020
- Signs Commissioned May 2020
- Construction ended August 2020

Construction

Fiber Optic

Construction

*WSDOT Organized Chain-Up 2014



ethod of installation?

Construction

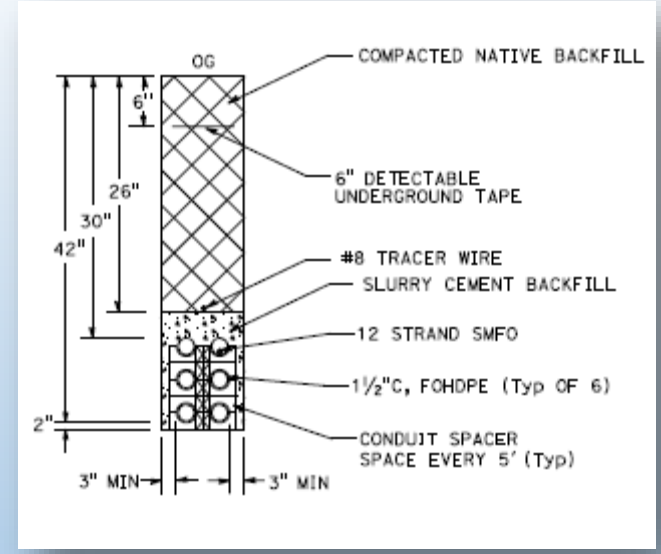
Fiber Optic

Construction

Fiber Optic

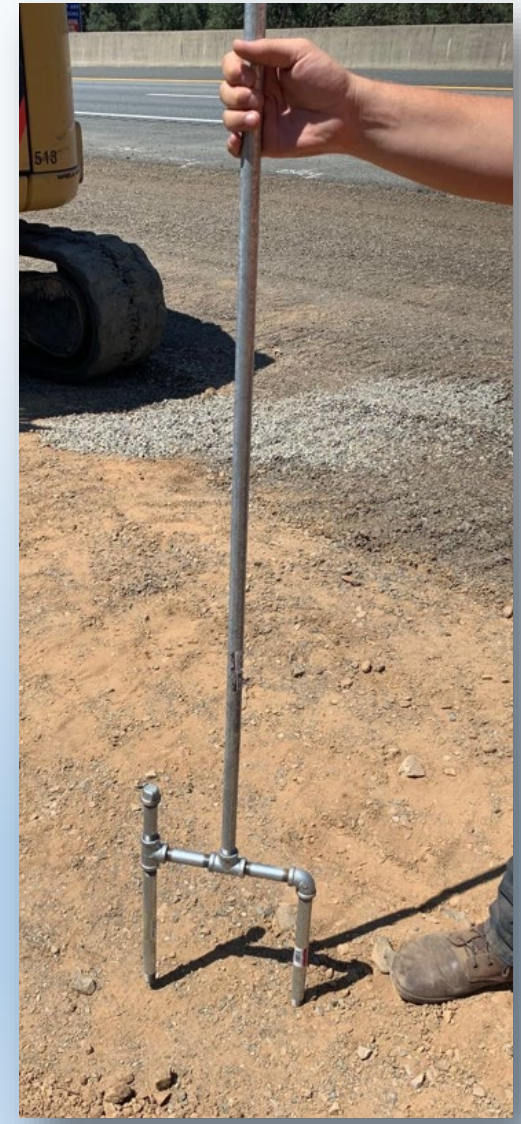
Construction

Fiber Optic



Construction

Fiber Optic



Creative Installation Aides

Construction

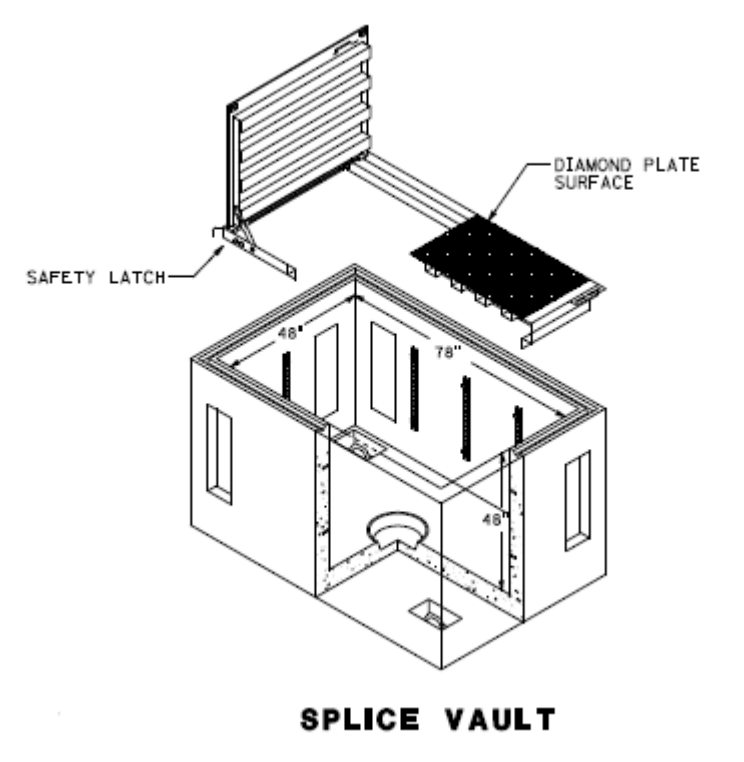
Fiber Optic

Construction

Fiber Optic

Construction

Fiber Optic



SPLICE VAULT

Construction

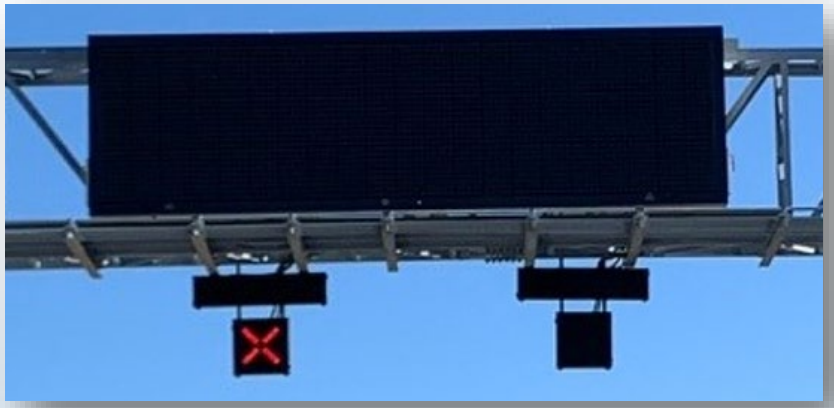
Sign Testing/Validating

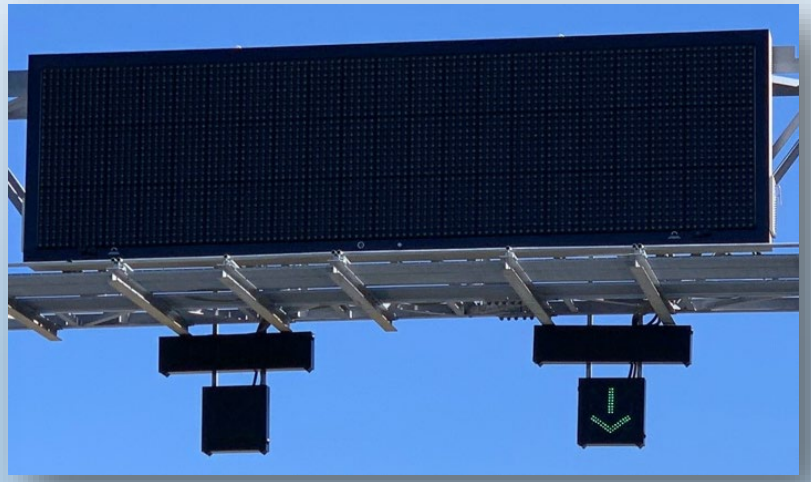
- Highway Electrical contractor lacked experience with electronics
  - Trained contractor how to terminate CAT5/RJ-45

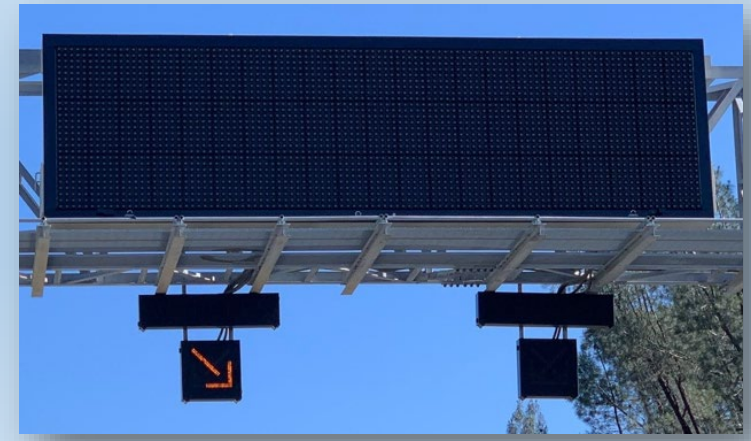
Construction

Sign Testing/Validating

- Highway Electrical contractor lacked experience with electronics
  - Trained contractor how to terminate CAT5/RJ-45
- BOS/LCS signs required manufacturer to “remote” in to test/validate operations
  - Manufacturer was located out of country
  - Improperly configured on arrival

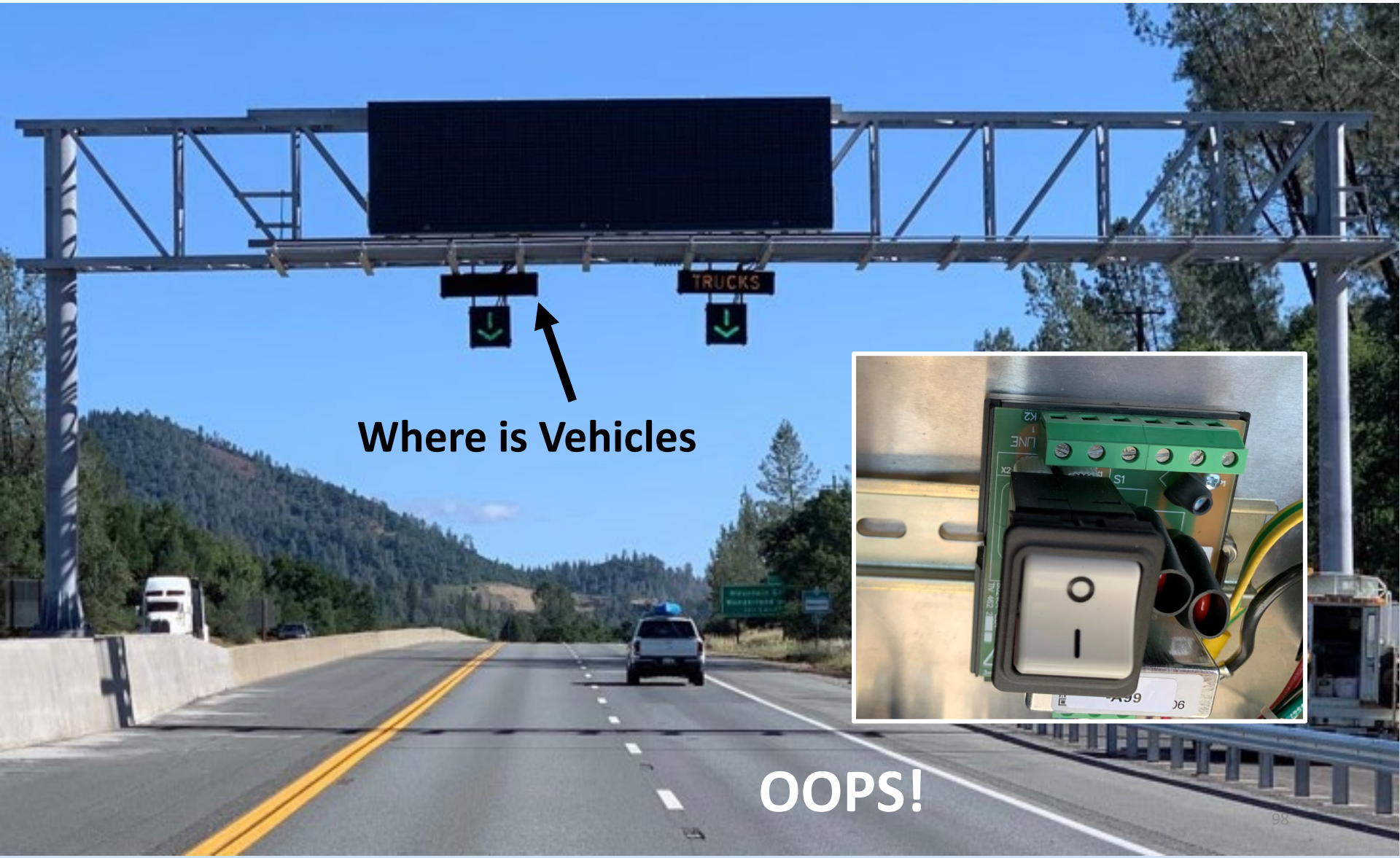






Construction

Sign Testing/Validating



Construction

Sign Testing/Validating

- Highway Electrical contractor lacked experience with electronics
  - Trained contractor how to terminate CAT5/RJ-45
- BOS/LCS signs required manufacturer to “remote” in to test/validate operations
  - Manufacturer was located out of country
  - Improperly configured on arrival
- CMS signs were commissioned by HQ Translab (State Forces)

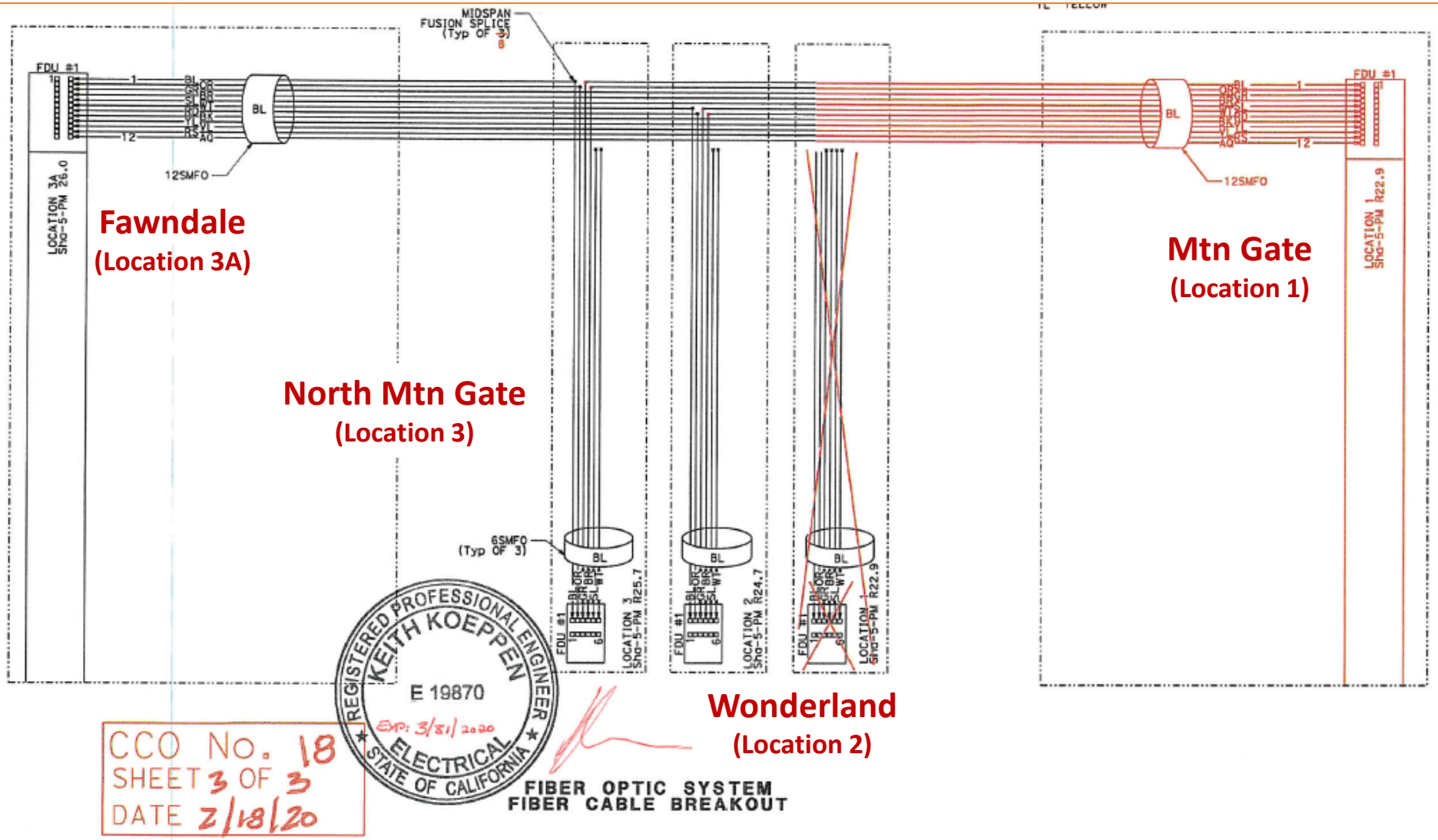
Construction

Fiber Install/Testing

- Telcom Contractor
  - Had expertise in testing/terminating fiber
  - Was the right prescription for the fever
  - Mobile Home outfitted for mobile testing/terminating
  - Added CCO for additional Splices

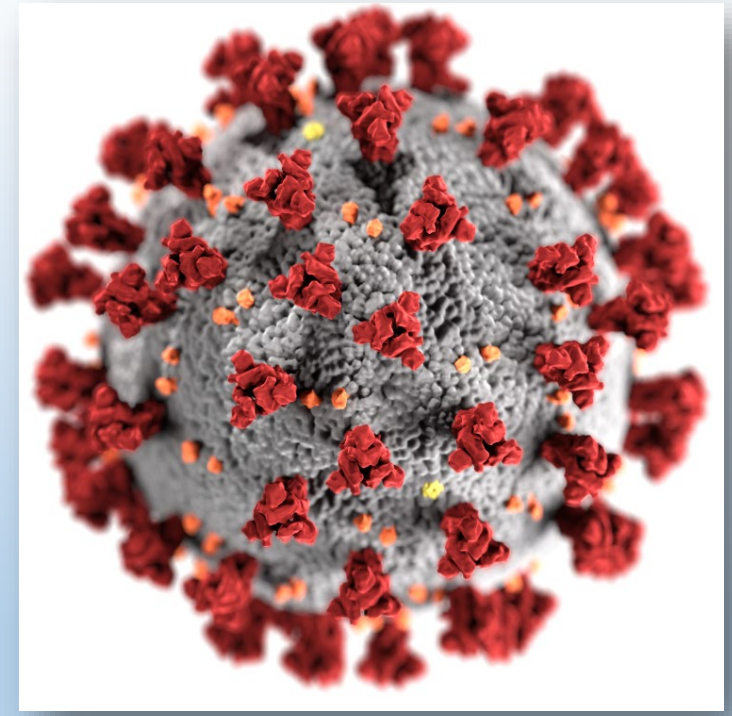
Construction

Fiber Install/Testing



Construction

COVID-19



- COVID-19
  - Teleworking
    - Added layer of communication of delays

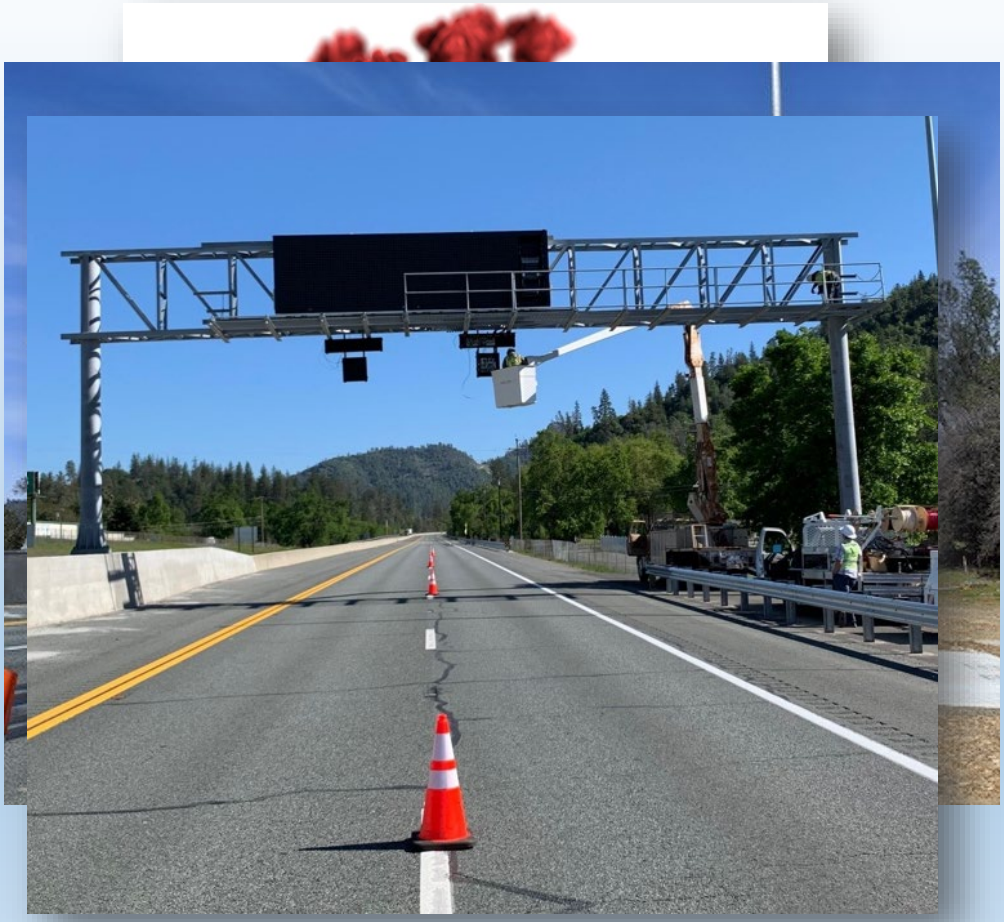
Construction

COVID-19

- COVID-19
  - Teleworking
    - Added layer of communication of delays
  - Manufacturing shutdowns
  - Construction Project delayed

Construction

COVID-19

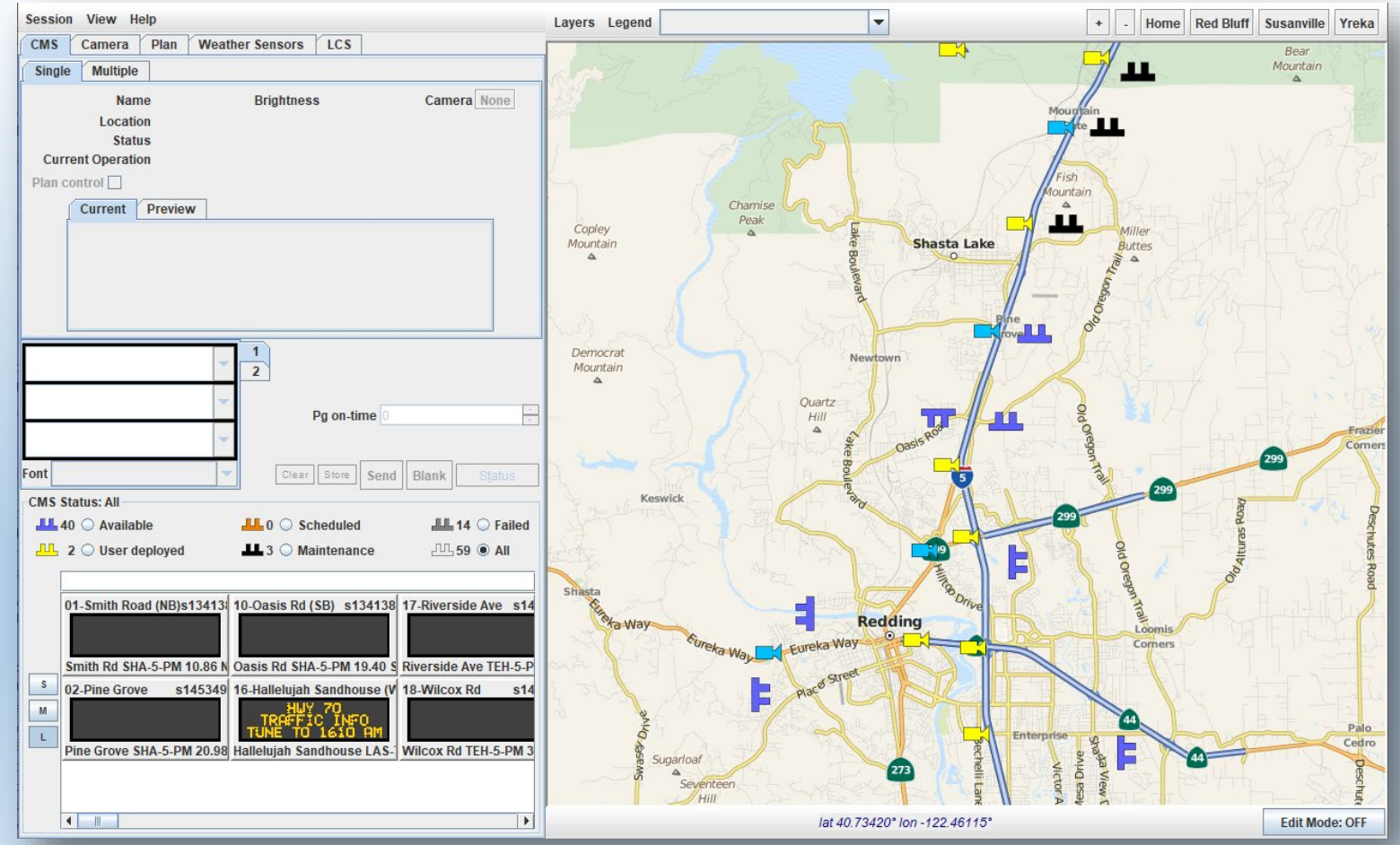


- COVID-19
  - Teleworking
    - Added layer of communication of delays
  - Manufacturing shutdowns
  - Construction Project delayed
  - Downturn in traffic
    - Could stand on Interstate 5

Integration/System Turnup

Central Systems

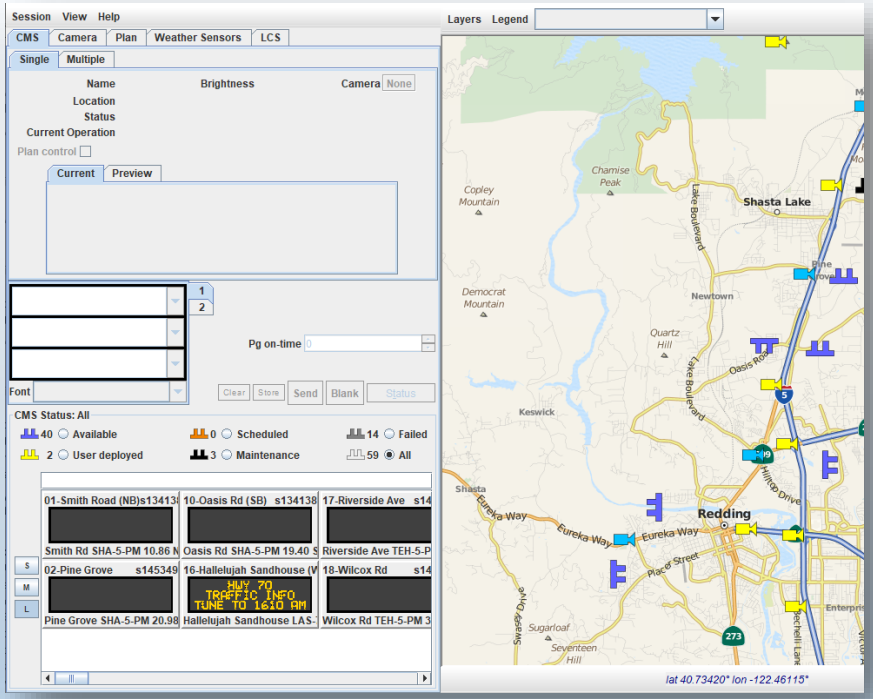
- Intelligent Roadway Information System (IRIS)



Integration/System Turnup

Central Systems

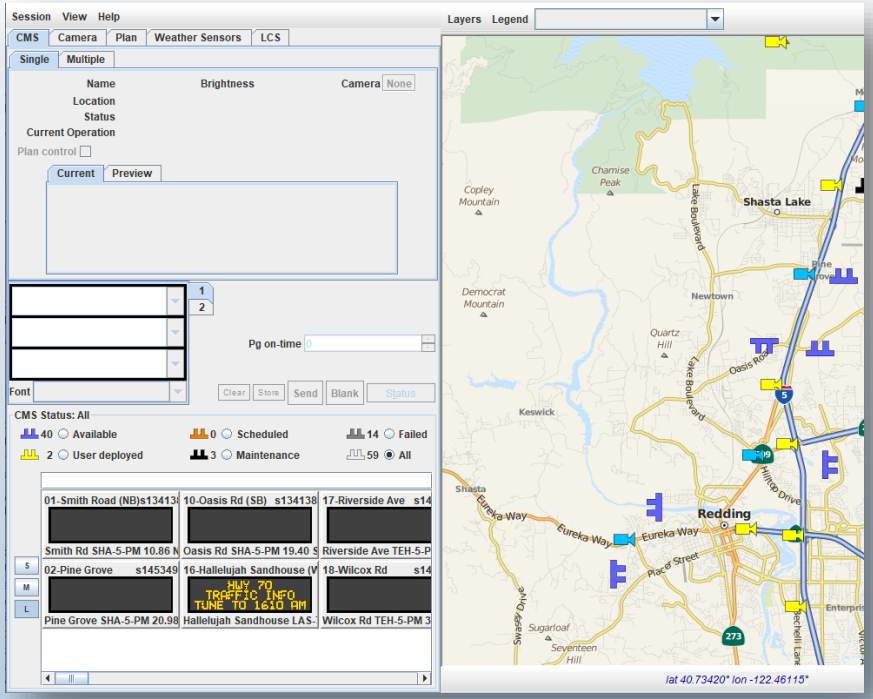
- Intelligent Roadway Information System (IRIS)
  - Open-source Advanced Traffic Management System (ATMS)
  - Developed by Minnesota DOT IRIS
    - 2007-Present
  - Modified and deployed by Advanced Highway Maintenance and Construction Technology (AHMCT) for Caltrans
    - 2007-2011 – D10 Pilot Project
    - 2011-2014 – D1,D2, D5 Deployment
  - Maintained and enhanced by Southwest Research Institute (SwRI)
    - 2014-2021
  - Maintained by TansTec
    - 2021-Present



Integration/System Turnup

Central Systems

- IRIS Software Contract
  - HQ Manages contract
  - Required Change Control Board (CCB) approval
  - Funding Availability



Caltrans SwRI AHMCT MINNESOTA DEPARTMENT OF TRANSPORTATION

Integration/System Turnup

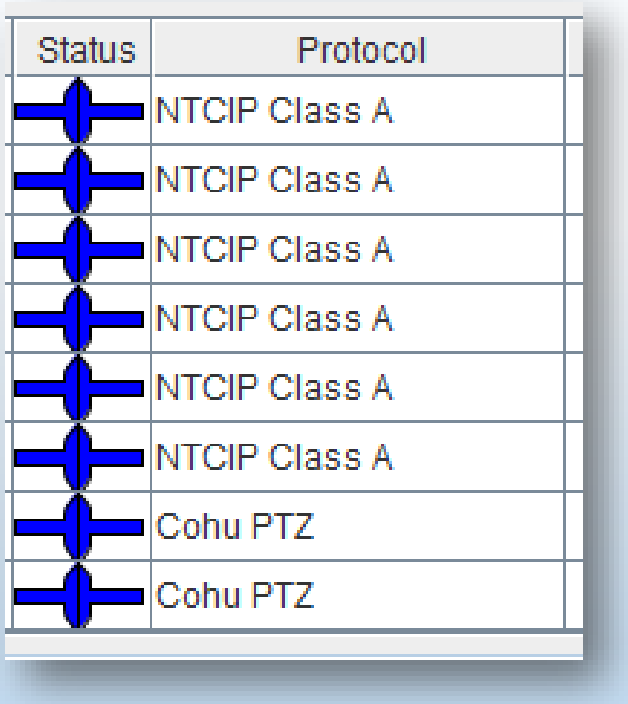
Central Systems

- IRIS Requirements
  - Integrate NTCIP 1203 for DMS
  - Integrate notion of “sign bridges”
  - Integrate feature to control all elements as single system
  - Allow controlling of system with “single-click” operations

Integration/System Turnup

Central Systems

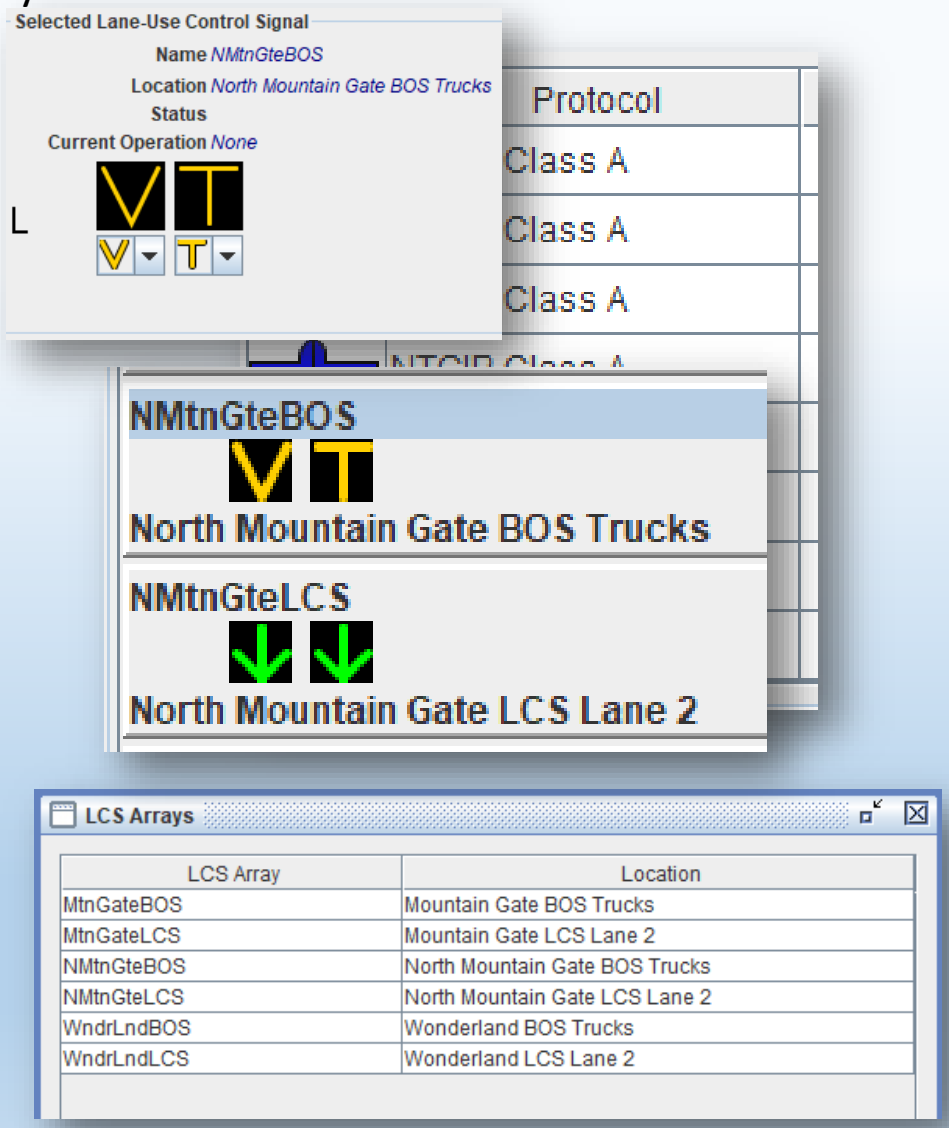
- IRIS Requirements
  - Integrate NTCIP 1203 for DMS
  - Integrate notion of “sign bridges”
  - Integrate feature to control all elements as single system
  - Allow controlling of system with “single-click” operations
- Implemented in IRIS
  - NTCIP 1203 for DMS



Integration/System Turnup

Central Systems

- IRIS Requirements
  - Integrate NTCIP 1203 for DMS
  - Integrate notion of “sign bridges”
  - Integrate feature to control all elements as single system
  - Allow controlling of system with “single-click” operations
- Implemented in IRIS
  - NTCIP 1203 for DMS
  - “Sign bridges” are configured as “arrays”



LCS Array	Location
MtnGateBOS	Mountain Gate BOS Trucks
MtnGateLCS	Mountain Gate LCS Lane 2
NMtnGteBOS	North Mountain Gate BOS Trucks
NMtnGteLCS	North Mountain Gate LCS Lane 2
WndrLndBOS	Wonderland BOS Trucks
WndrLndLCS	Wonderland LCS Lane 2

Integration/System Turnup

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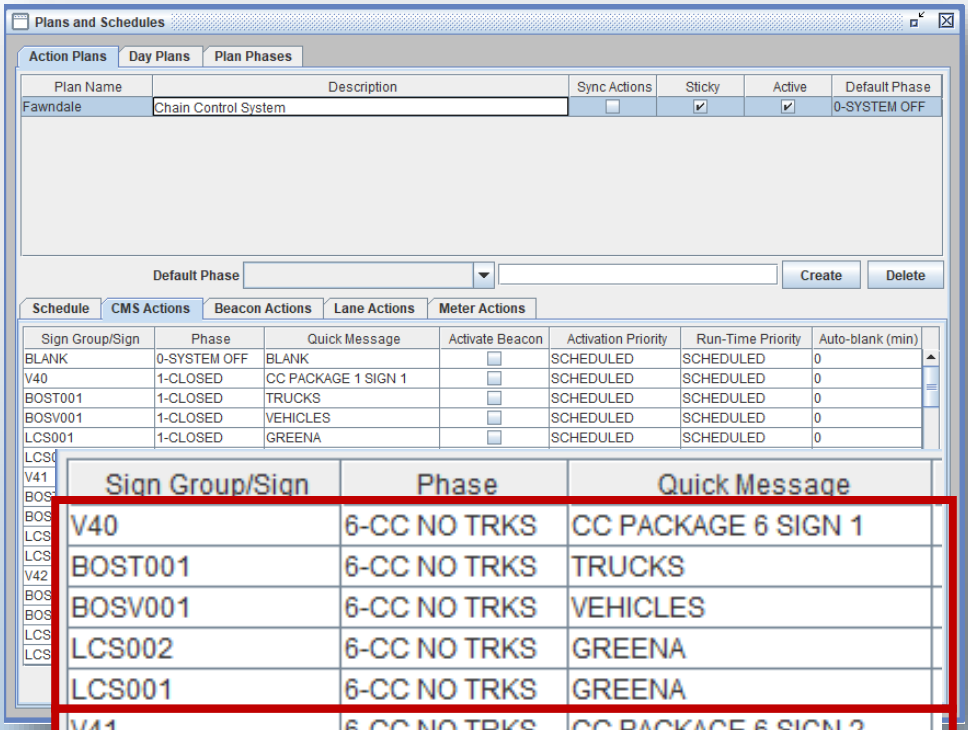
  - Elements are configured as system via “Plans” with phases



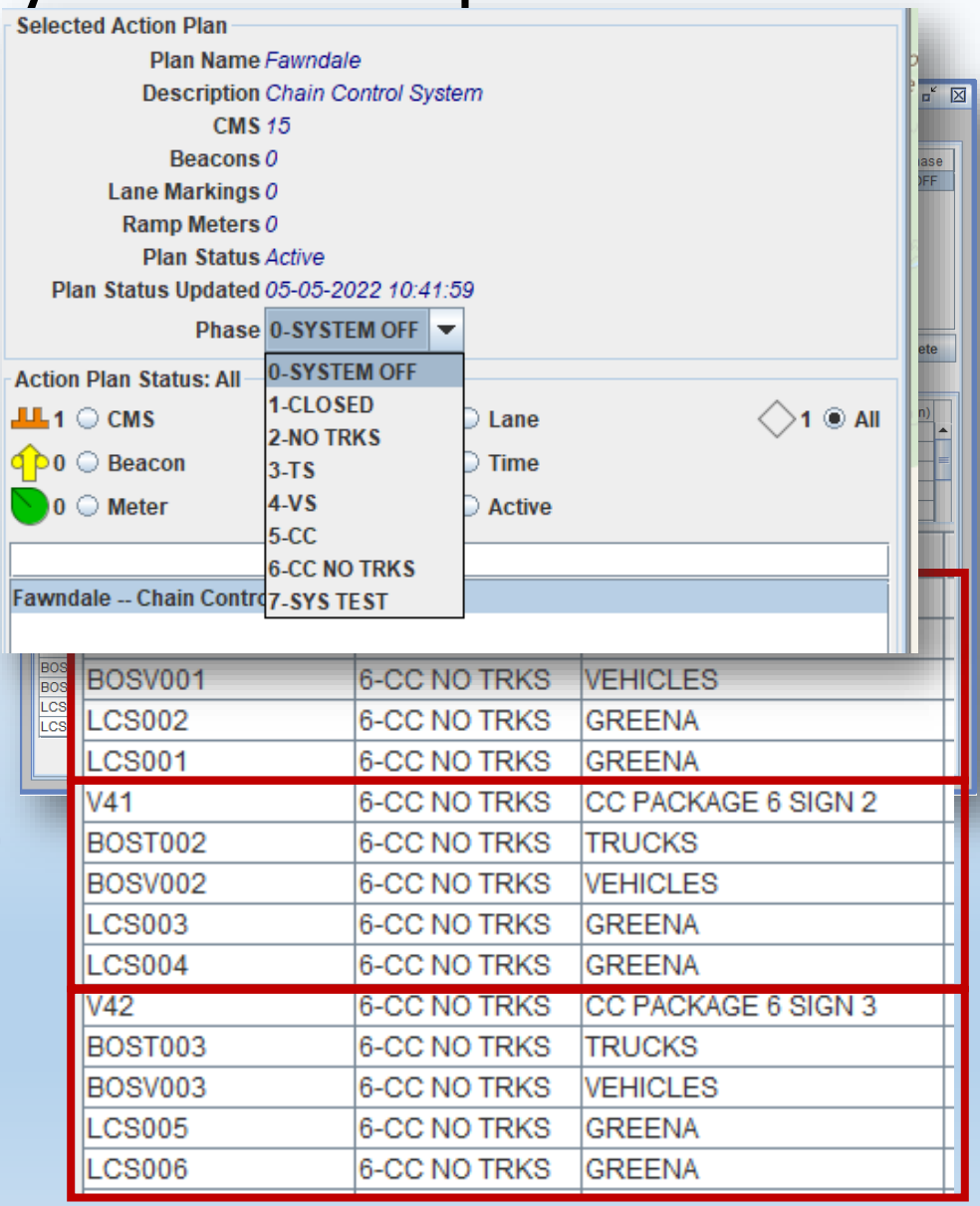
Sign Group/Sign	Phase	Quick Message
V40	6-CC NO TRKS	CC PACKAGE 6 SIGN 1
BOST001	6-CC NO TRKS	TRUCKS
BOSV001	6-CC NO TRKS	VEHICLES
LCS002	6-CC NO TRKS	GREENA
LCS001	6-CC NO TRKS	GREENA
V41	6-CC NO TRKS	CC PACKAGE 6 SIGN 2
BOST002	6-CC NO TRKS	TRUCKS
BOSV002	6-CC NO TRKS	VEHICLES
LCS003	6-CC NO TRKS	GREENA
LCS004	6-CC NO TRKS	GREENA
V42	6-CC NO TRKS	CC PACKAGE 6 SIGN 3
BOST003	6-CC NO TRKS	TRUCKS
BOSV003	6-CC NO TRKS	VEHICLES
LCS005	6-CC NO TRKS	GREENA
LCS006	6-CC NO TRKS	GREENA

Single Phase Shown

Integration/System Turnup

Centra

- IRIS Requirements
  - Integrate NTCIP 1203 for DMS
  - Integrate notion of “sign bridges”
  - Integrate feature to control all elements as single system
  - Allow controlling of system with “single-click” operations
- Implemented in IRIS
  - NTCIP 1203 for DMS
  - “Sign bridges” are configured as “arrays”
  - Elements are configured as system via “Plans” with phases
  - Controlled by single dropdown selection

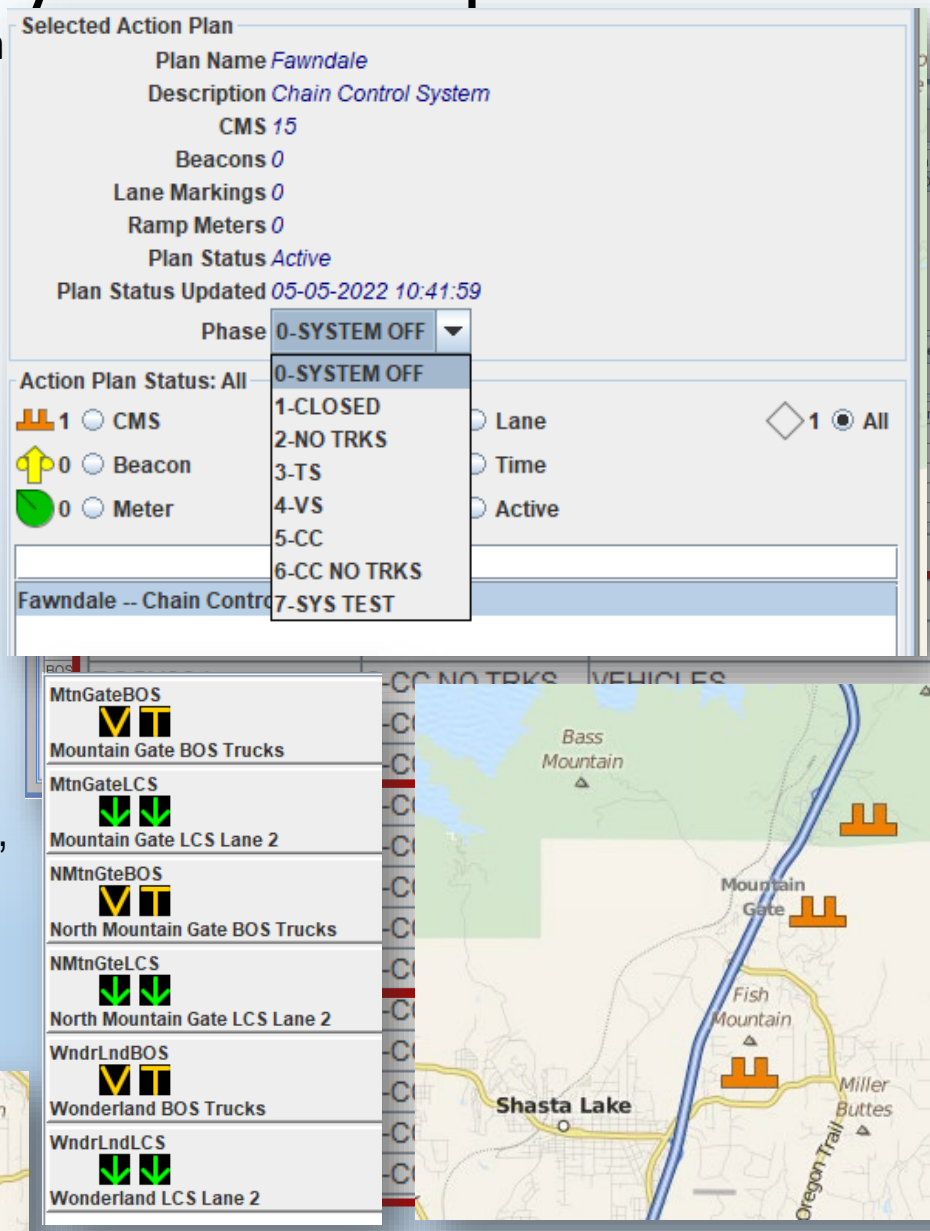


Integration/System Turnup

Centra

- IRIS Requirements
  - Integrate NTCIP 1203 for DMS
  - Integrate notion of “sign bridges”
  - Integrate feature to control all elements as single system
  - Allow controlling of system with “single-click” operations

- Implemented in IRIS
  - NTCIP 1203 for DMS
  - “Sign bridges” are configured as “arrays”
  - Elements are configured as system via “Plans” with phases
  - Controlled by single dropdown selection
  - Operator can confirm signs are activated



Integration/System Turnup

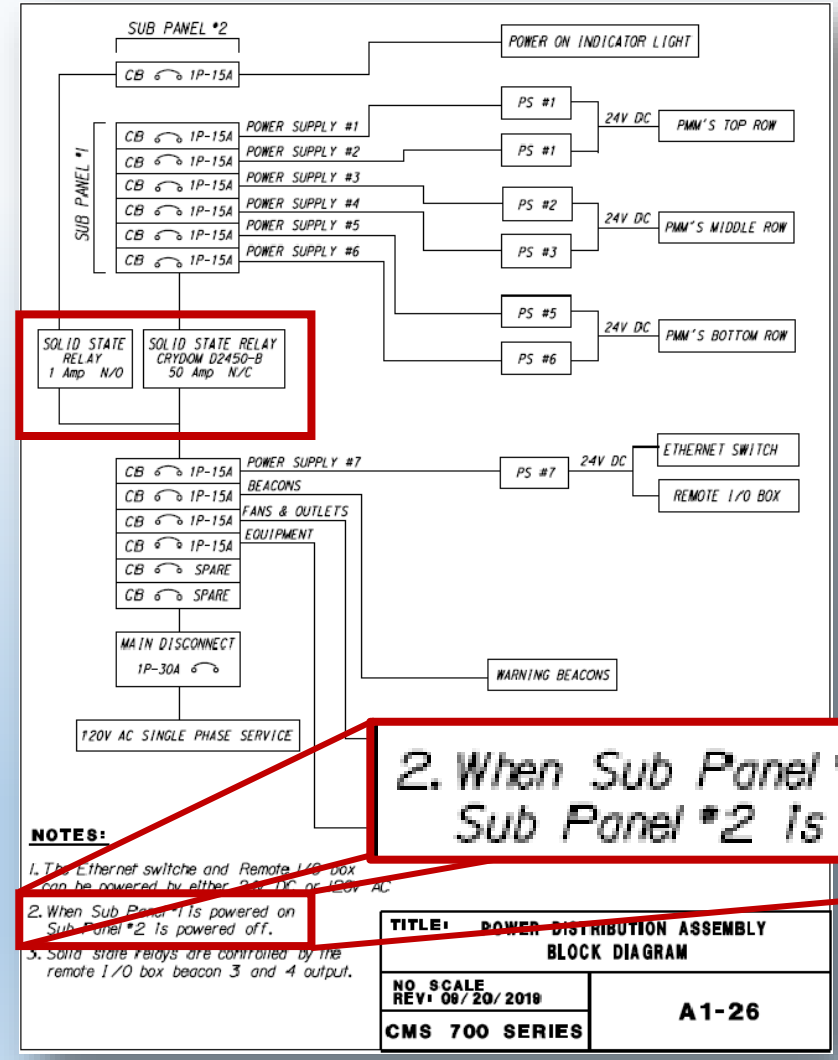
Field Systems

- Model 700 CMS
  - District 3 identified several issues with the new model during early adoption
    - Water intrusion
    - Duplicate IP Address
  - Required field retrofits to correct issues
    - Signs deployed in District 2 were retrofitted by vendor prior to deployment

***District 3 AVMS Status Report v2**

Integration/System Turnup

Field Systems



2. When Sub Panel #1 is powered on Sub Panel #2 is powered off.

- Model 700 CMS
  - District 3 identified several issues with the new model during early adoption
    - Water intrusion
    - Duplicate IP Address
  - Required field retrofits to correct issues
    - Signs deployed in District 2 were retrofitted by vendor prior to deployment
  - Power saving “feature”
    - Results in ~15 second delay when is sent to sign after extended

***Caltrans TEES (Chapter 13, A1-26)**

Integration/System Turnup

Field Systems

- Lane Control / Blank Out Signs
  - Stopped responding when testing with IRIS
  - Needed lane closure to troubleshoot and fix

Integration/System Turnup

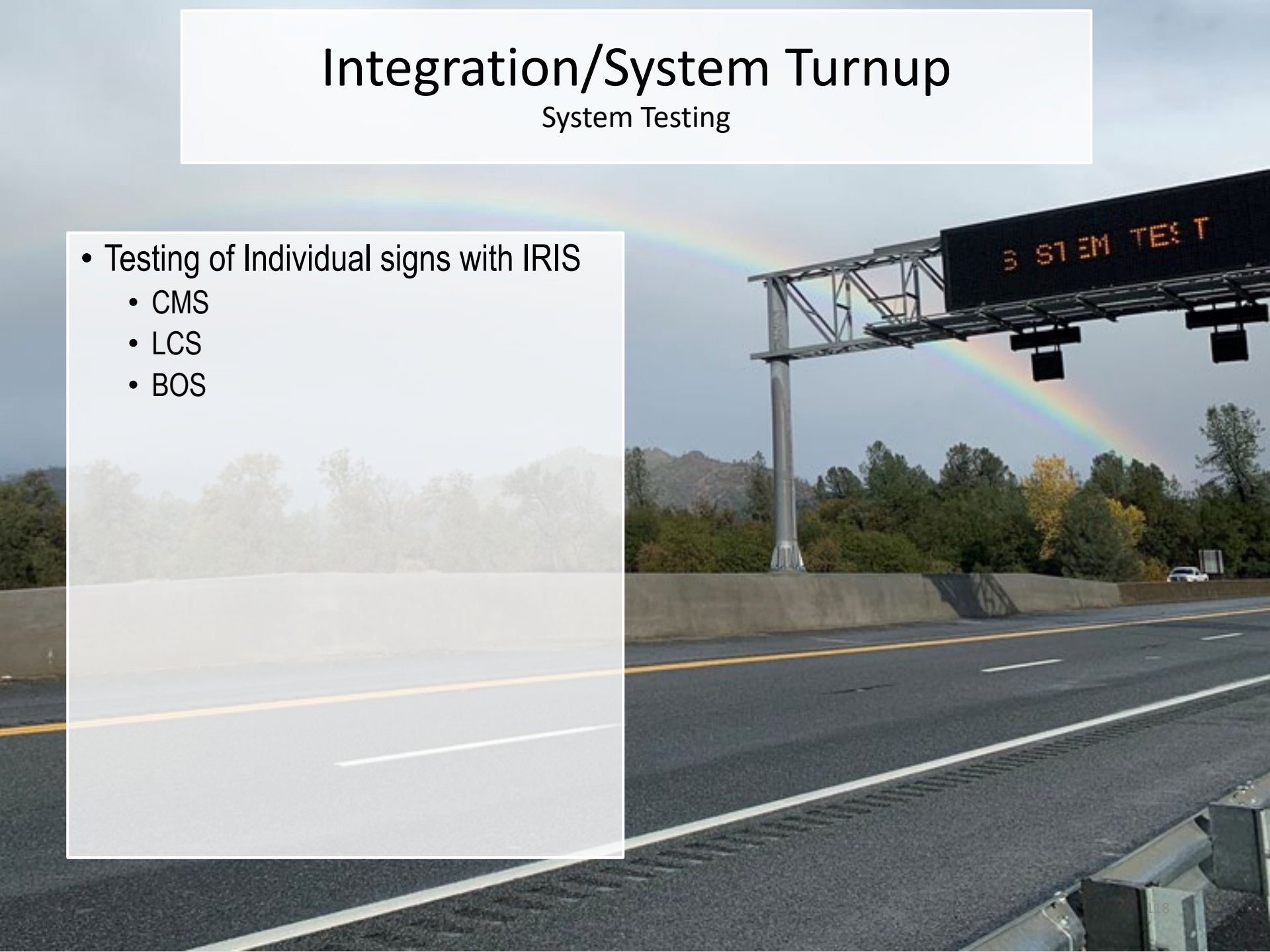
Field Systems

- Lane Control / Blank Out Signs
  - Stopped responding when testing with IRIS
  - Needed lane closure to troubleshoot and fix
  - Poorly terminated RJ-45 (contractor)
  - Factory terminated power connector

Integration/System Turnup

System Testing

- Testing of Individual signs with IRIS
  - CMS
  - LCS
  - BOS



Integration/System Turnup

System Testing

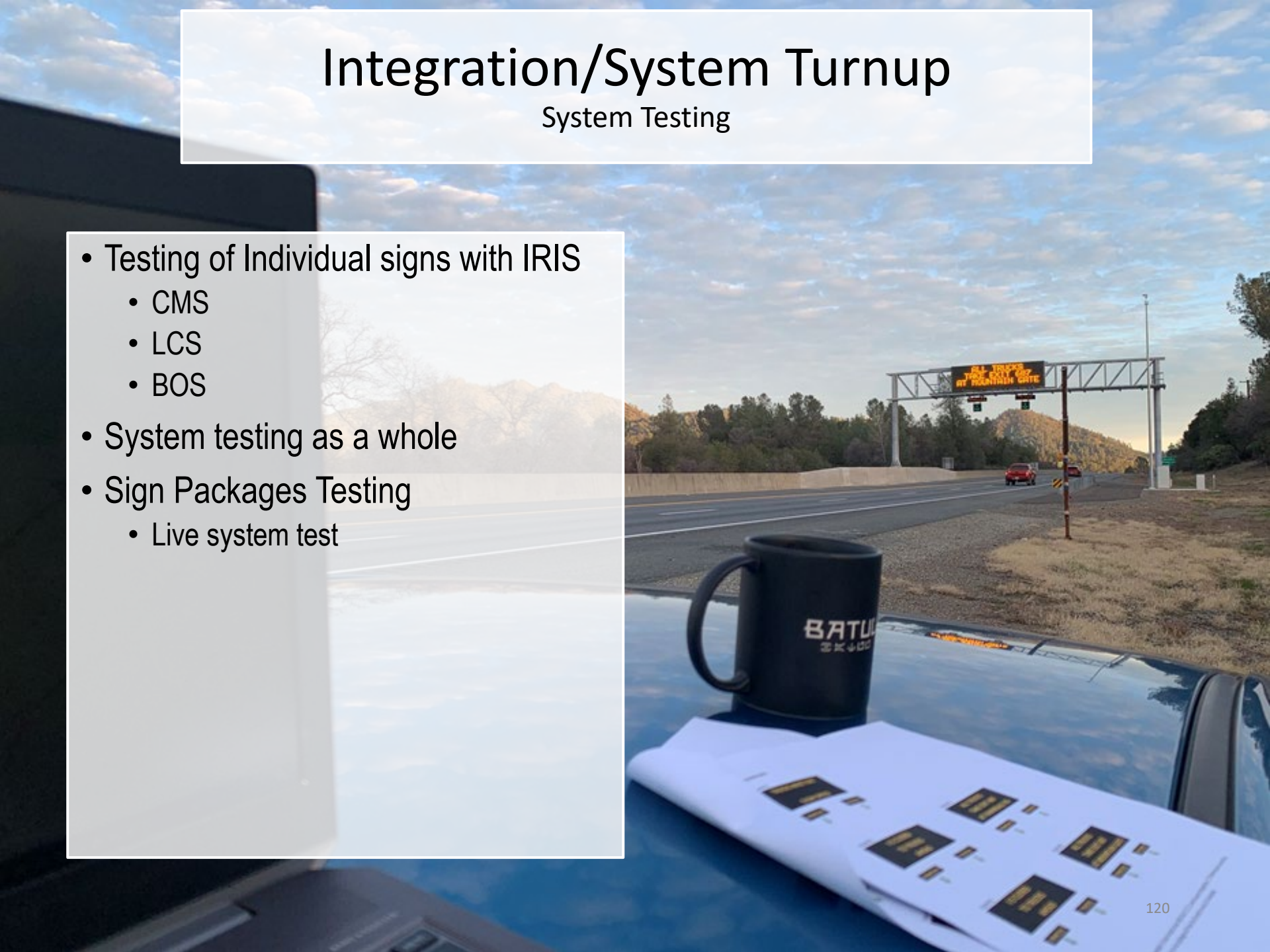
- Testing of Individual signs with IRIS
  - CMS
  - LCS
  - BOS
- System testing as a whole

*sign aliasing

Integration/System Turnup

System Testing

- Testing of Individual signs with IRIS
  - CMS
  - LCS
  - BOS
- System testing as a whole
- Sign Packages Testing
  - Live system test



Integration/System Turnup

System Testing

- Testing of Individual signs with IRIS
  - CMS
  - LCS
  - BOS
- System testing as a whole
- Sign Packages Testing
  - Live system test

Operations and Training

Who is?

- Who is “in charge” of when the system activates?

Maintenance

Operations and Training

Who is?

- Who is “in charge” of when the system activates?

  Maintenance

- Who Operates the system?

  TMC

Operations and Training

Who is?

- Who is “in charge” of when the system activates?

  Maintenance

- Who Operates the system?

  TMC

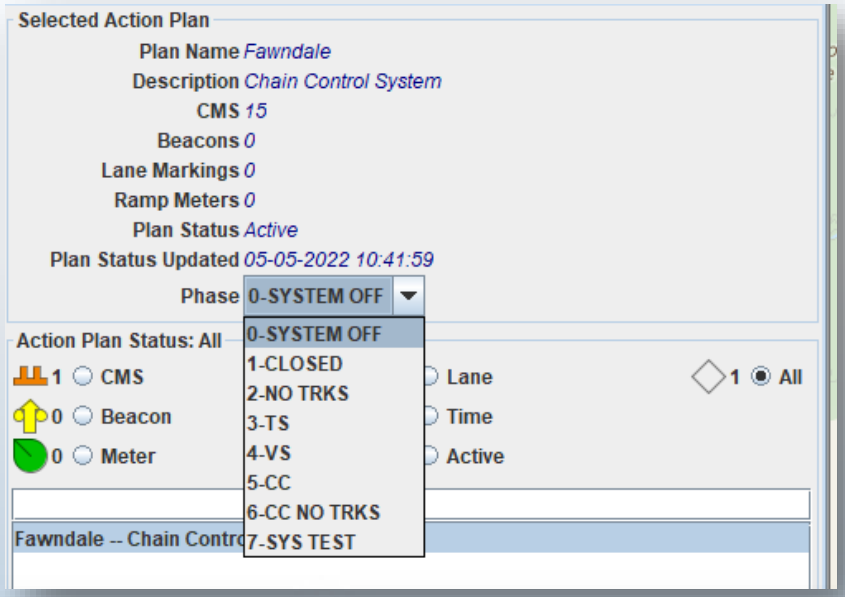
- Who maintains the system?

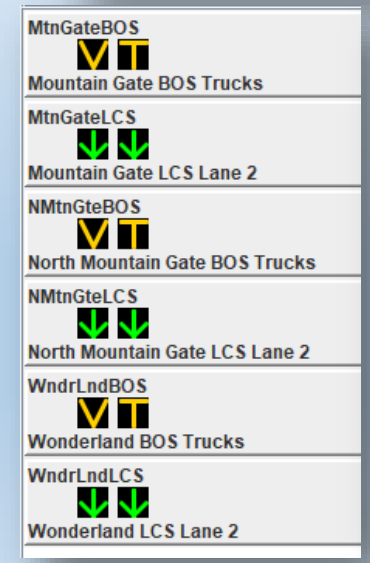
  ITS / ITS Electrical Maint

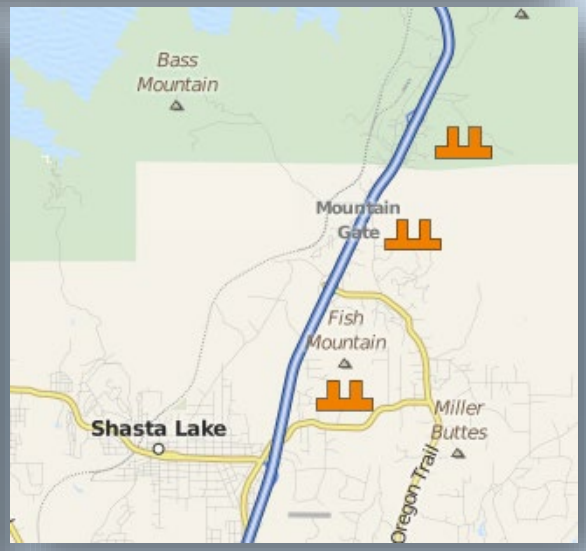
Operations and Training

Training

- TMC
  - Shown how to use IRIS to control
- Maintenance
  - Delayed Start Behavior
  - Showed how signs eliminate/operate







Season One Operations

2020/2021 Kicking the Tires

- The District had two winter events requiring restrictions (Jan & Mar)
- System was operational during second event
- NTCIP Problems
  - Signs were activated with default 10-minute time-out or blank out interval
    - Resulted in signs blanking every 10 minutes
    - IRIS would then reactivate the signs when polled
    - On/off behavior

Season One Operations

2020/2021 Kicking the Tires

- Restrictions without system operational

Season One Operations

2020/2021 Kicking the Tires

- Restrictions without system operational
- Heavy enforcement

Season One Operations

2020/2021 Kicking the Tires

- Restrictions without system operational
- Heavy enforcement
- Tractor Trailers Stuck

Season One Operations

2020/2021 Kicking the Tires

Season One Operations

2020/2021 Kicking the Tires

Season One Operations

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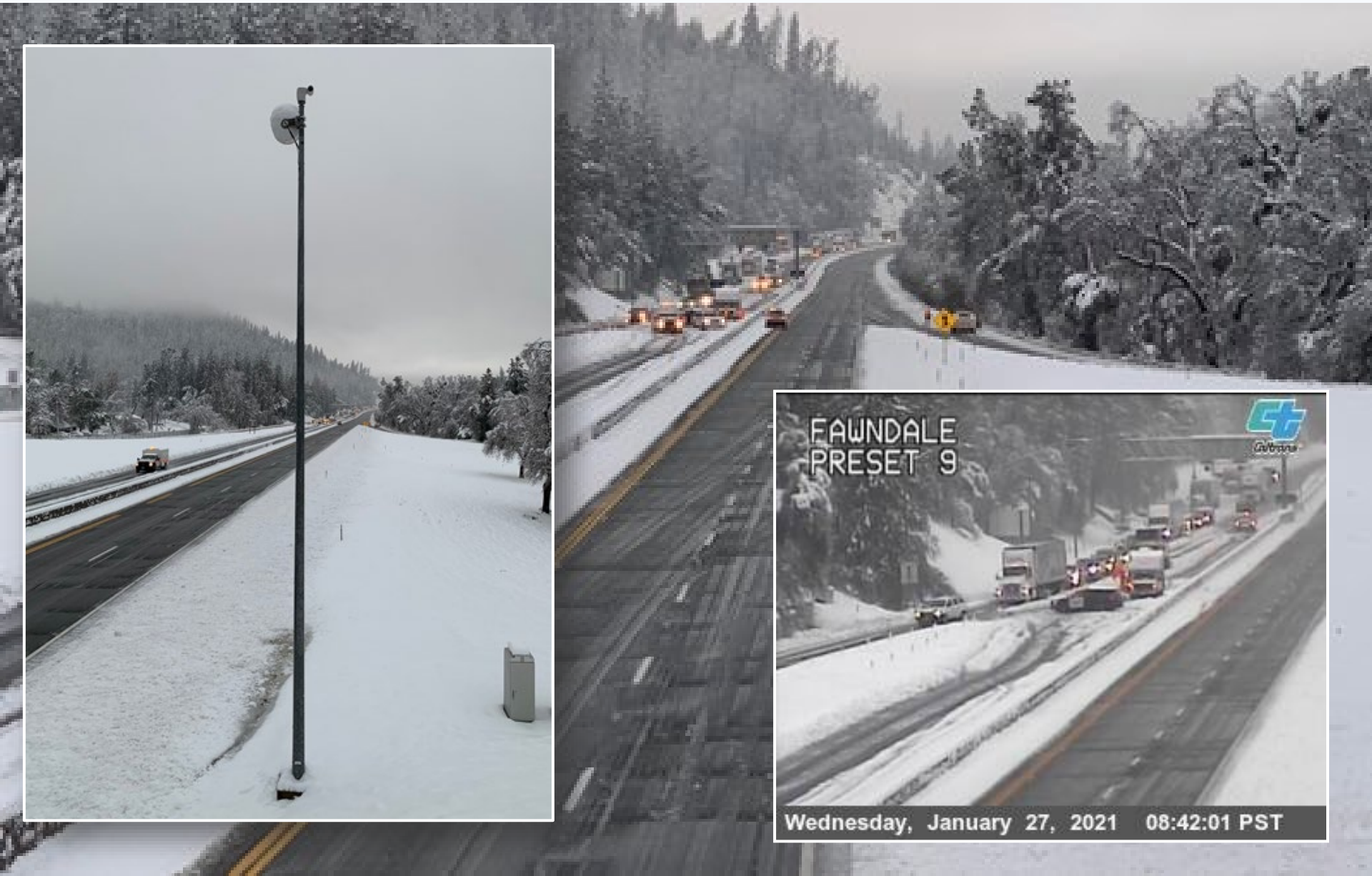
Season One Operations

2020/2021 Kicking the Tires



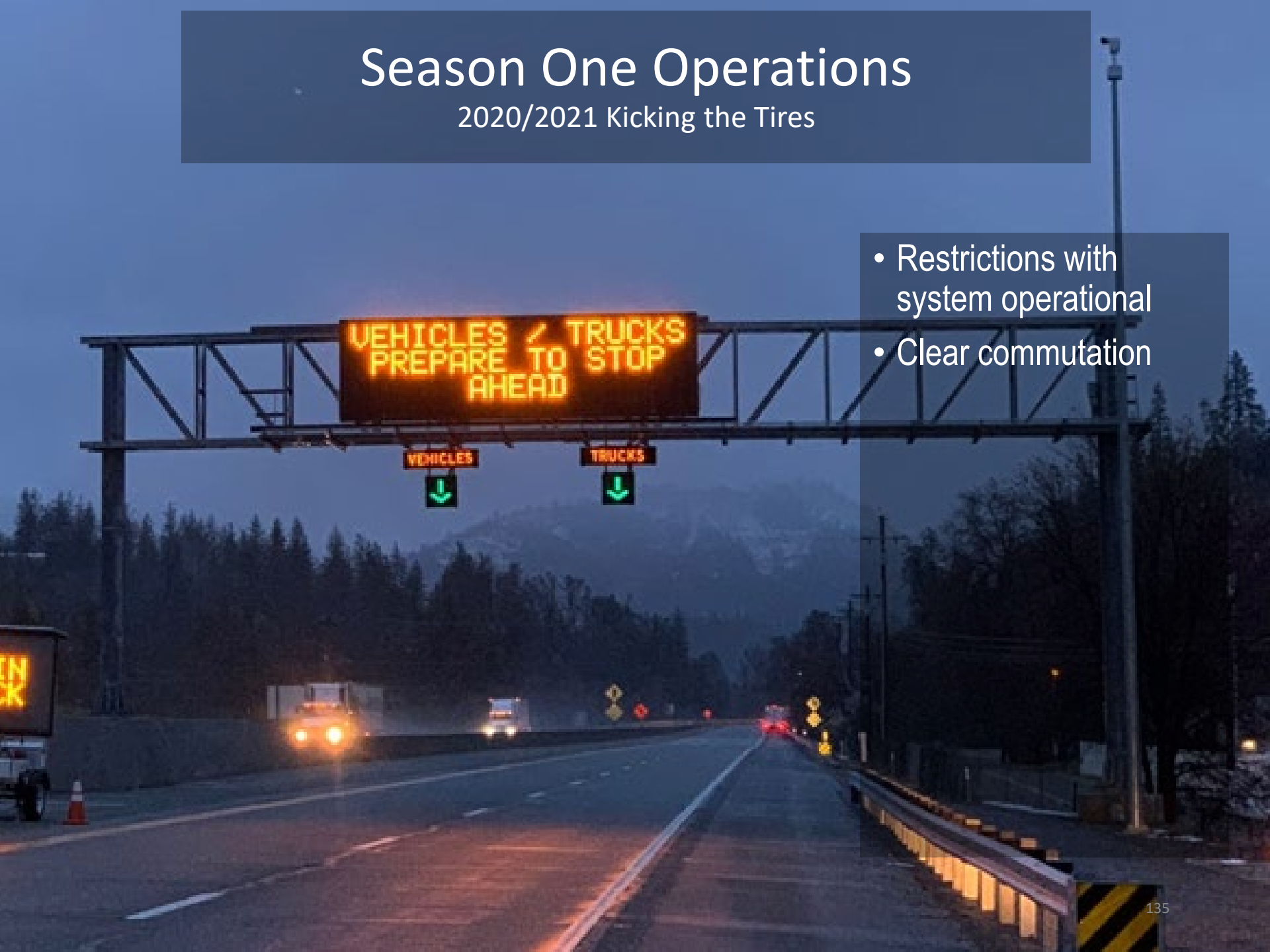
Season One Operations

2020/2021 Kicking the Tires

- Restrictions with system operational

Season One Operations

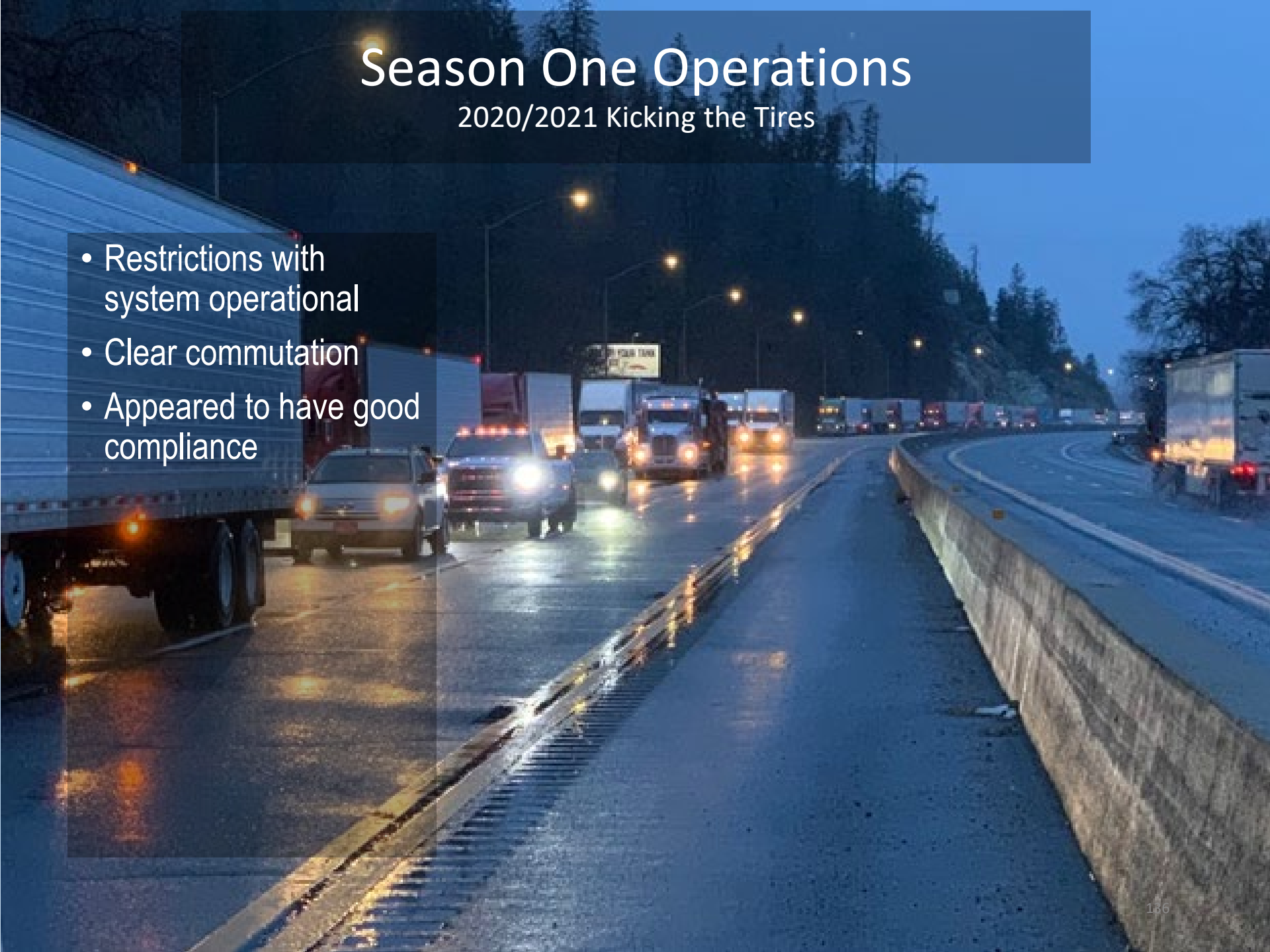
2020/2021 Kicking the Tires



- Restrictions with system operational
- Clear commutation

Season One Operations

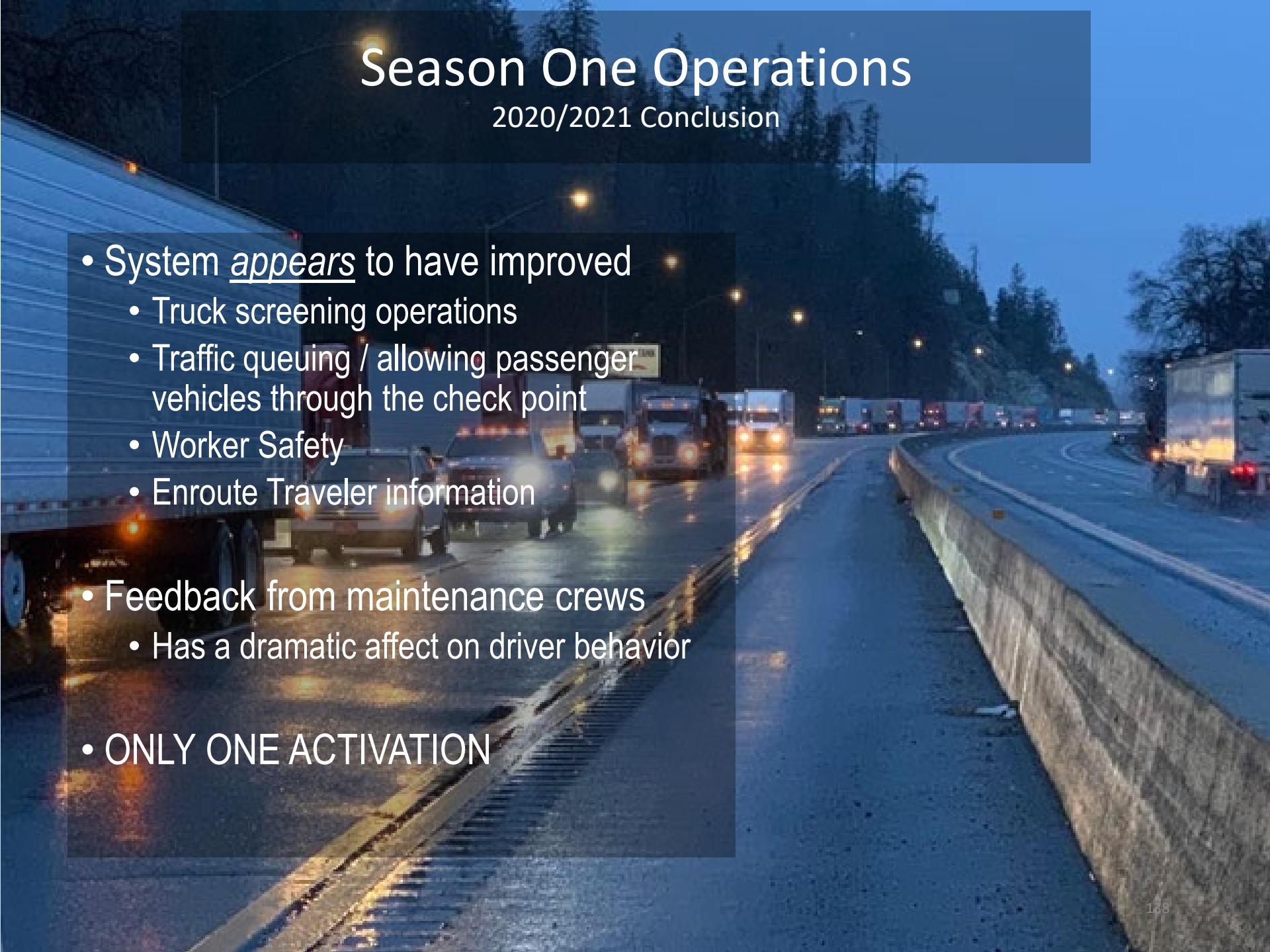
2020/2021 Kicking the Tires



- Restrictions with system operational
- Clear commutation
- Appeared to have good compliance

Season One Operations

2020/2021 Conclusion



- System *appears* to have improved
  - Truck screening operations
  - Traffic queuing / allowing passenger vehicles through the check point
  - Worker Safety
  - Enroute Traveler information
- Feedback from maintenance crews
  - Has a dramatic affect on driver behavior
- ONLY ONE ACTIVATION

Season Two Operations

2021/2022

- District had five winter events requiring restrictions (Dec)

Season Two Operations
2021/2022

- District had five winter events requiring restrictions (Dec)
  - Only one event closed I5
- Where is the queue

Season Two Operations

2021/2022

- District had five winter events requiring restrictions (Dec)
  - Only one event closed I5
- Where is the queue
  - Shoulders

Season Two Operations

2021/2022

- District had five winter events requiring restrictions (Dec)
  - Only one event closed I5
- Where is the queue
  - Shoulders
  - Onramps

Season Two Operations

2021/2022

- District had five winter events requiring restrictions (Dec)
  - Only one event closed I5
- Where is the queue
  - Shoulders
  - Onramps
  - Truck stops

Season Two Operations

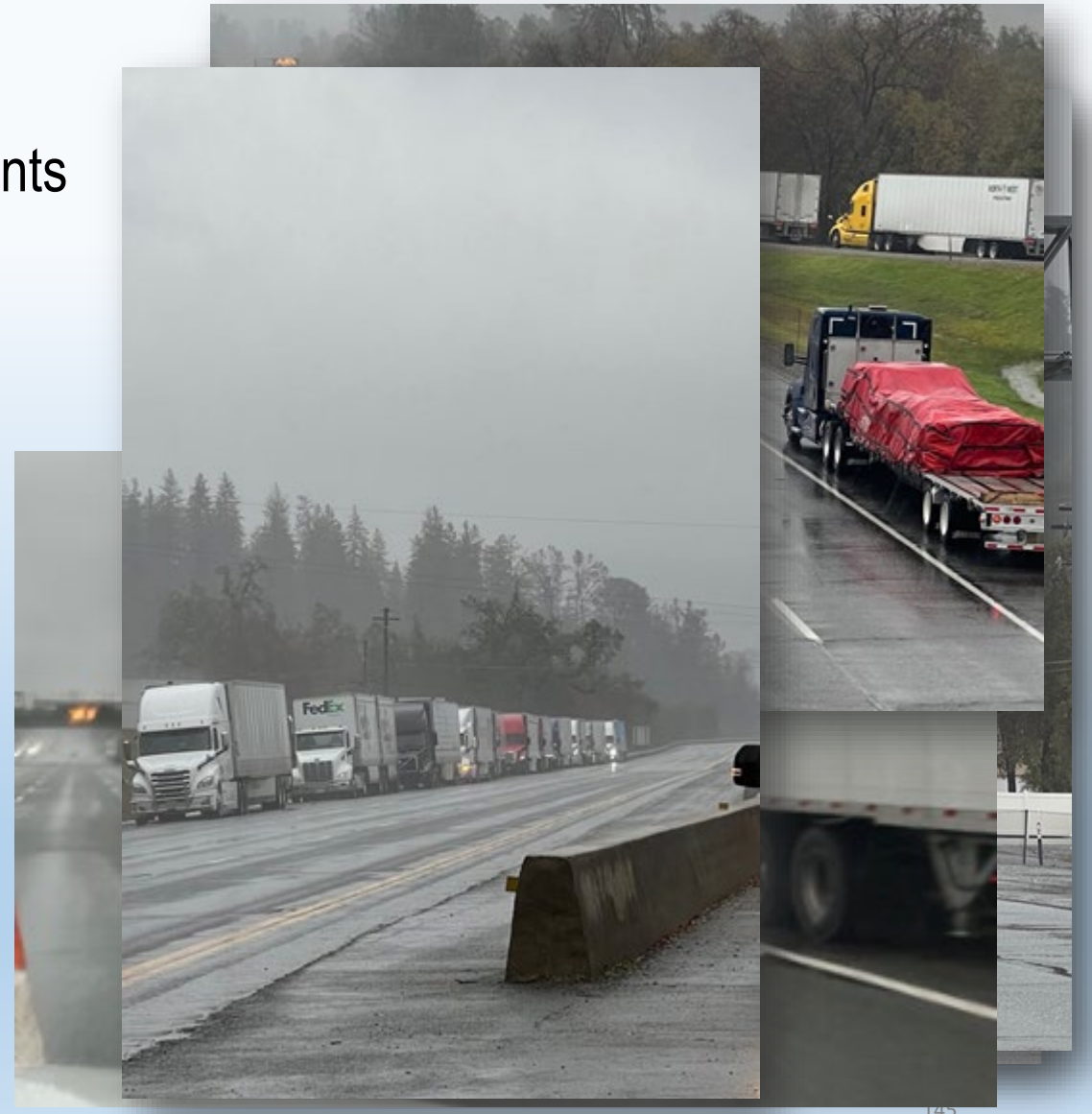
2021/2022

- District had five winter events requiring restrictions (Dec)
  - Only one event closed I5
- Where is the queue
  - Shoulders
  - Onramps
  - Truck stops
  - Rest areas

Season Two Operations

2021/2022

- District had five winter events requiring restrictions (Dec)
  - Only one event closed I5
- Where is the queue
  - Shoulders
  - Onramps
  - Truck stops
  - Rest areas
  - Everywhere but mainline



Season Two Operations

2021/2022 Conclusion

- System *appears* to have improved
  - Truck screening operations
  - Traffic queuing / allowing passenger vehicles through the check point
  - Worker Safety
  - Enroute Traveler information
- Feedback from maintenance crews
  - Has a dramatic affect on driver behavior
  - Maintenance indicated a need for more phases

Moving Forward

- Identified a need for additional sign packages (phases)
  - TMC Operators are creative!
- Future ATMS systems will need to have similar functionality
- Add additional point-to-point wireless to Southern ITS Node
  - Adds network resiliency (redundant paths)

Lessens Learned

COMMUNICATION

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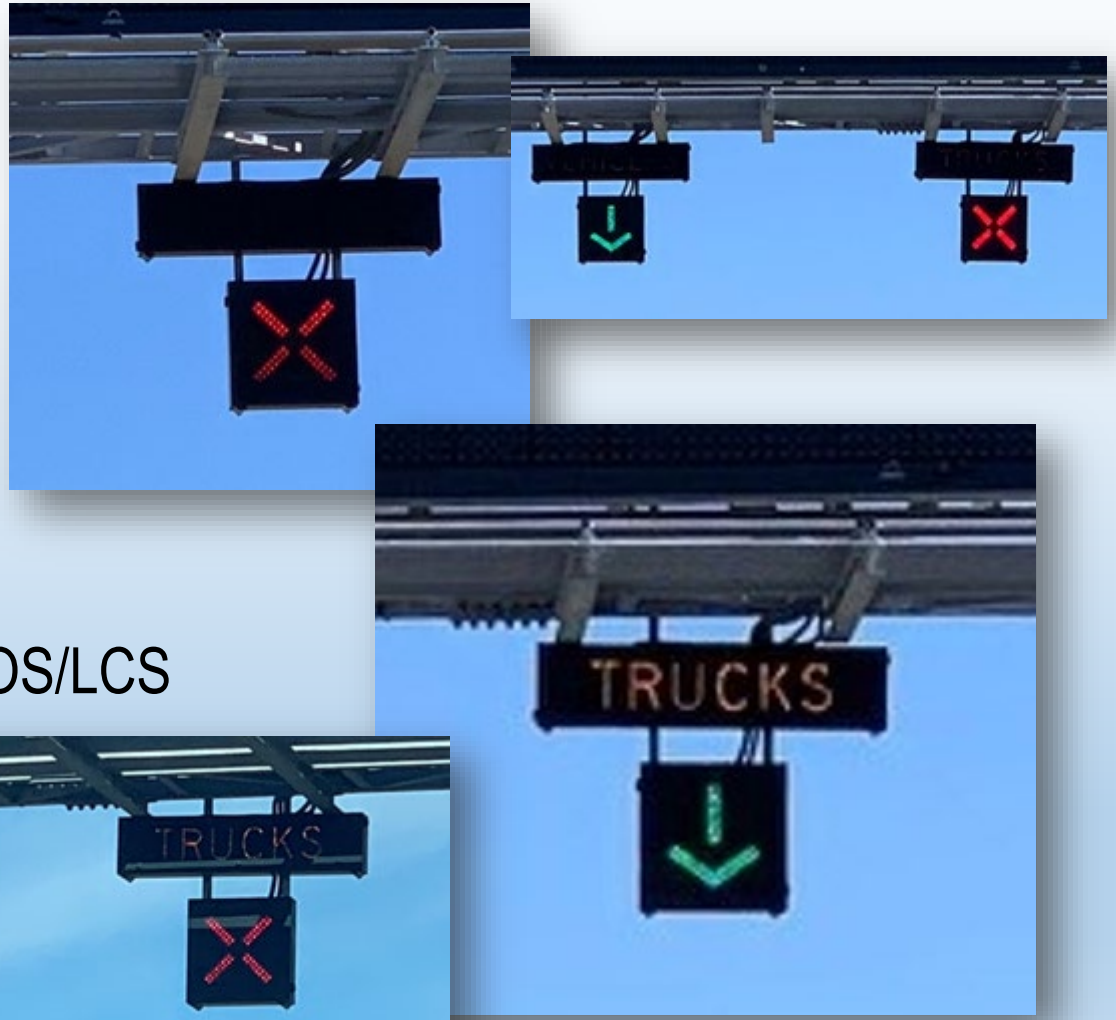
Lessons Learned

- Communication
  - The ***prescription*** for success!
  - Early and often between
    - Concept
    - Design
    - Construction
    - Integration
    - Maintenance
    - TMC

Photo Credit (Mary Ellen Matthews/NBCU Photo Bank/NBCUniversal via Getty Images via Getty Images)

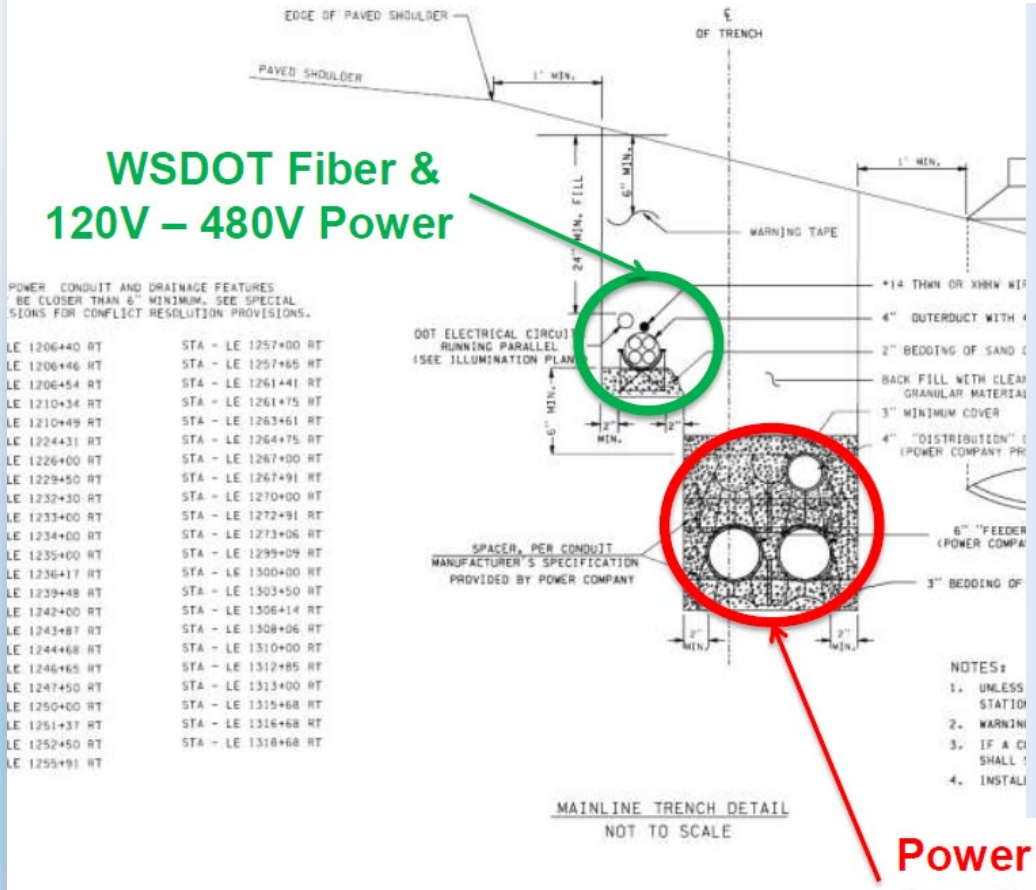
Lessons Learned

- Communication
  - The prescription for success
  - Early and often between
    - Concept
    - Design
    - Construction
    - Integration
    - Maintenance
    - TMC
- Sizing and Brightness of BOS/LCS



Lessons Learned

Joint Utility Company / DOT Fiber Trench

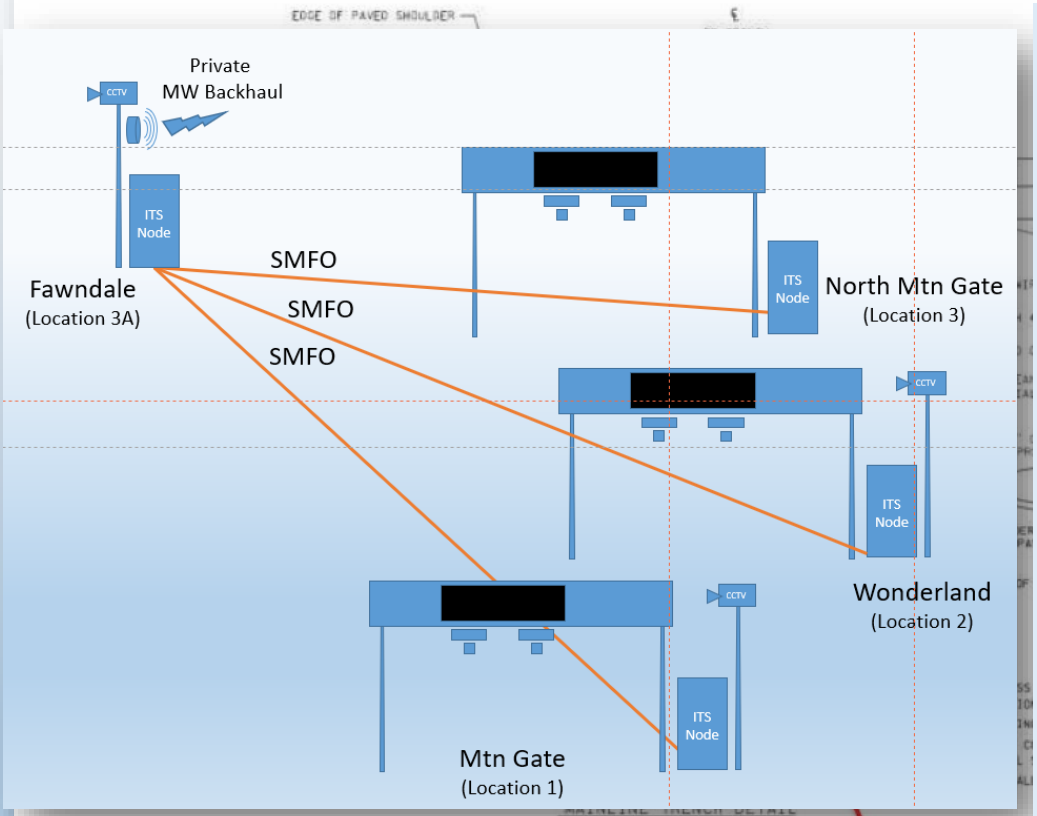


- Power
  - Individual locations vs distributed
    - WSDOT Partnered with Utility Co for power along corridor
    - Caltrans individual service locations

*WSDOT Organized Chain-Up 2014

Lessons Learned

Joint Utility Company / DOT Fiber Trench



Power Company Conduits

- Power
  - Individual locations vs distributed
    - WSDOT Partnered with Utility Co for power along corridor
    - Caltrans individual service locations
  - Communication backhaul is through single ITS Node
    - Whole system is down even if Fawndale loses power
    - Added CCO to help (future)

Lessons Learned

- Build in Flexibility During
  - Concept
  - Design
  - Construction
  - Integration
  - Operations

Lessons Learned

- Build in Flexibility During
  - Concept
  - Design
  - Construction
  - Integration
  - Operations

Changed by design committee
Changed by operational changes
Changed by integration changes/needs
Changed by central system requirements
Changed by Maintenance / TMC staffing

***** PEOPLE AND OPERATIONAL PRACTICES CHANGE OVER TIME*****

PLAN FOR IT AND BUILD FLEXIBILITY
INTO EVERY STAGE

Questions