



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

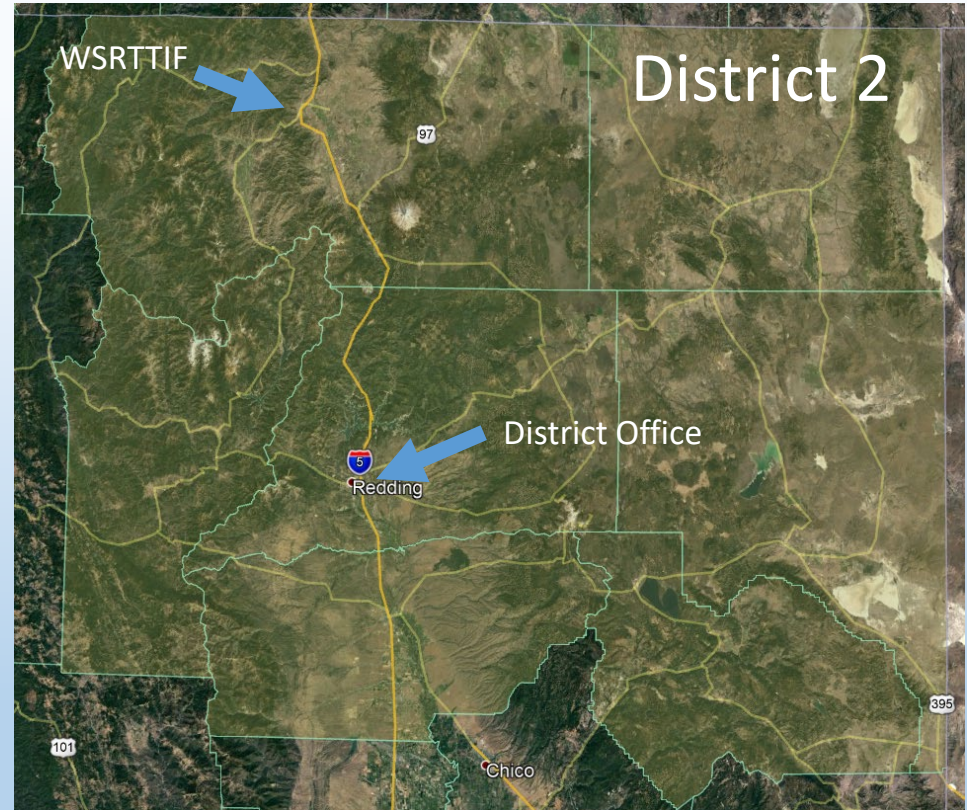
VPH – Vehicles per hour

WAN – Wide Area Network

WSRTTIF – Western States Rural Transportation Technology Implementers Forum

Background

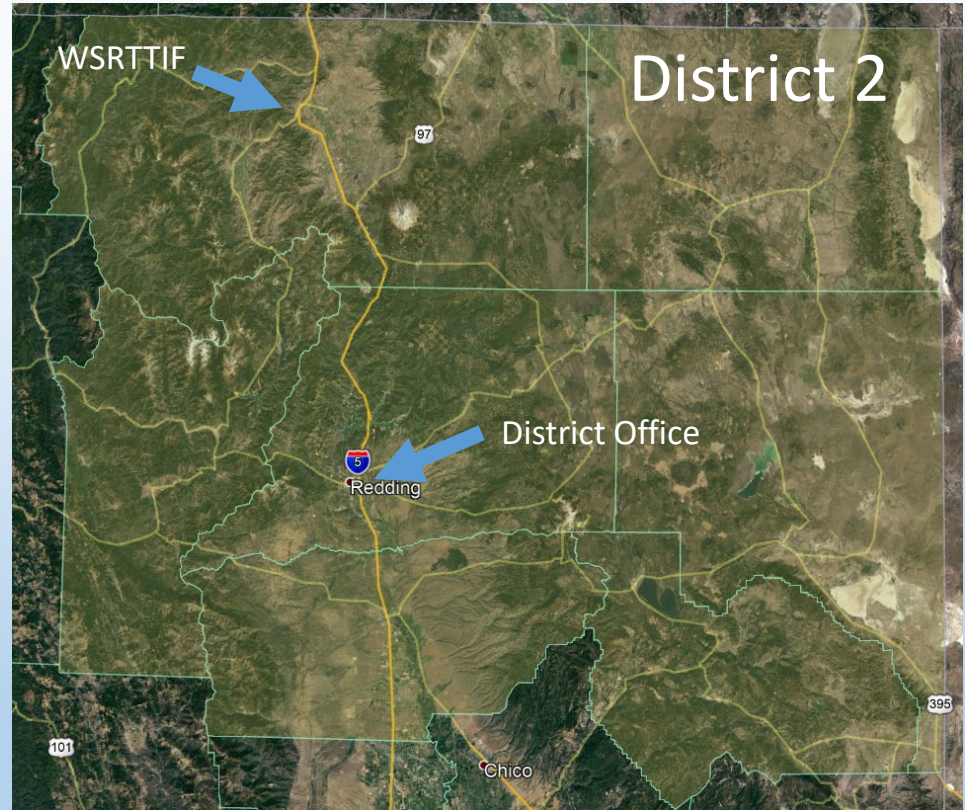
District 2



Background

District 2

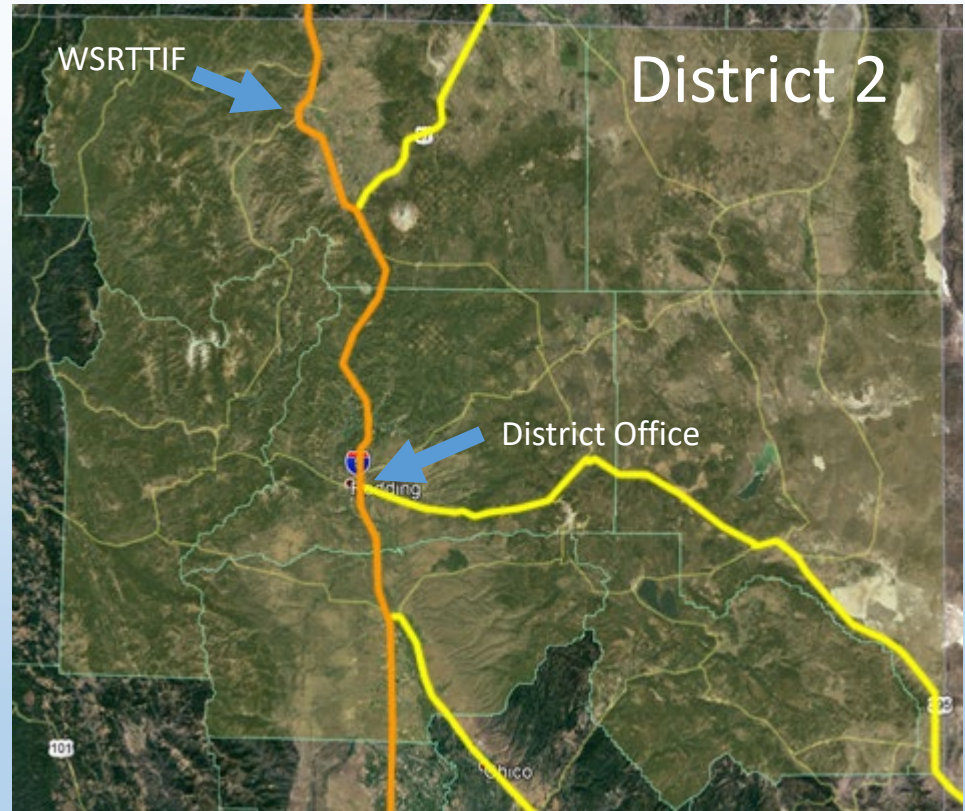
- Very Rural District
- Winter Operations
 - 33 passes/summits
 - 172 chain control signs



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 south 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

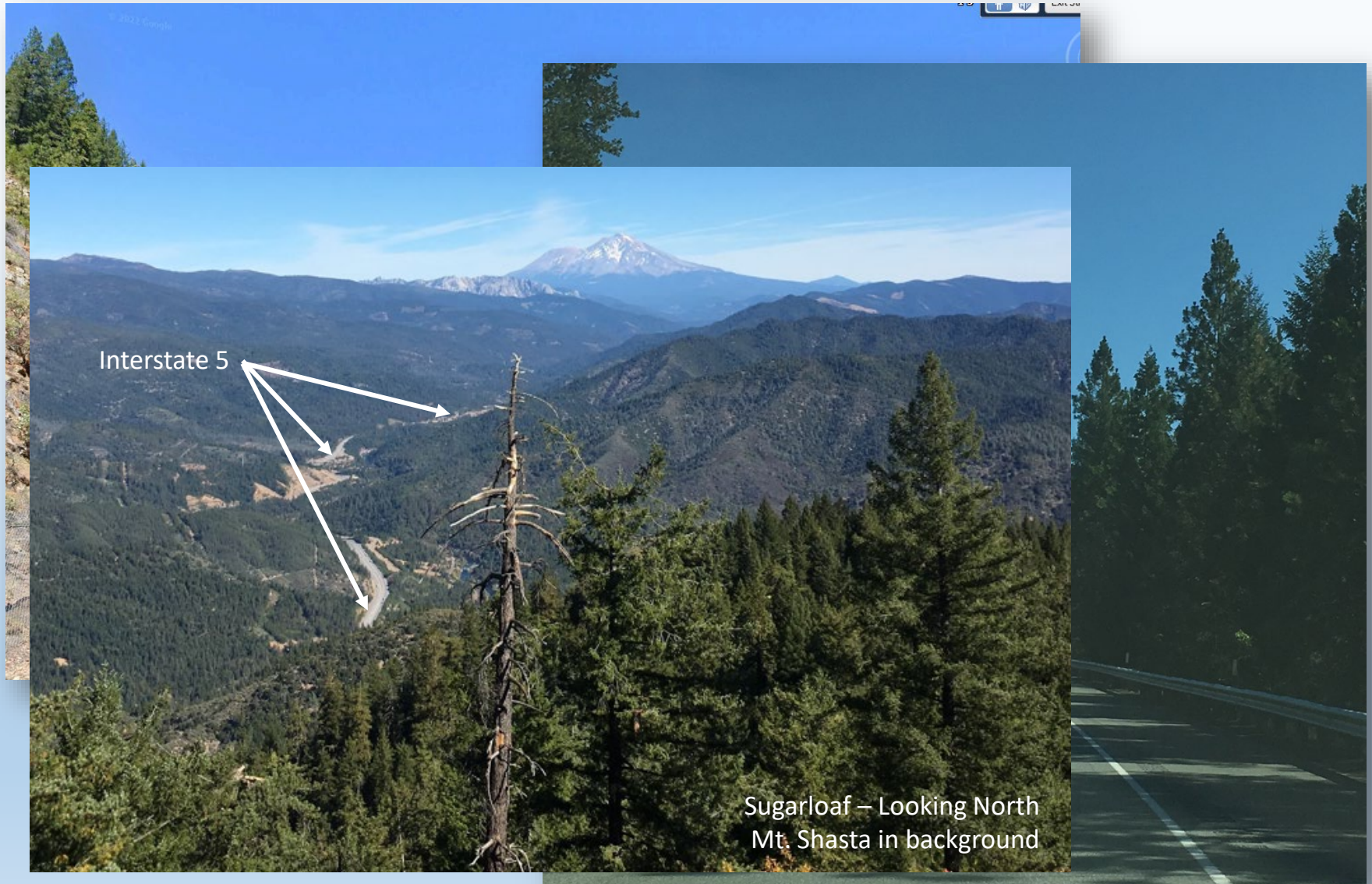
Sacramento River Canyon



Interstate 5 Castella – Looking North
Mt. Shasta in background

Background

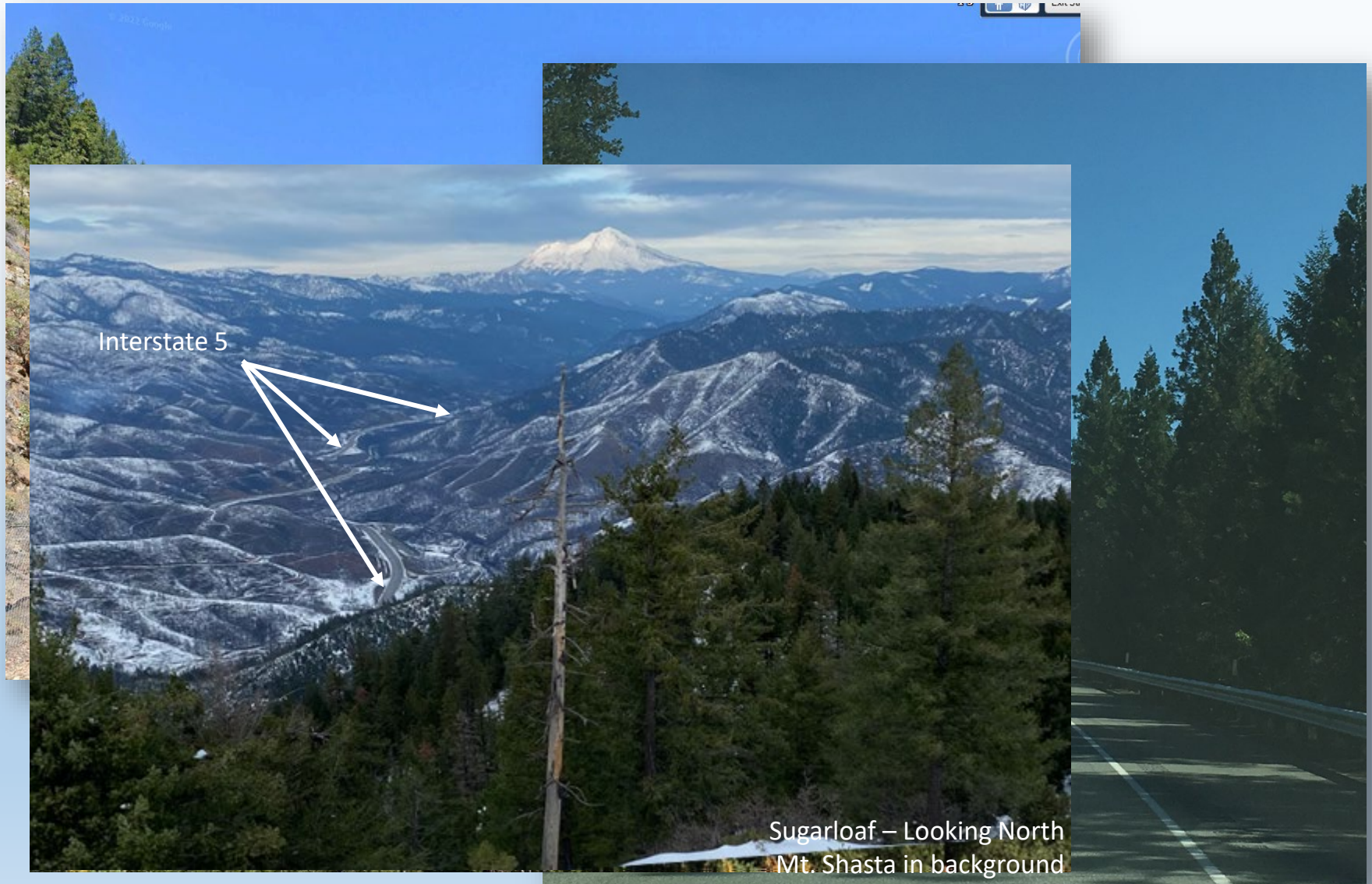
Sacramento River Canyon



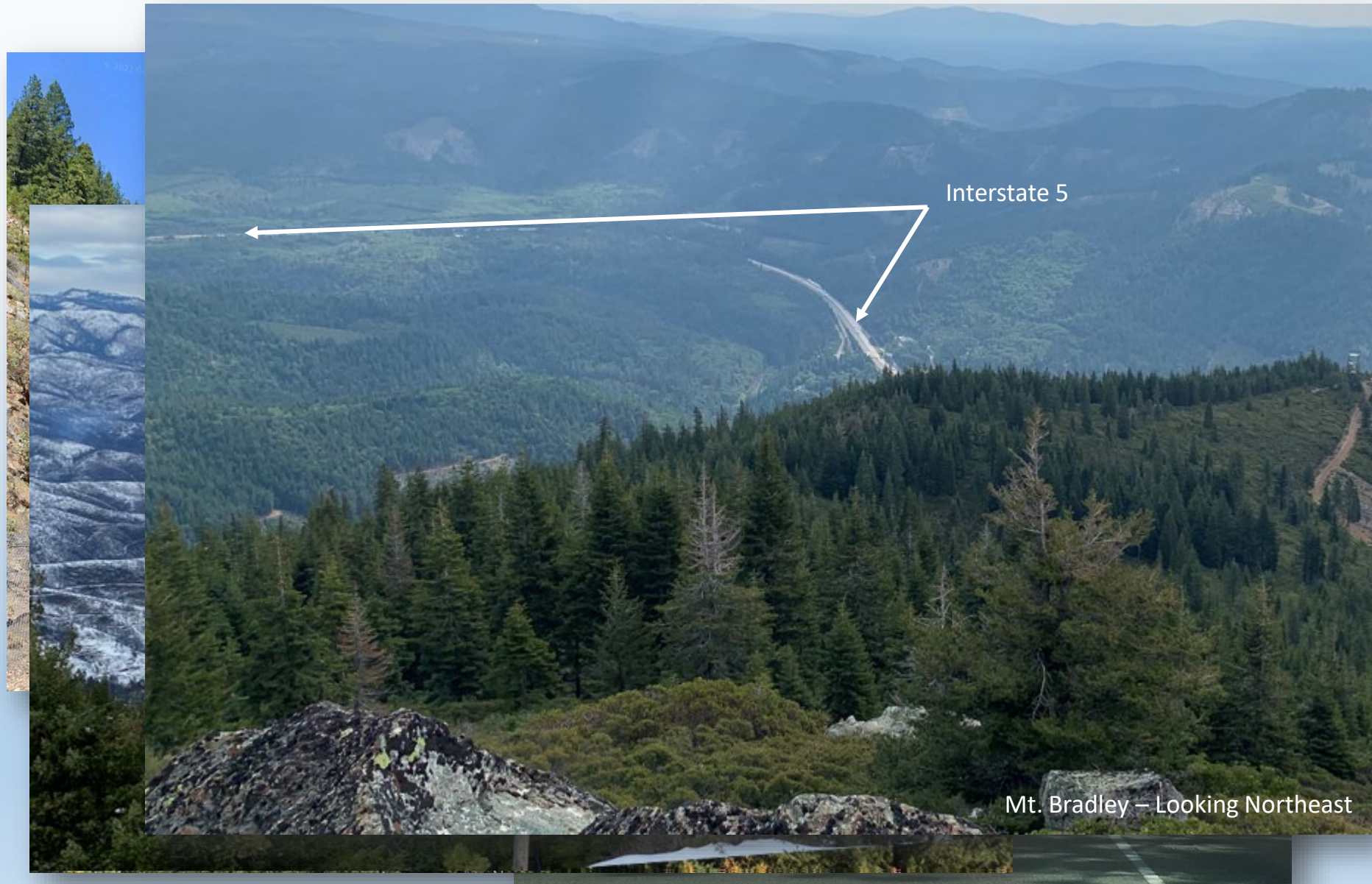
Sugarloaf – Looking North
Mt. Shasta in background

Background

Sacramento River Canyon



Background



Background

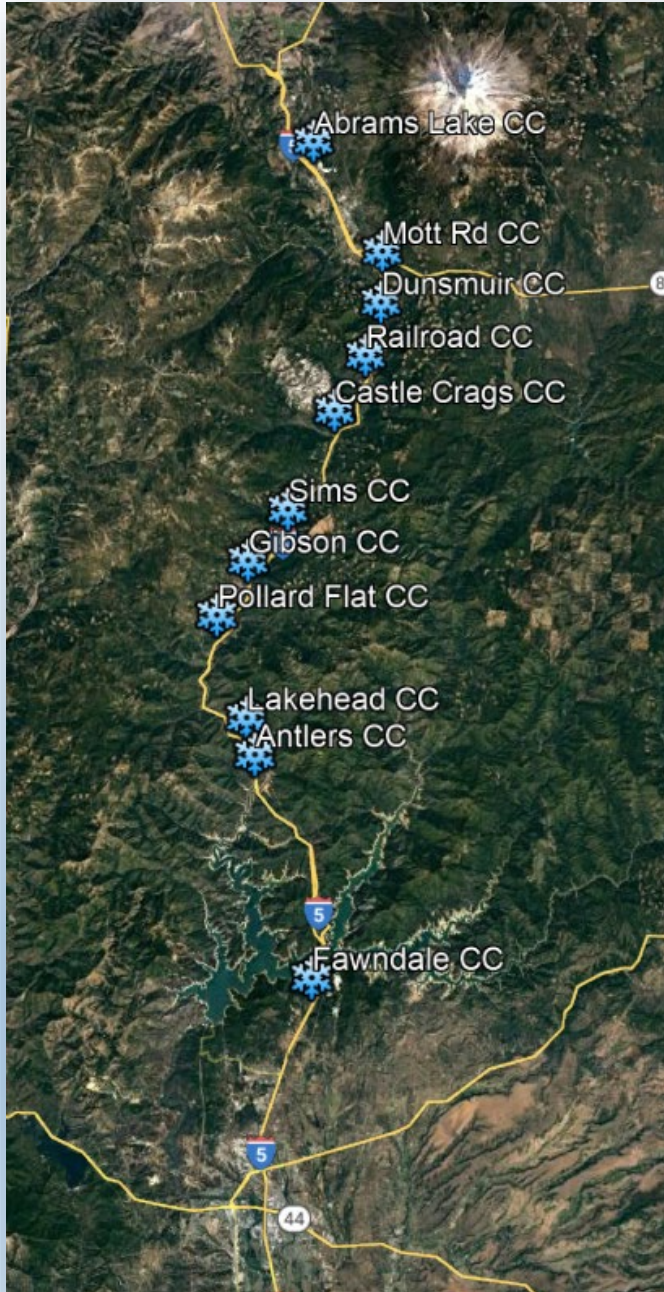


Interstate 5

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

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 - **Truck Hold (TH)** – All truck trailer combinations are being held at the chain **check point** due to accidents or weather-related conditions
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Check Point?

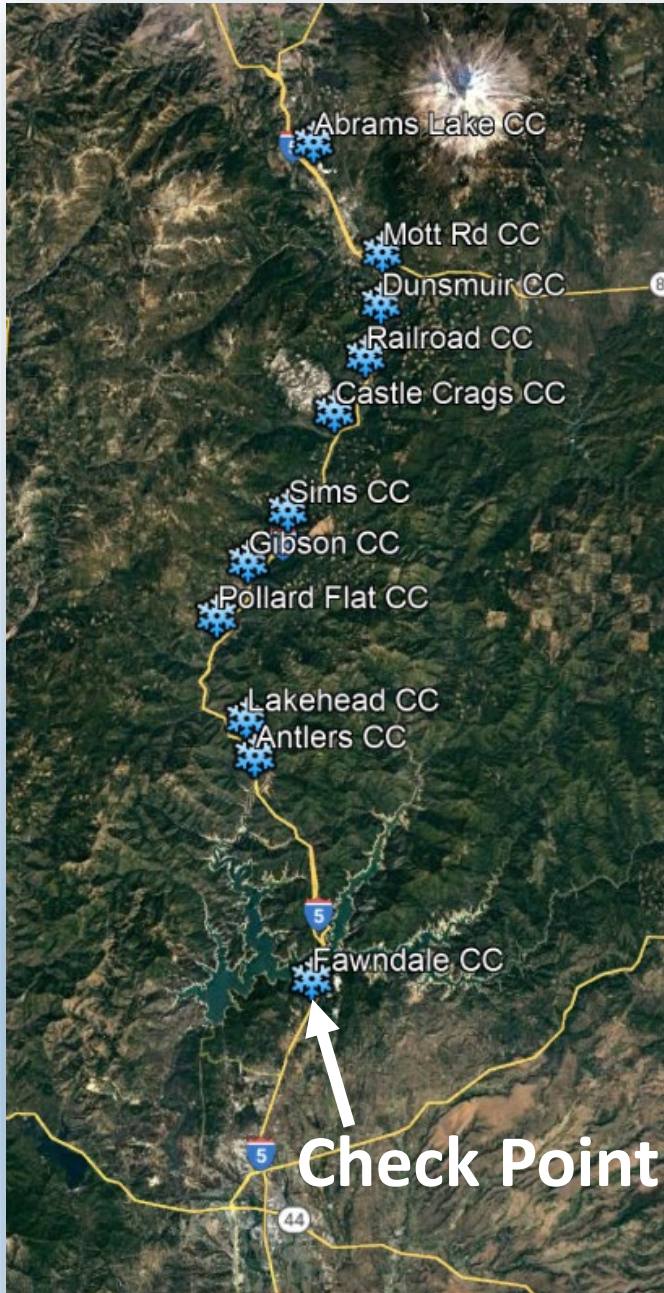
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Background

Check Point

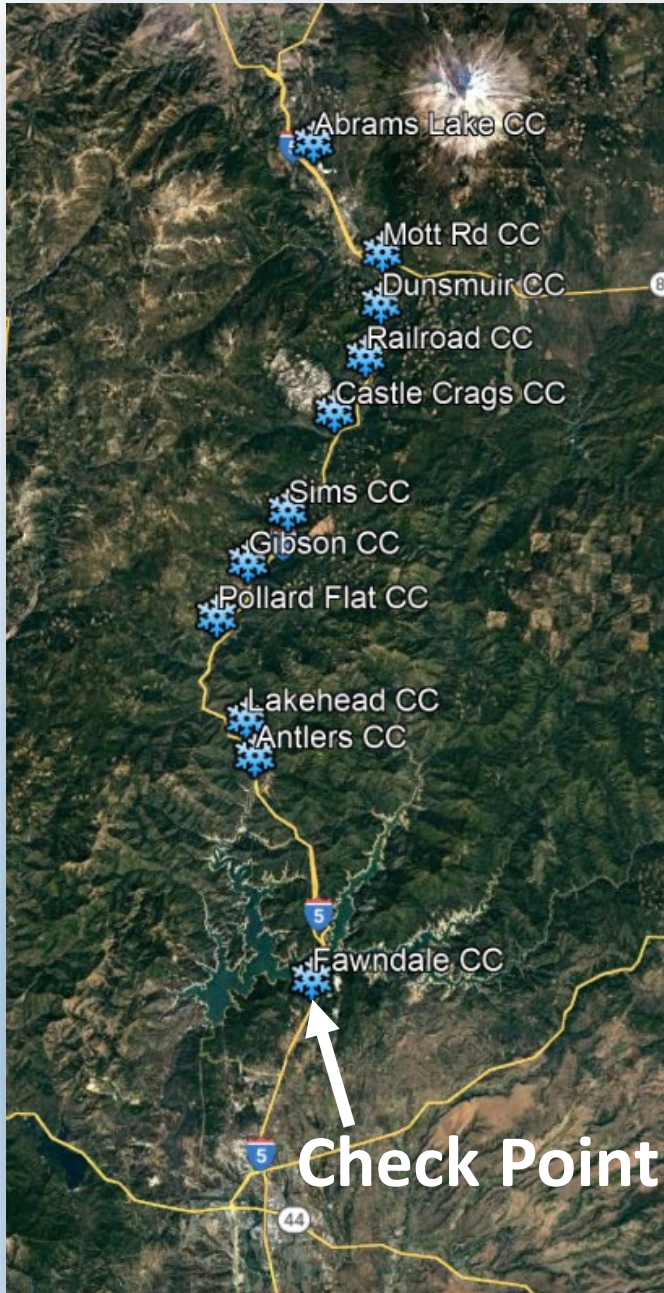
- Ensures motorists have proper traction devices before entering the Sacramento River Canyon
- Allows for metering vehicles when chain conditions are active



Background

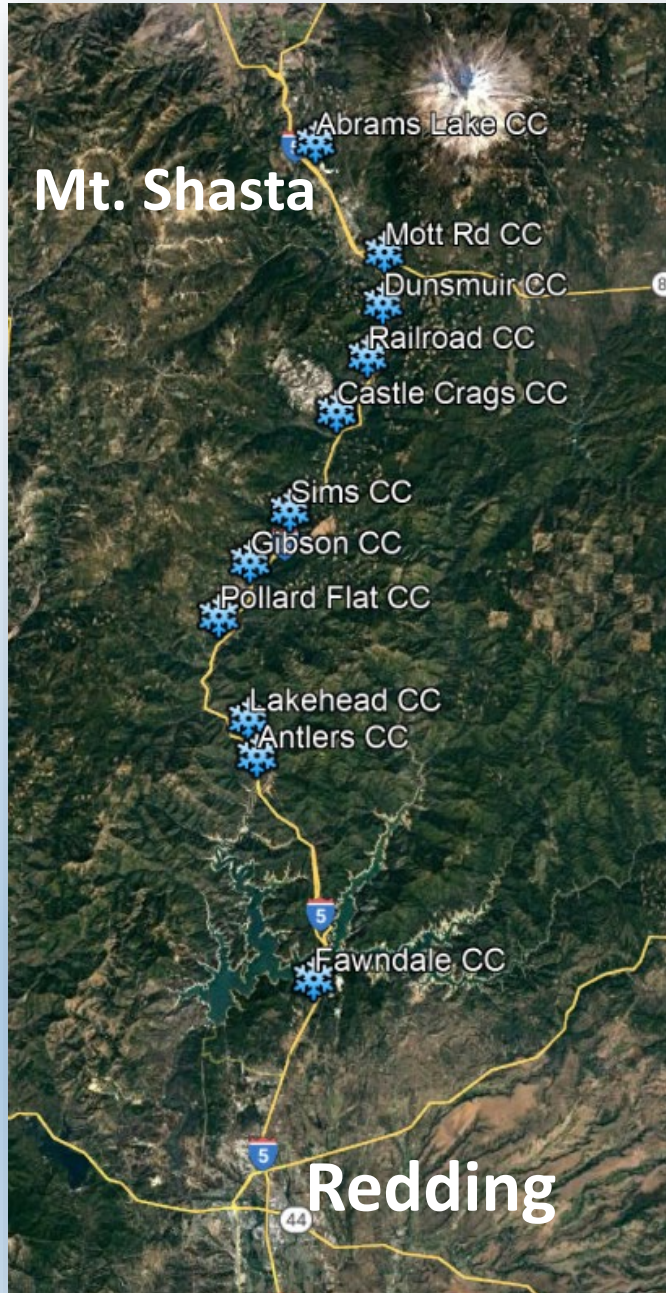
Check Point

- 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?



Thursday, January 28, 2021 09:59:02 PST

Background

So, what's the problem?


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



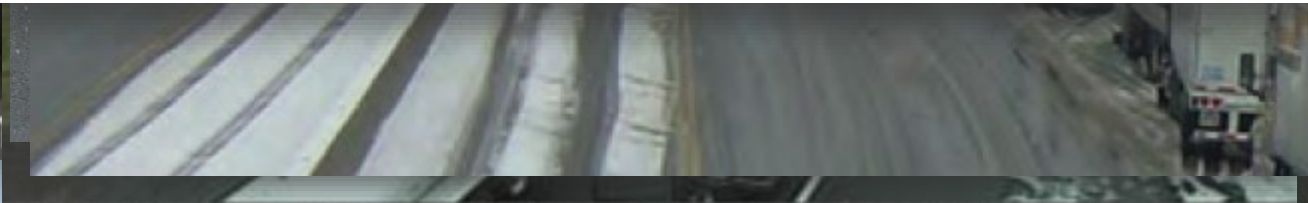
Background

So, what's the problem?

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



"So what happened is that this morning around 2 a.m. there was a break in the weather and we had good driving conditions with chains being required (on) northbound I-5 from Pollard Flat north so Caltrans went ahead and tried to open it up and screen vehicles to make sure they had the chains," said Jason Morton, Public Information Officer with CHP Redding.




Thursday, January 28, 2021 09:59:02 PST

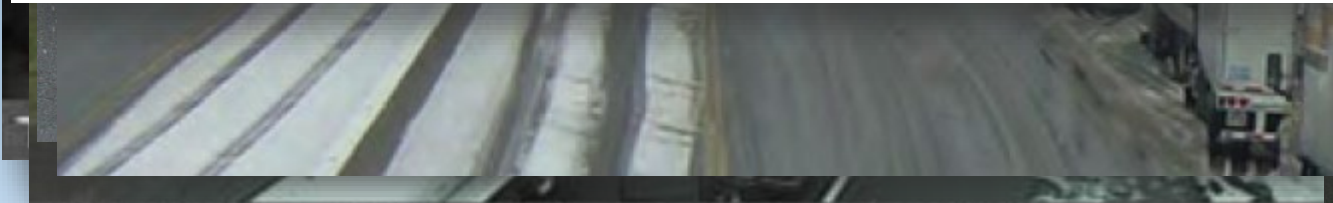
Background

So, what's the problem?

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



"So what happened is that this morning around 2 a.m. there was a blizzard in the weather and we had good driving conditions with chains being required (on) northbound I-5 from Pollard Flat north so Caltrans went ahead and tried to open it up and screen vehicles to make sure they had the chains," said Jason Morton, Public Information Officer with CHP Redding.



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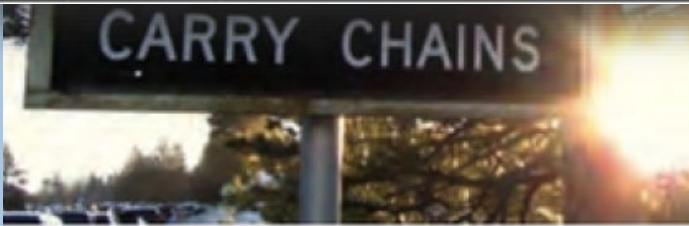
So, what's the problem?



- 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?



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

Background

So, what's the problem?



- Queuing Impacts
 - Vehicles not needing to be screen
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 - Parking on Shoulders
 - Parking on On/Off Ramps
- Queuing extends several miles
 - Screening location
 - 1-mile queue



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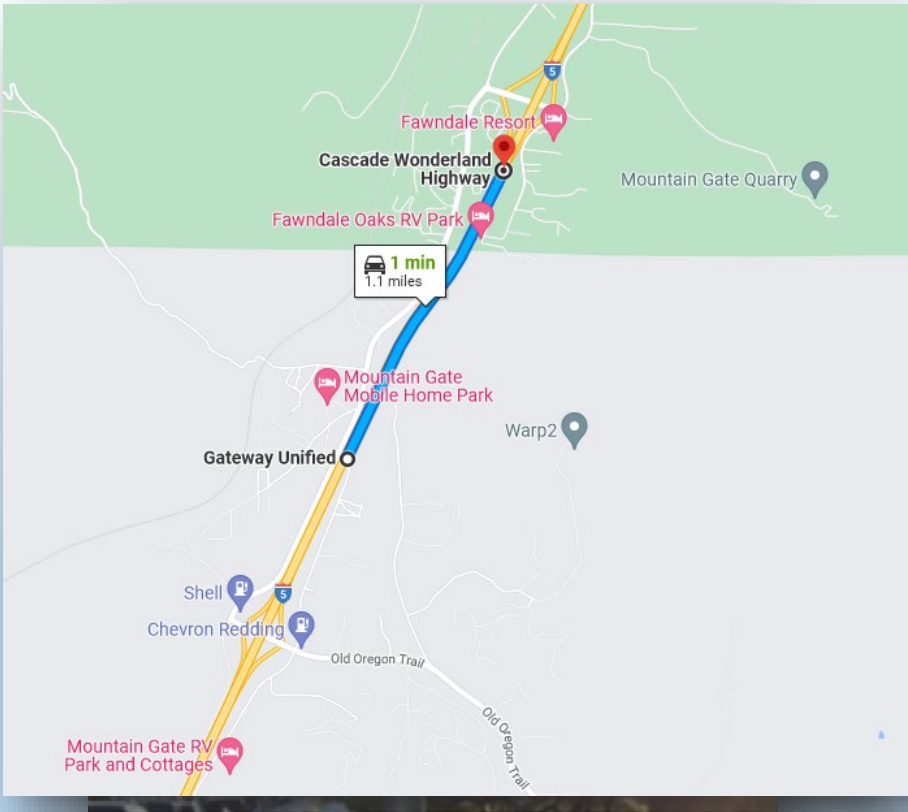
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- Queuing Impacts

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- Queuing extends several miles

- Screening location
- 1-mile queue



Background

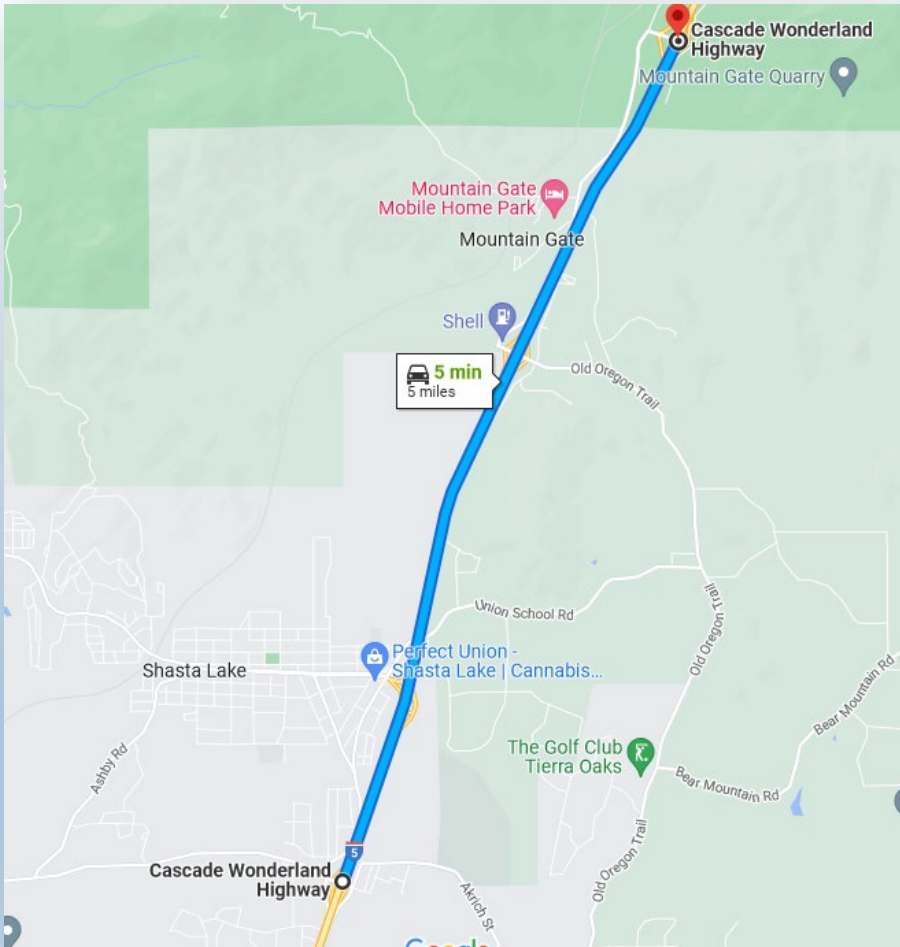
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- Queuing extends several miles
 - Screening location
 - 1-mile queue
 - 5-mile queue

Background

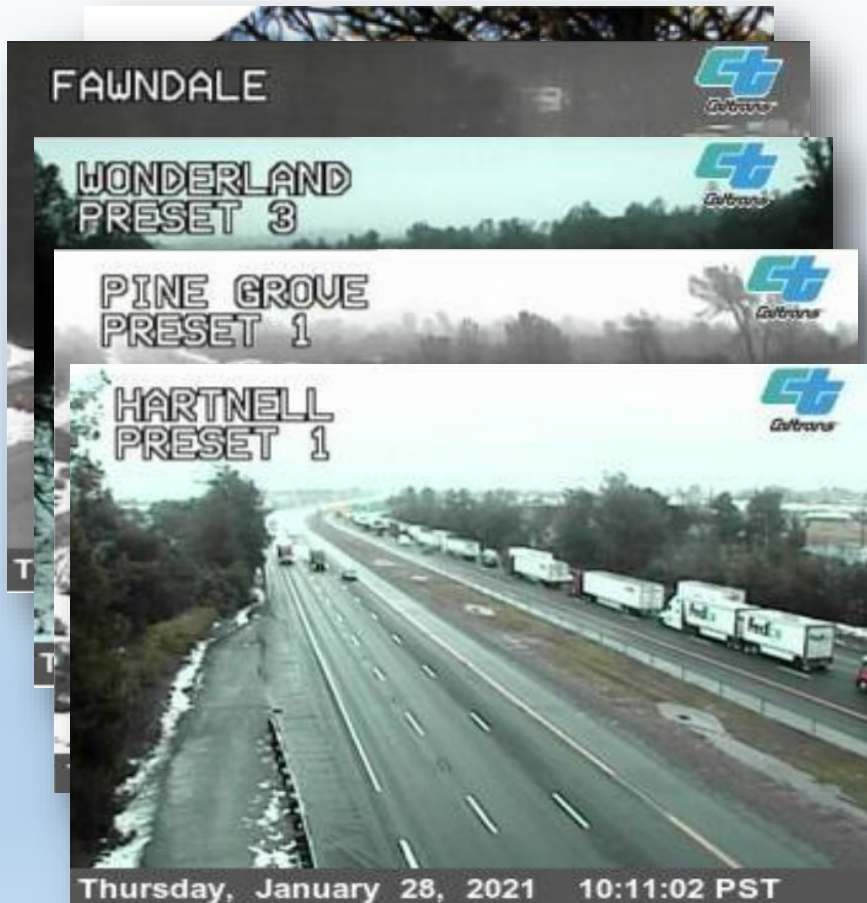
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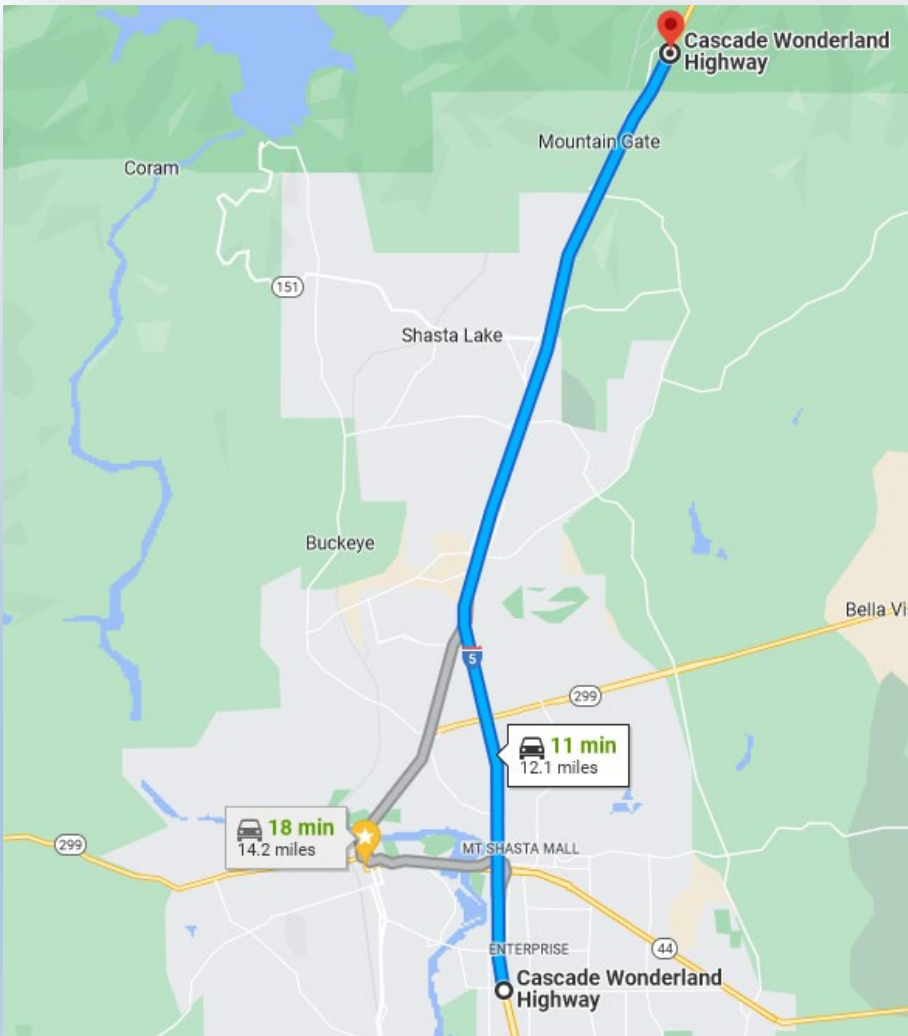
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- Queuing Impacts
 - Vehicles not needing to be screen
 - First Responders
 - Snow removal operations
 - Communities
 - Traffic Hazards
 - Parking on Shoulders
 - Parking on On/Off Ramps
- Queuing extends several miles
 - Screening location
 - 1-mile queue
 - 5-mile queue
 - 12-mile queue

Background

So, what's the problem?



- Queuing Impacts

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

- Queuing extends several miles

- Screening location
- 1-mile queue
- 5-mile queue
- 12-mile queue

Background

Look Familiar?

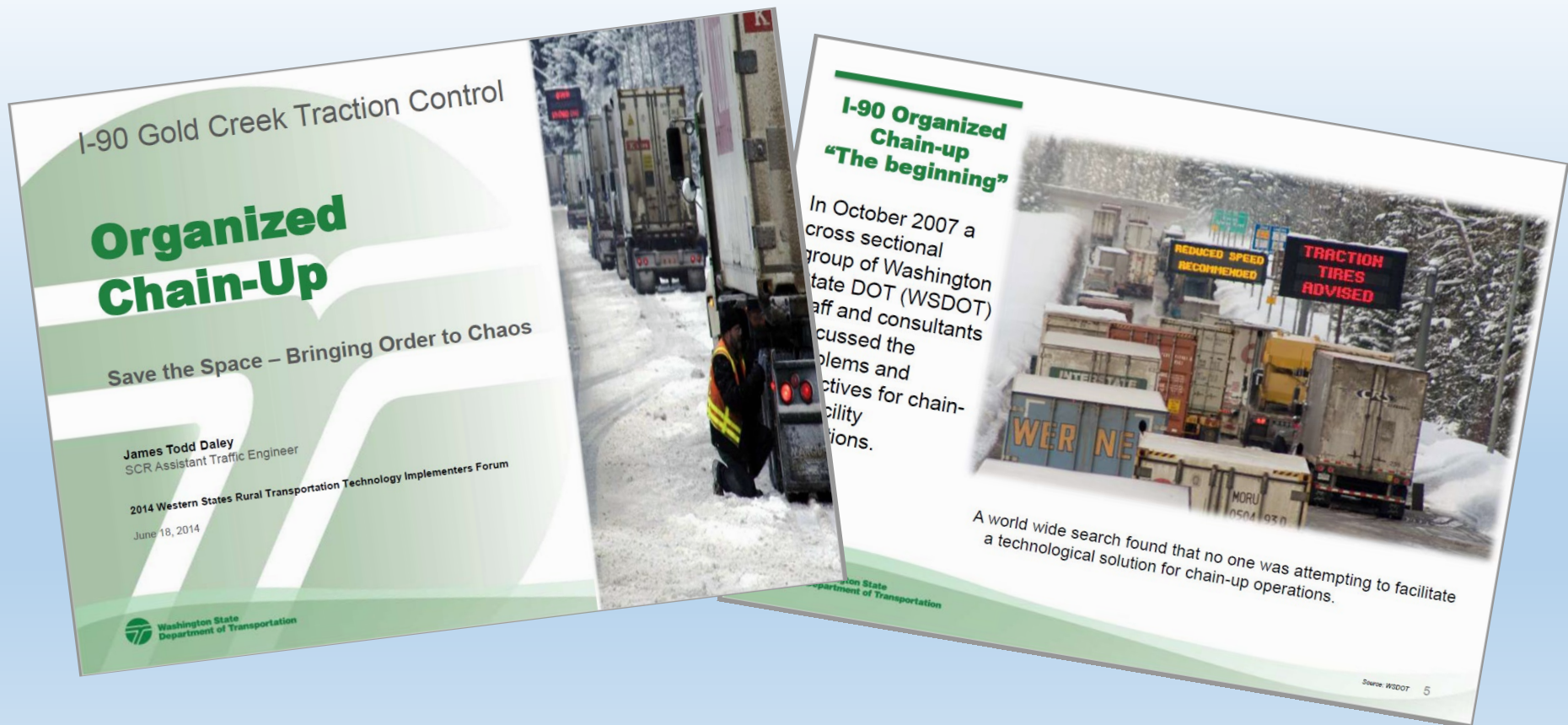


*WSDOT I-90 Snoqualmie Pass

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



Interstate 5

Fawndale OC

Northbound Check point

Fawndale Exit

Fawndale CC

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



Fawndale CC

Operations

How it was before / Fawndale Check point

- Vehicle Screening

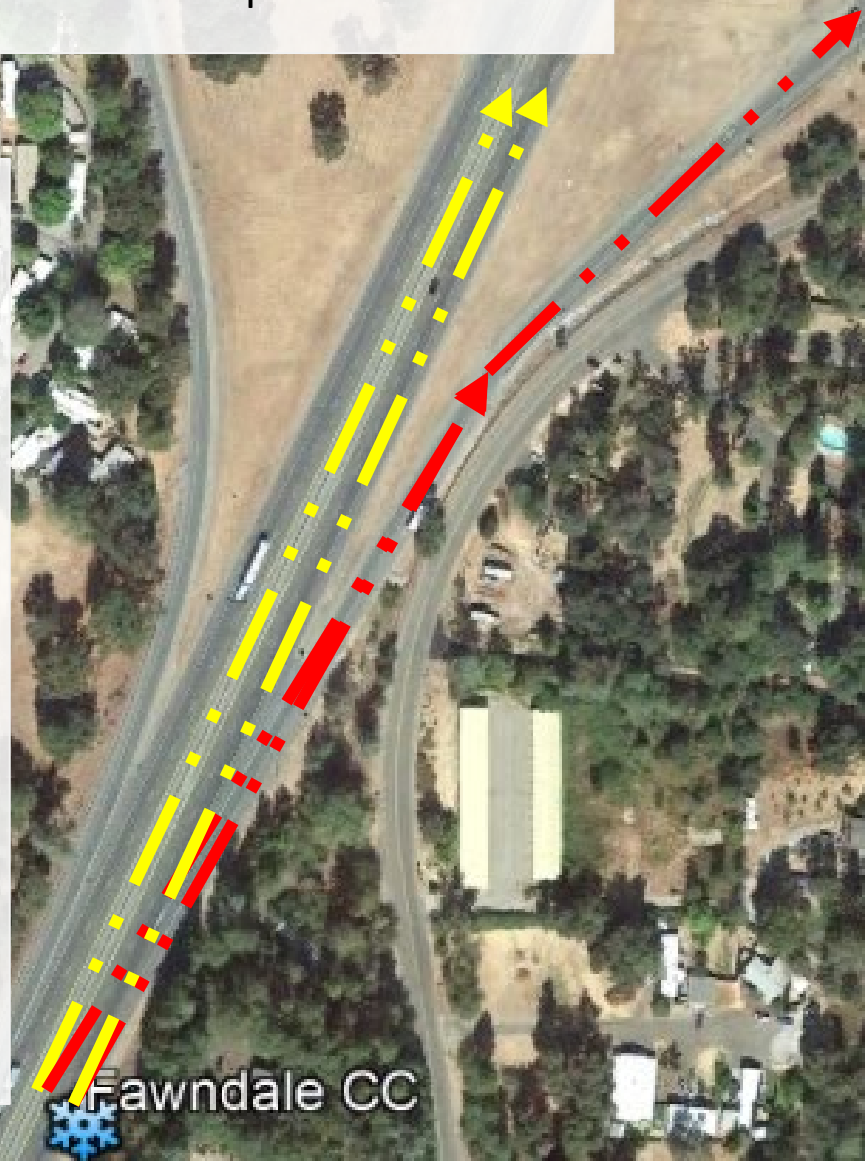
- All vehicles are stopped and checked for chains
- All vehicles are metered
- All vehicles without chains are turned around

Fawndale CC

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

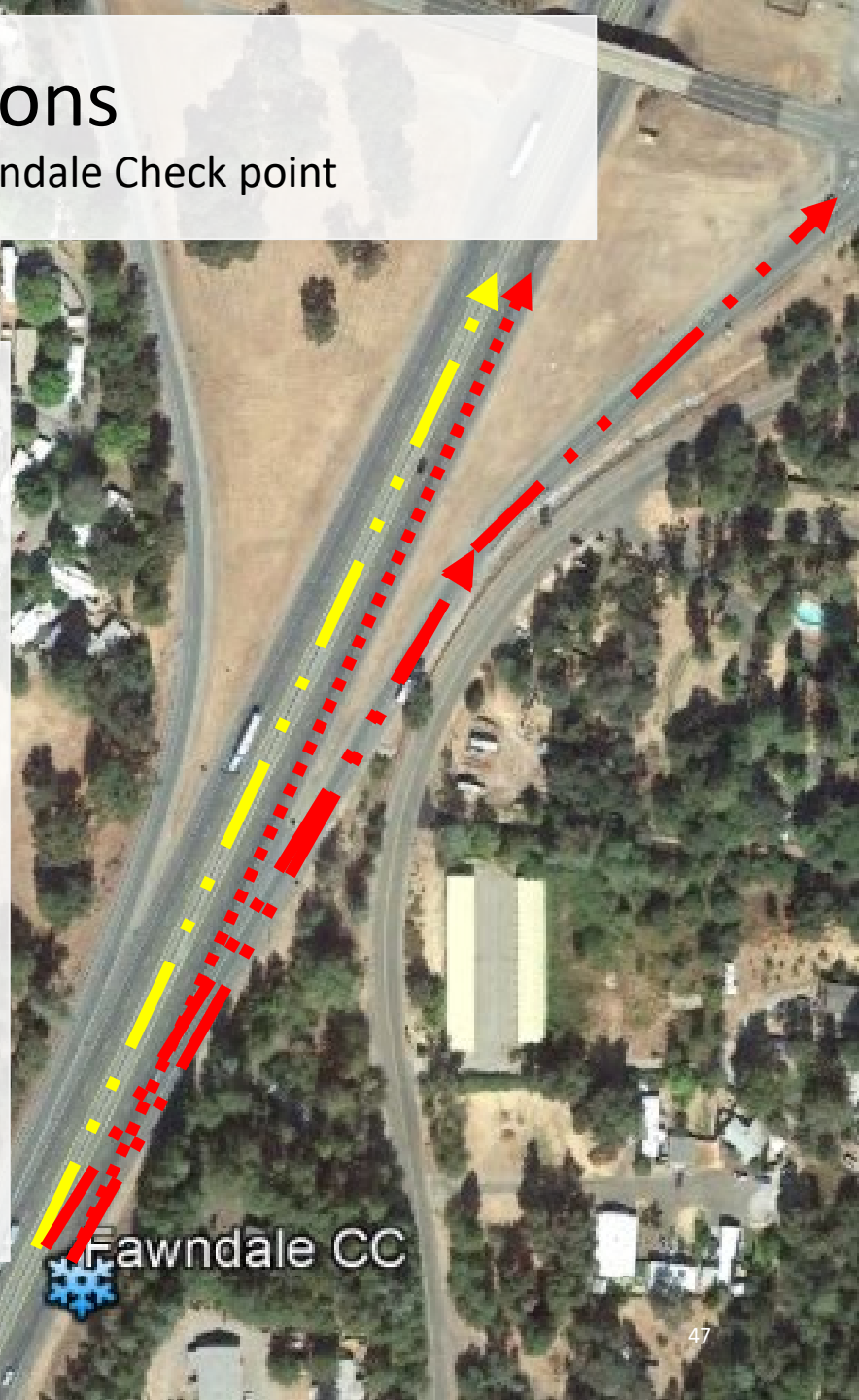


Operations

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

Fawndale CC



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

* MAINT NEEDS

- METER TRUCKS IN #2 LN
- NO NEED TO ASK TRUCKS IF THEY'RE CARRYING CHAINS; ~~THE~~ PROFESSIONAL DRIVERS; WILL BE TICKETED IN CANYON IF NO CHAINS
- WISH TO REMAIN ON PYMT (IN PERSON) WHEN ASKING VEHICLES IF THEY'RE CARRYING CHAINS
- STOP VEHICLES AND TRUCKS ON MAINLINE; TRUCKS TOO OFTEN STALL ON INCLINE GRADE @ PAWNADE OFFRMP

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

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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

* MAINT NEEDS

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Need for Improvement

Early Concept

* CONCEPT THOUGHTS

* USE SIMILAR FIELD ELEMENTS USED ^{TODAY} ~~LC~~
COTTONWOOD T.I.F. (SEE PHOTOS)]

- SEE JOE'S NEW FAUNDALE CONCEPT

* TRUCKER'S #2 LN METER TO BE SET ON A TIMER
WITH MANUAL OVERRIDE TO ~~STOP~~ HOLD TRUCKS SO
THAT ~~THAT~~ VEHICLE'S MAY CROSS OVER TO EXIT I-5
WHEN NECESSARY

* WORKER SAFETY \Rightarrow CONCEPT REMOVES 2 MAINT. WORKERS
FROM #2 LN

* ~~NO PASS~~
EXIT T-5 IF NOT CARRYING CHAINS 2 OF 7

Need for Improvement

Early Concept

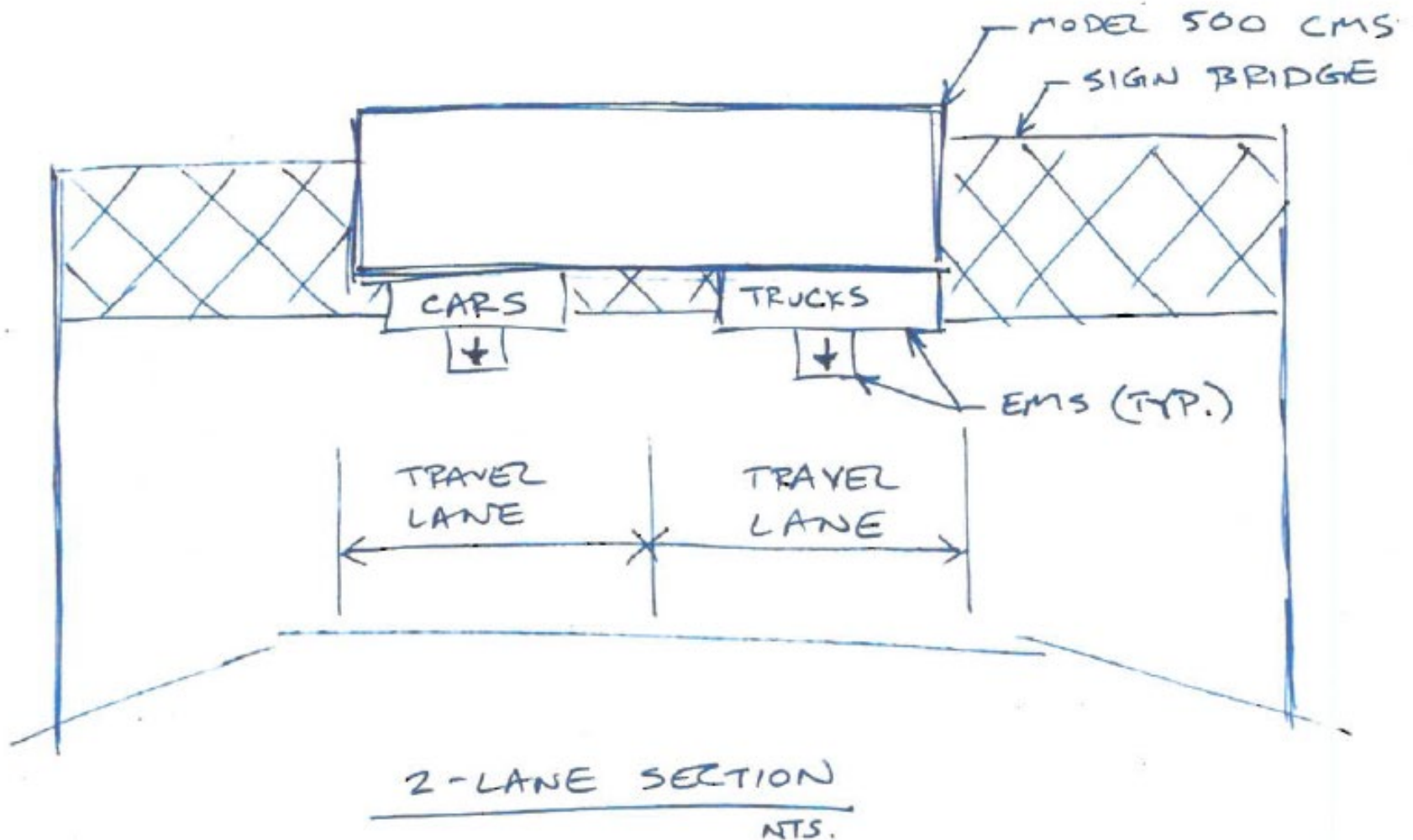
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- * ~~NO PASS~~ EXIT T-5 IF NOT CARRYING CHAINS 2 OF 2

- 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

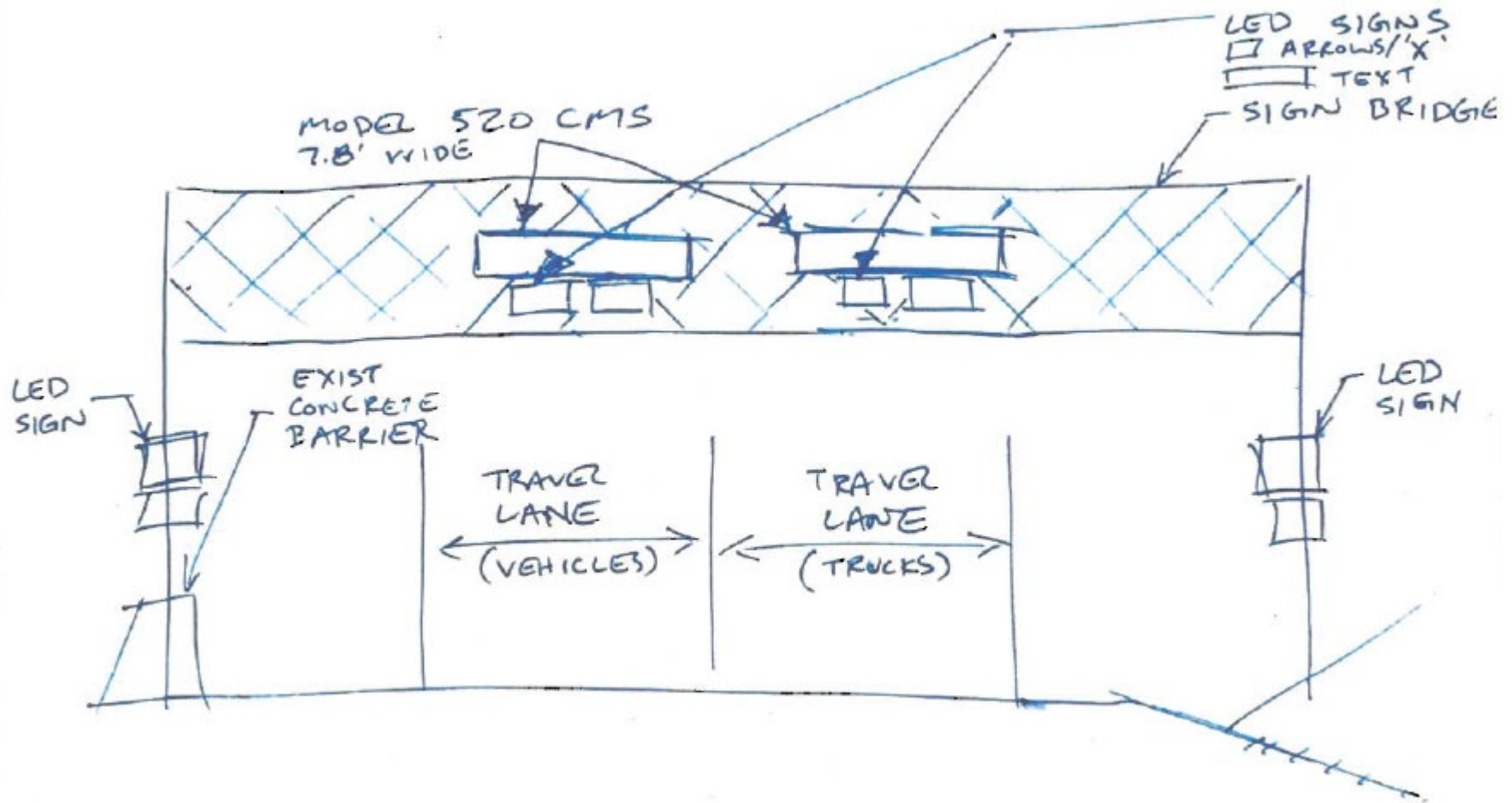
Need for Improvement

Early Concept



Need for Improvement

Early Concept



Design by Committee



Welcome the Design Committee!

Design by Committee

Sign Messages

- Who determines sign message?
TMC / Maintenance

**I-5 CLOSED AHEAD
TAKE EXIT 689
AT FAWNDALE RD**

**I-5 CLOSED
DUE TO SNOW
TAKE NEXT EXIT**

**CHAIN CHECK
TRUCKS / VEHICLES
WITH TRAILERS**

**IF NOT CARRYING
CHAINS
TAKE OFF RAMP**

Design by Committee

Controlling Elements

- Who determines sign message?

TMC / Maintenance

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

VEHICLES



TRUCKS



Design by Committee

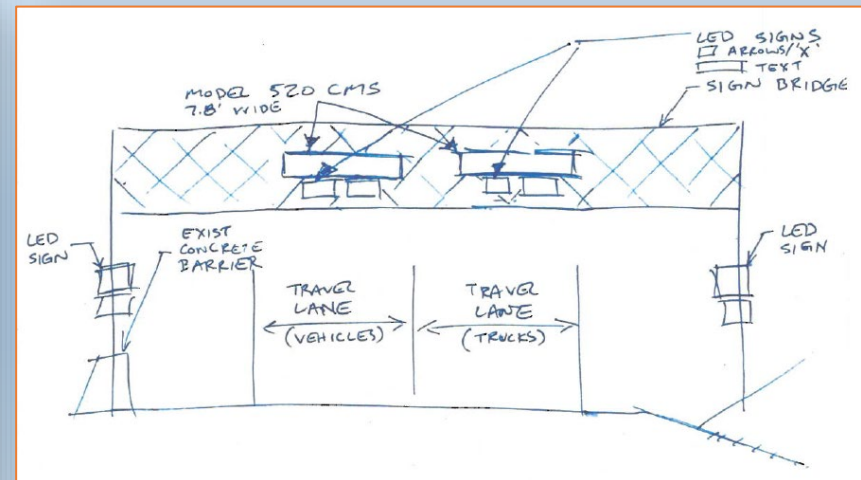
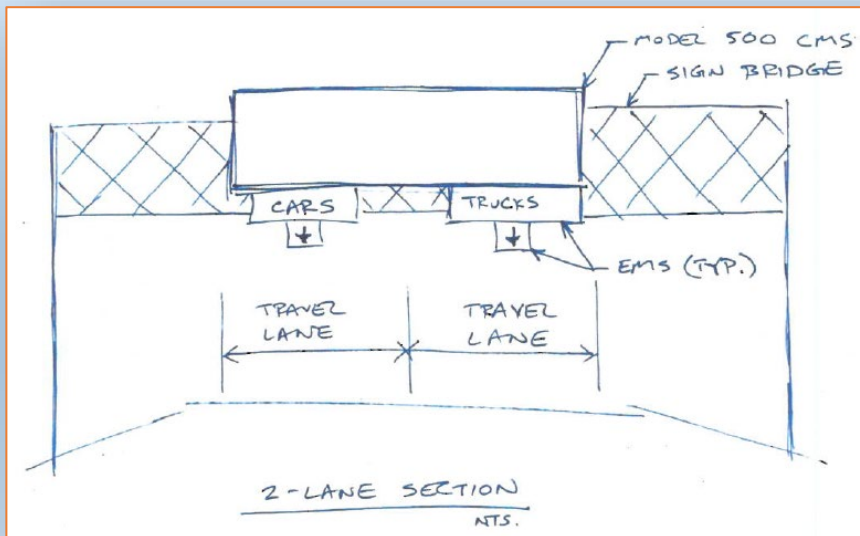
Sign Structure and Layout

- 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**



**I-5 CLOSED
TO TRUCKS
AHEAD**

A rectangular black sign with a white border. The text is white and reads "I-5 CLOSED TO TRUCKS AHEAD" in three lines.

**I-5 CLOSED
TO TRUCKS
AHEAD**

A rectangular black sign with a green border. The text is yellow and reads "I-5 CLOSED TO TRUCKS AHEAD" in three lines.

Design by Committee

Locations

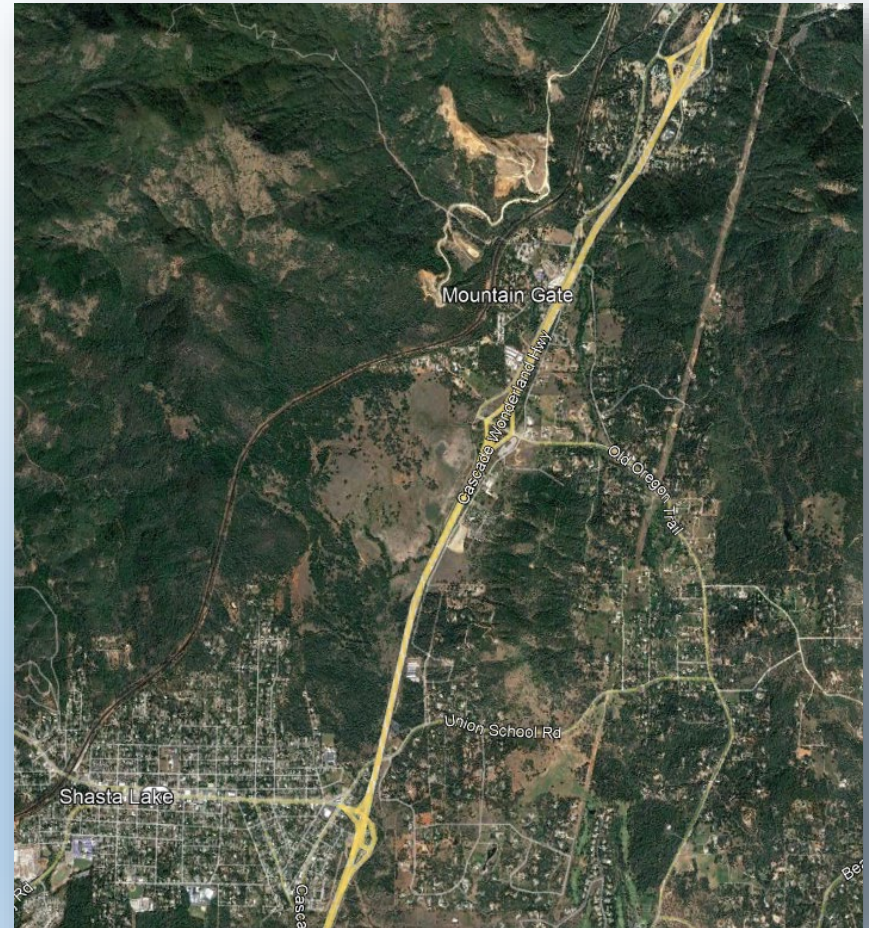
- Who determines sign message?

TMC / Maintenance

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

TMC / ITS

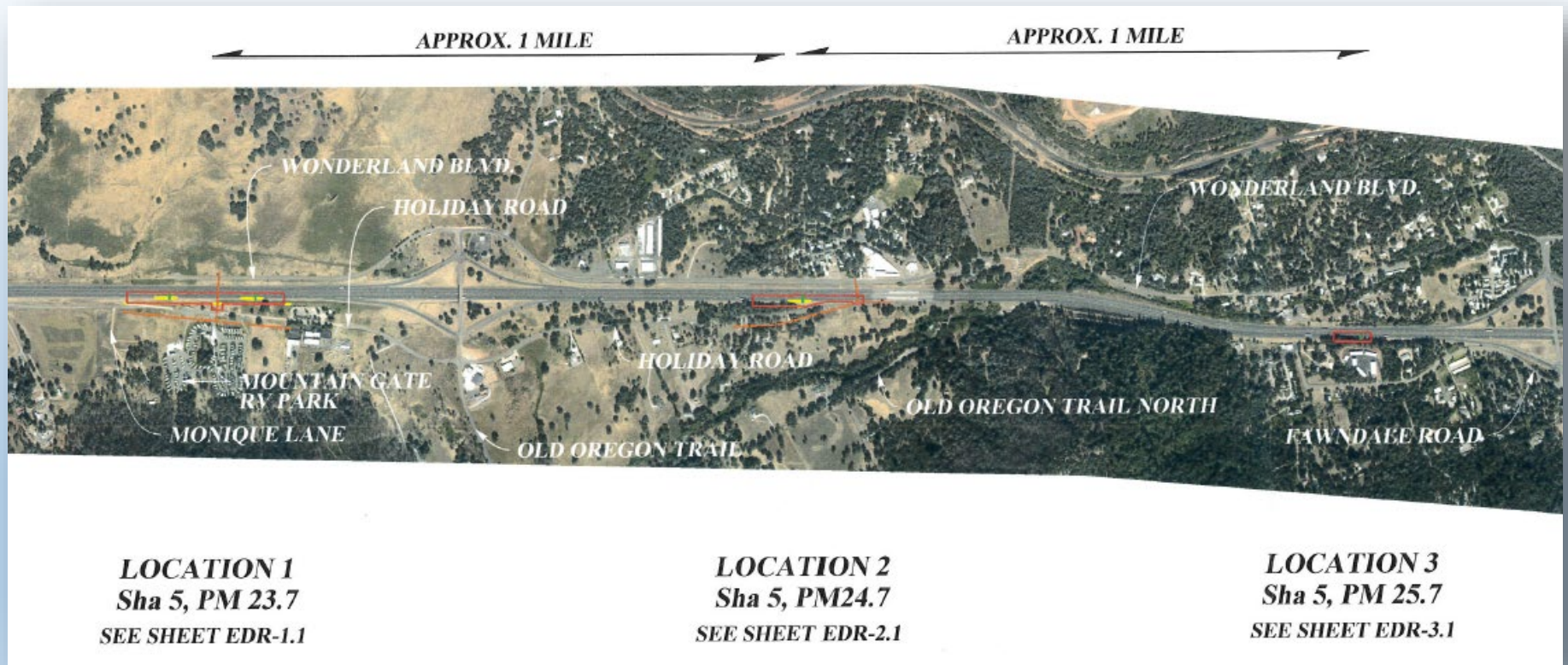
- Who determines regulatory vs advisory? **Sign Group**
- Who determines locations?
 - **TMC (Operations)**
 - **Maintenance (Operations)**
 - **ITS (Communication/Power)**
 - **Design**
 - **Right of Way**



Design by Committee

Locations

- Proposed locations



Design by Committee

Locations

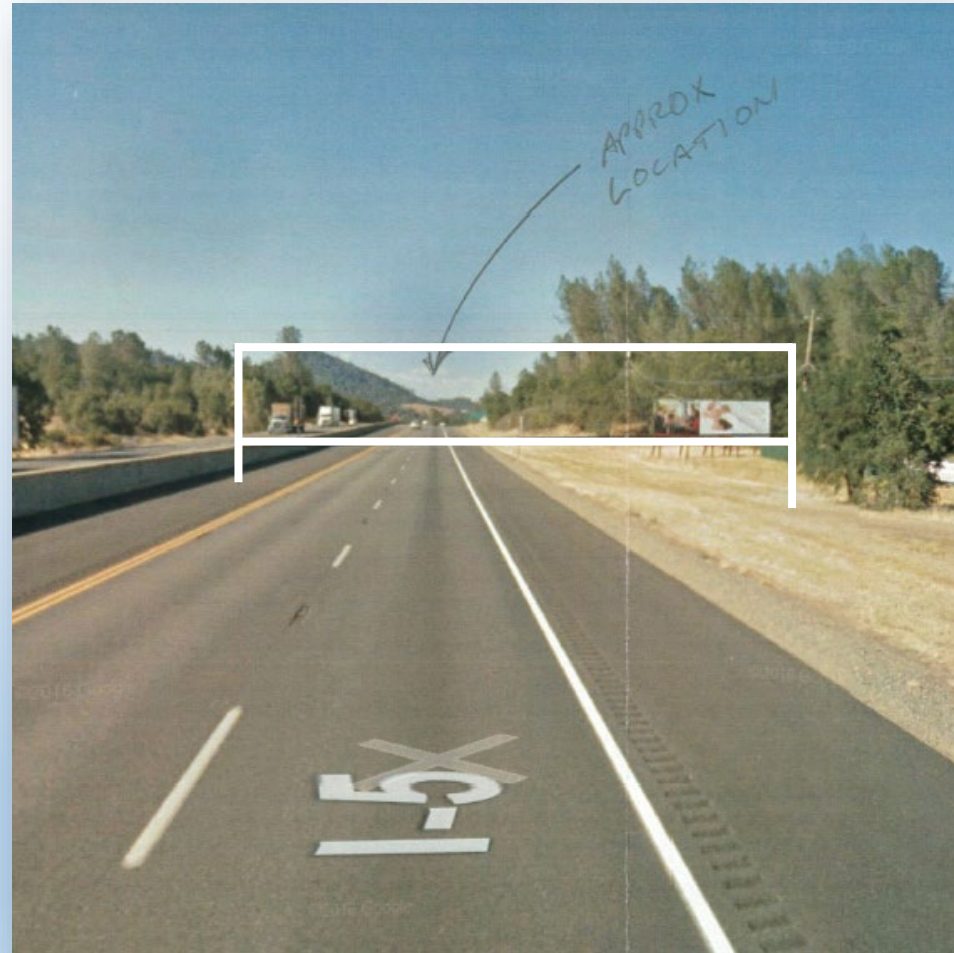
- Proposed locations
- Location Changes – Viewshed Permit Concerns
 - Location 1 was moved 200' north to not interfere with billboard



Design by Committee

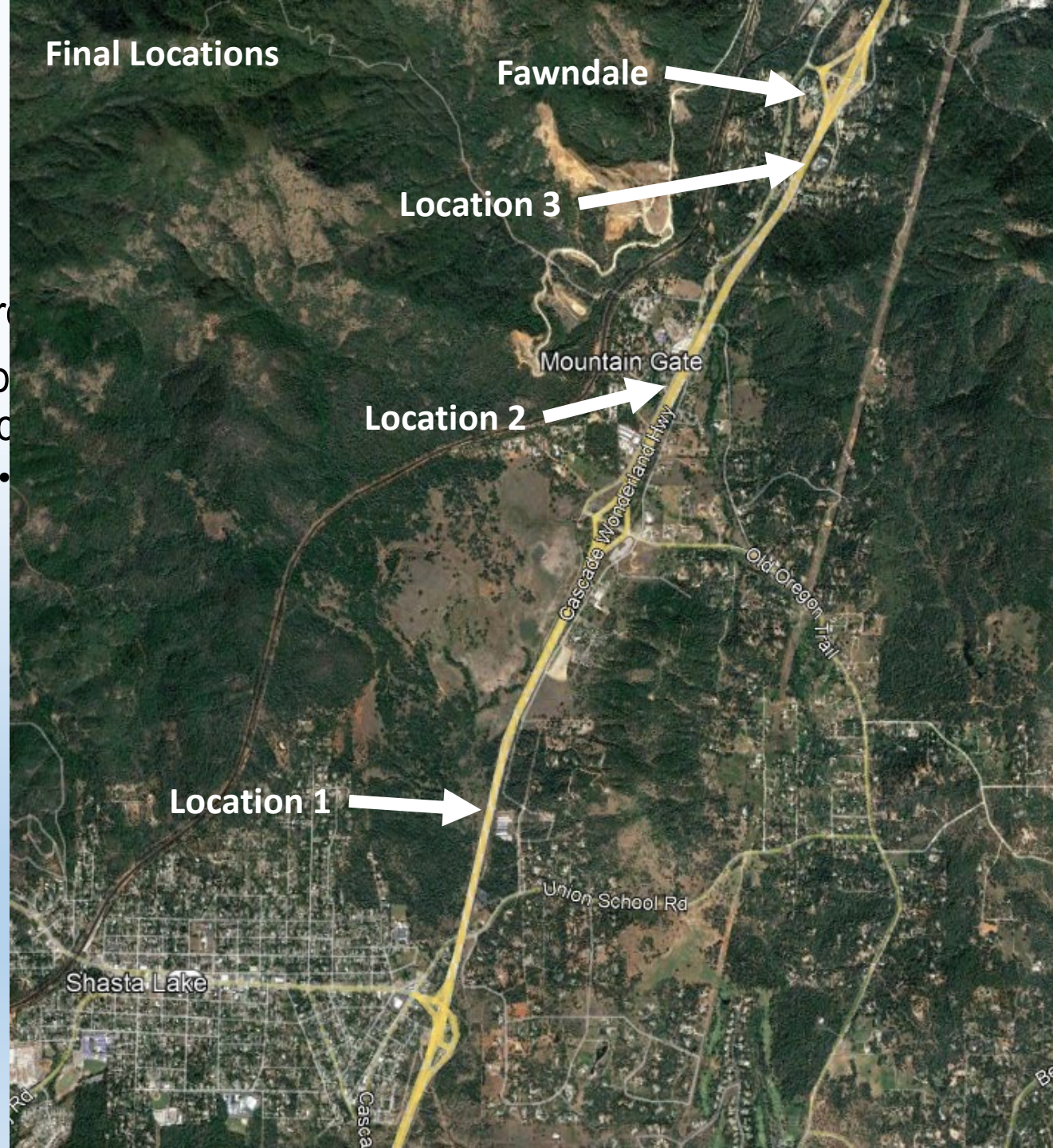
Locations

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Final Locations

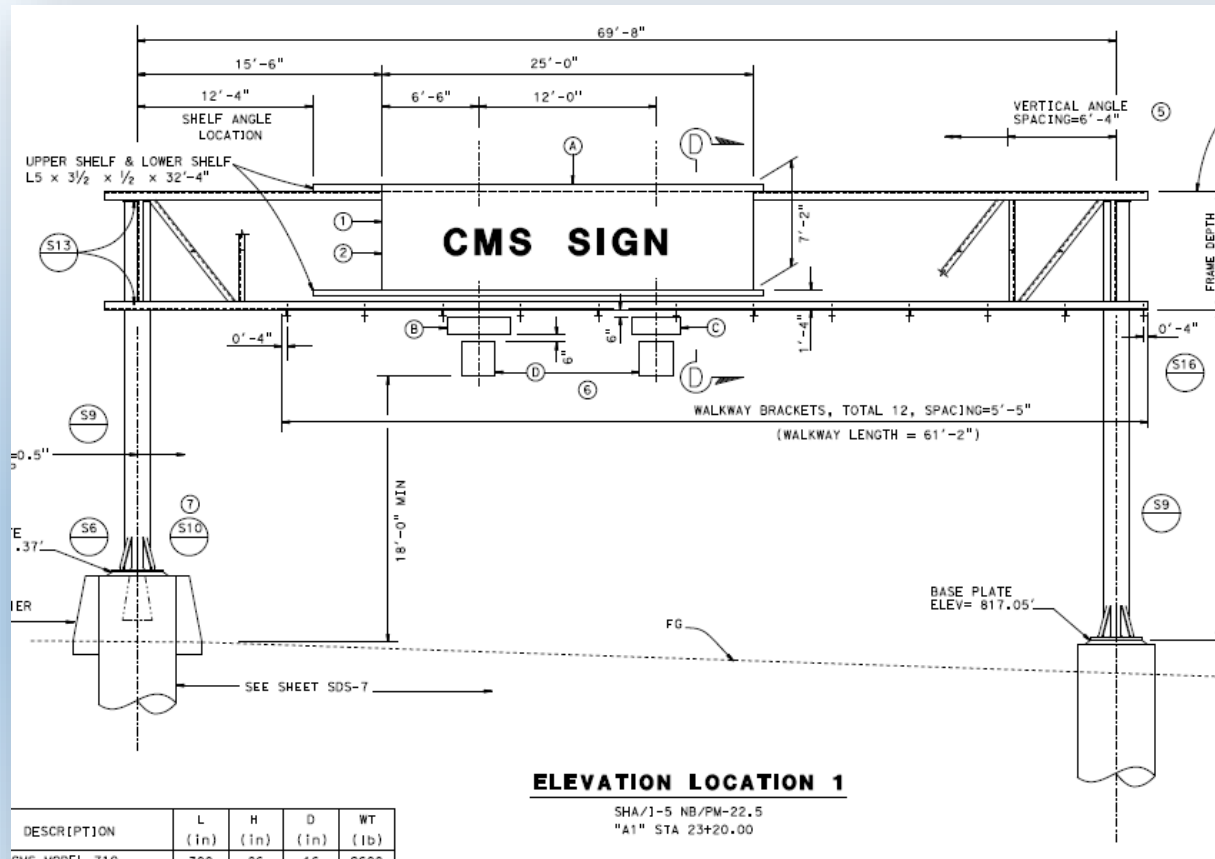
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Design by Committee

Physical Layout

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



Project Design

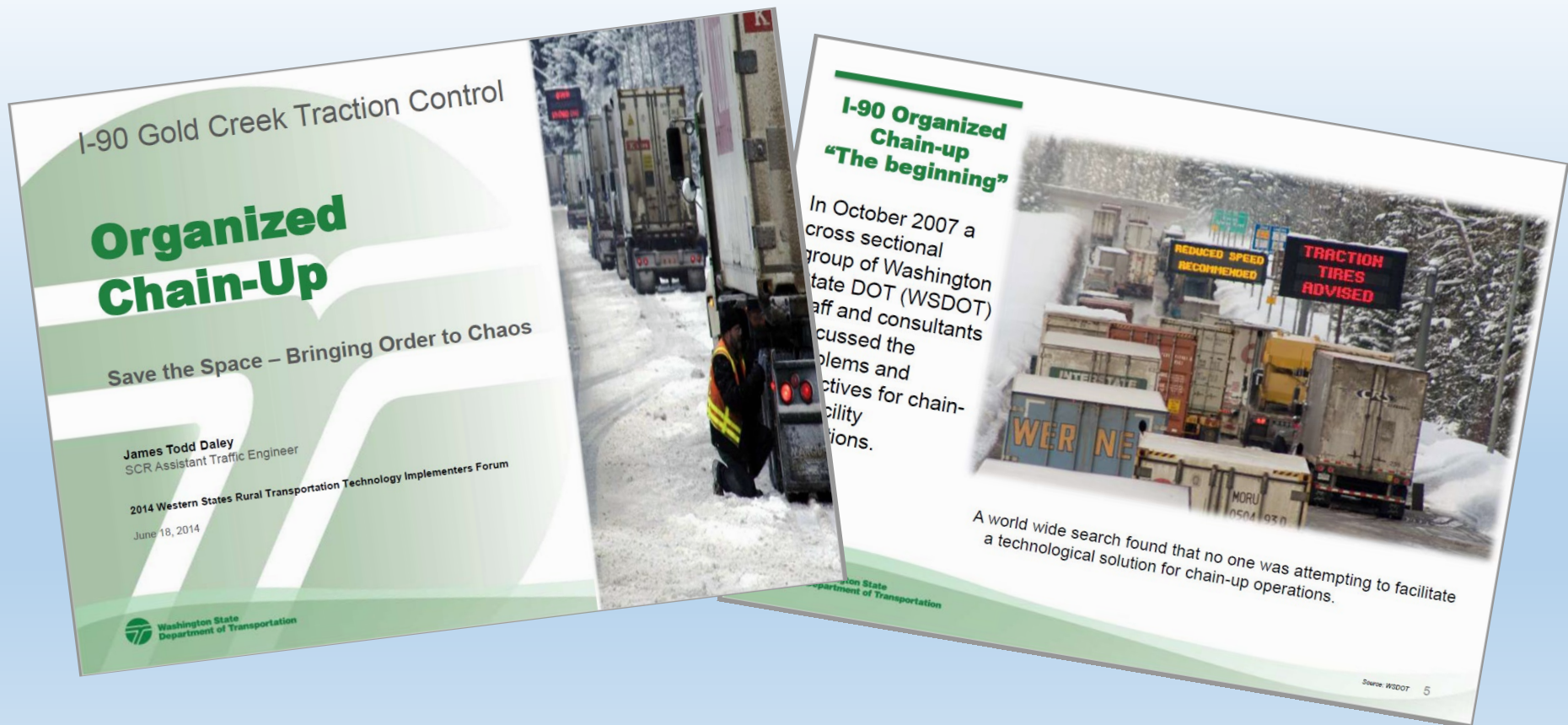
Capital Outlay Design

- 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

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)

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

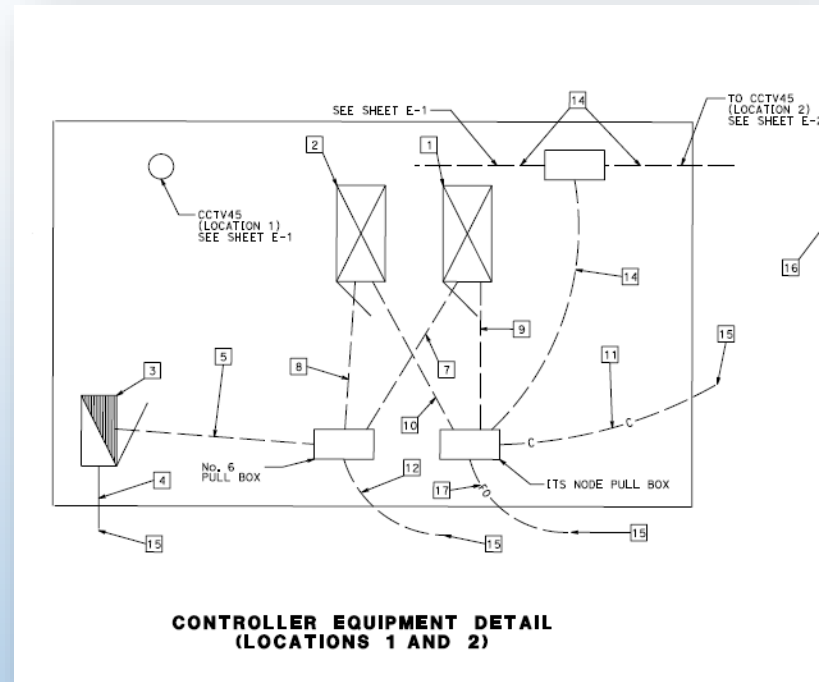
Caltrans Design

- 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

Project Design

Electrical

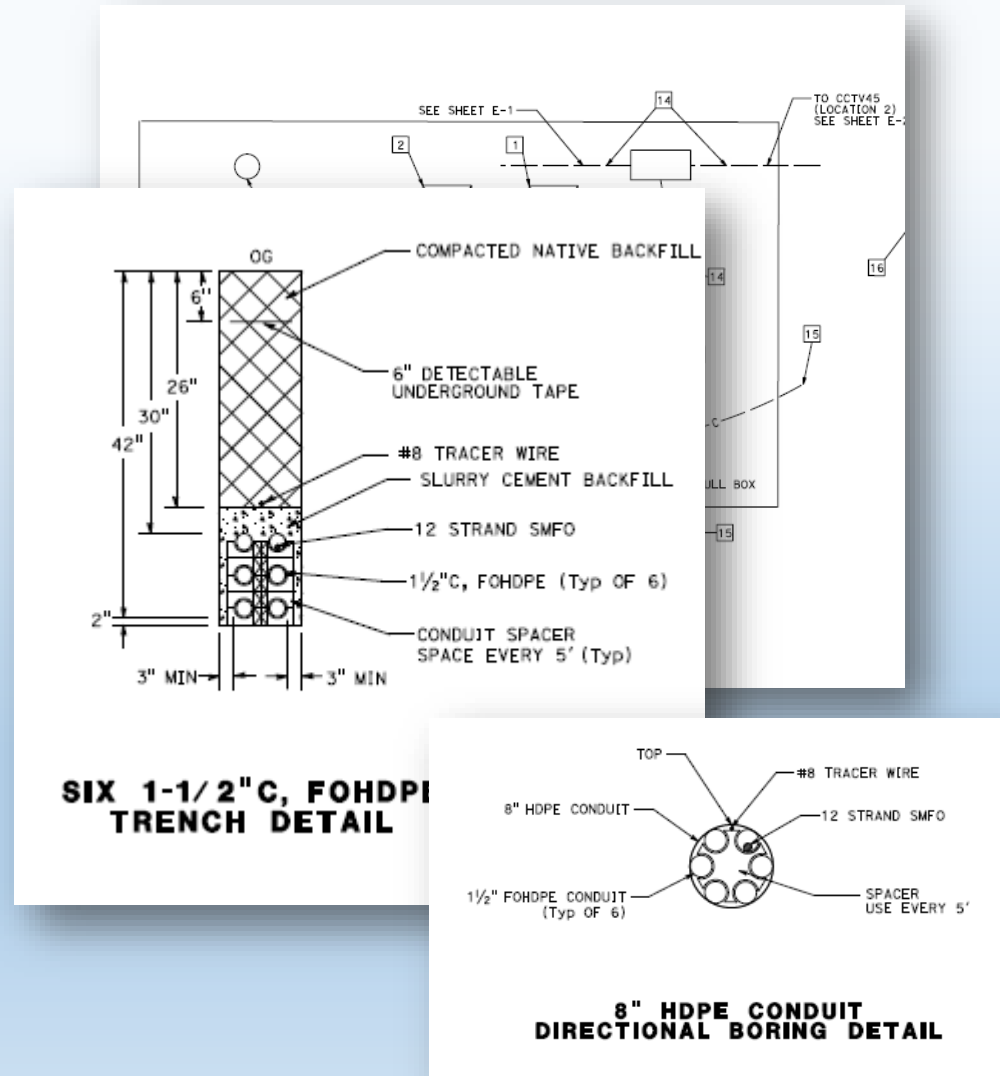
- Requirements for each location
 - Standard Controller Walkway
 - ITS Nodes
 - Power Service
 - Fiber Interconnect



Project Design

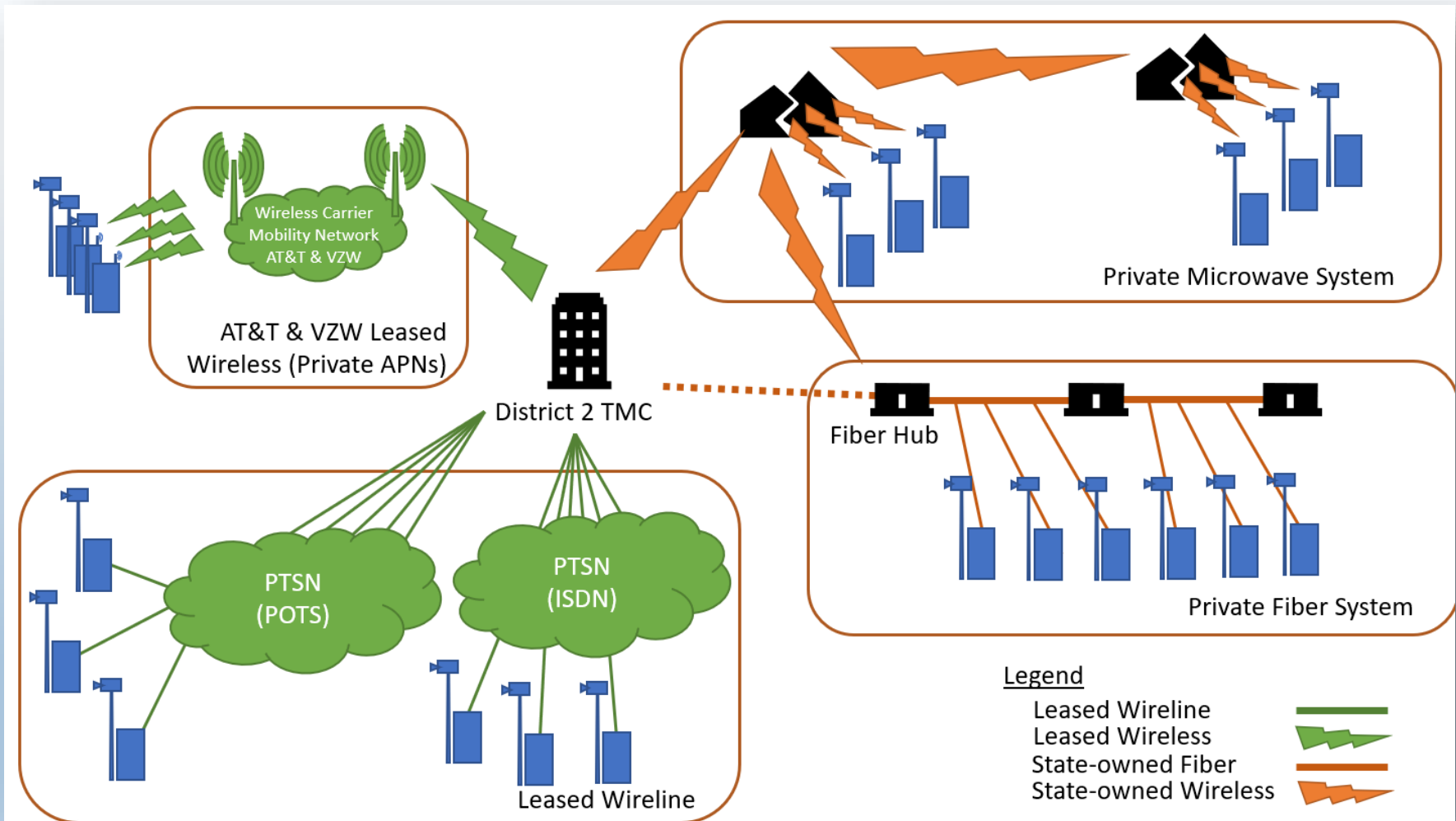
Electrical

- 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



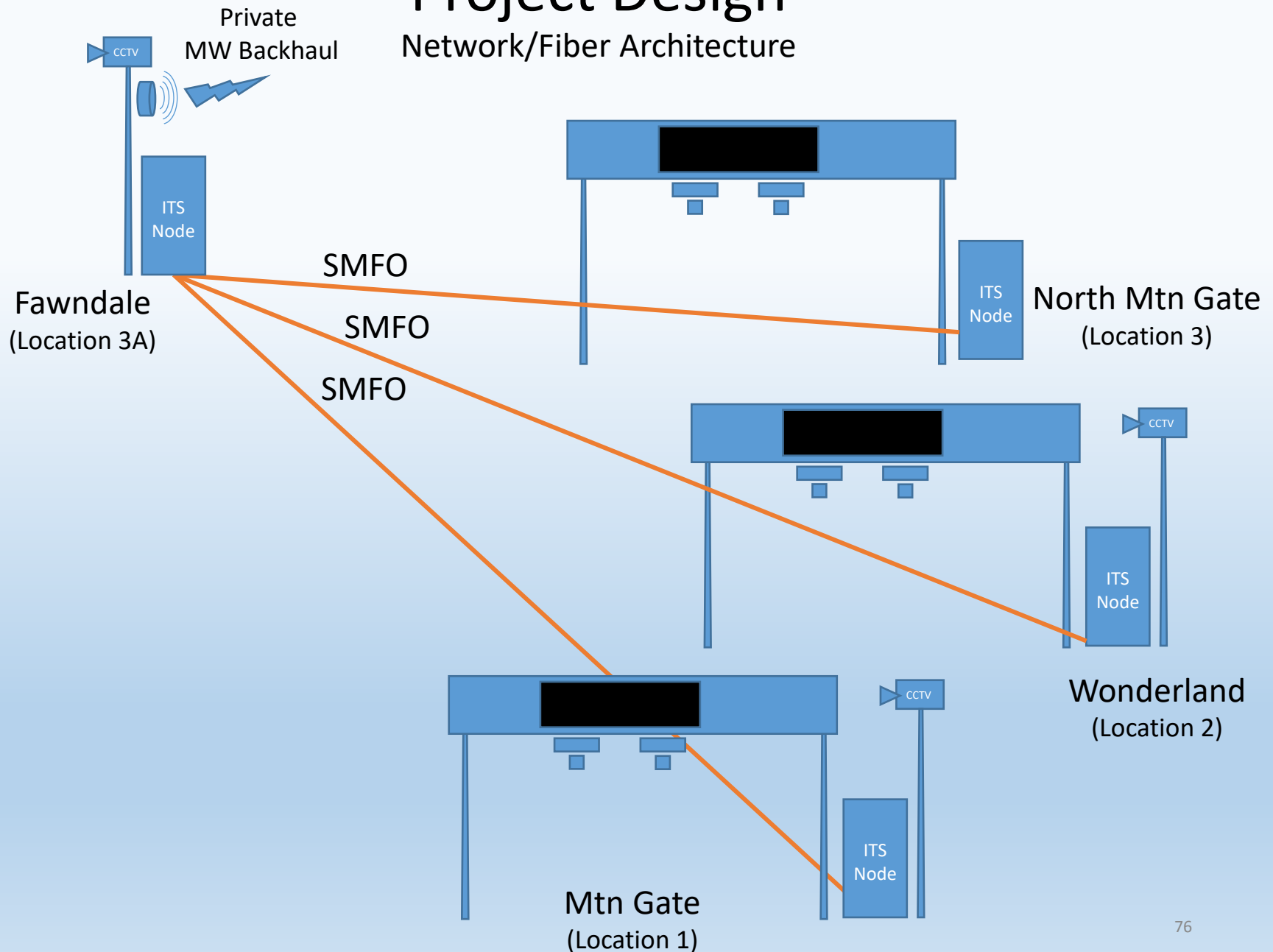
Project Design

Quick Network Architecture Overview



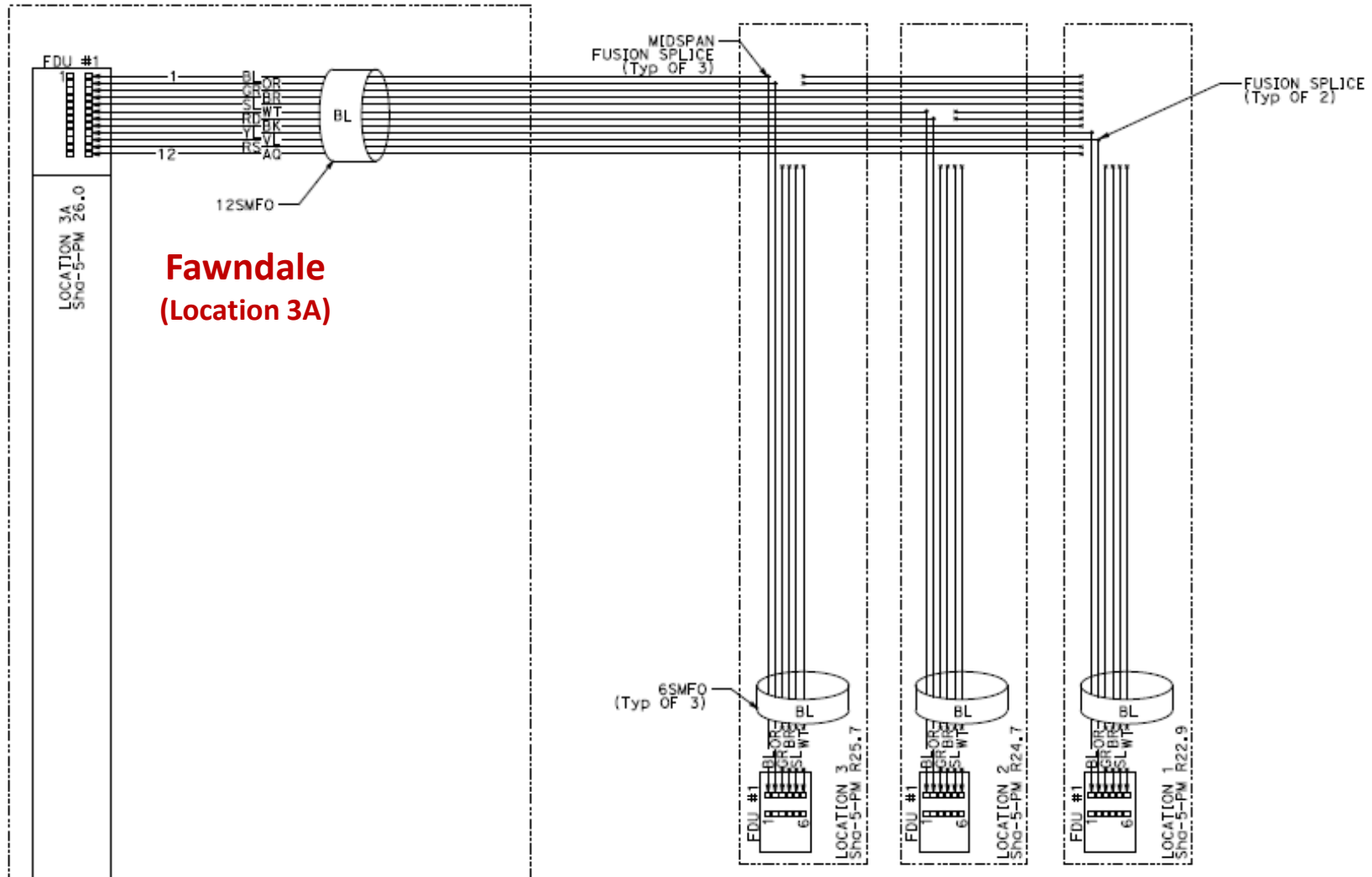
Project Design

Network/Fiber Architecture



Project Design

Network/Fiber Architecture



North Mtn Gate
(Location 3)

Wonderland
(Location 2)

Mtn Gate
(Location 1)

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

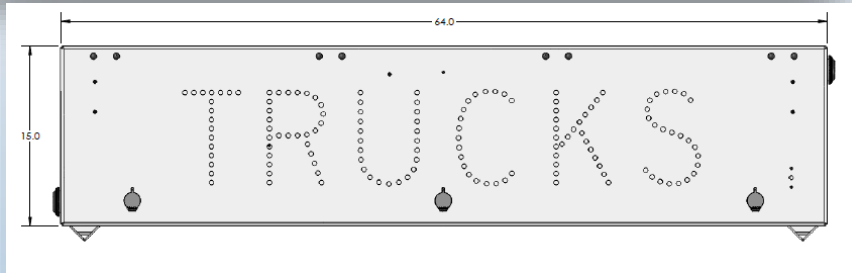
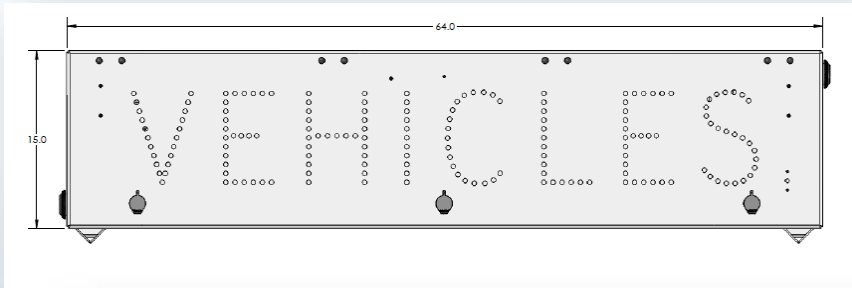
CMS Signs



- 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

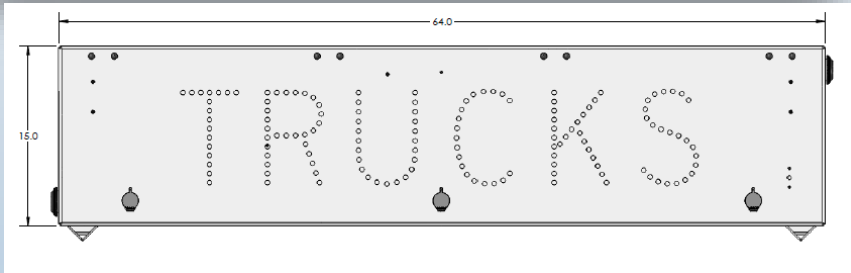
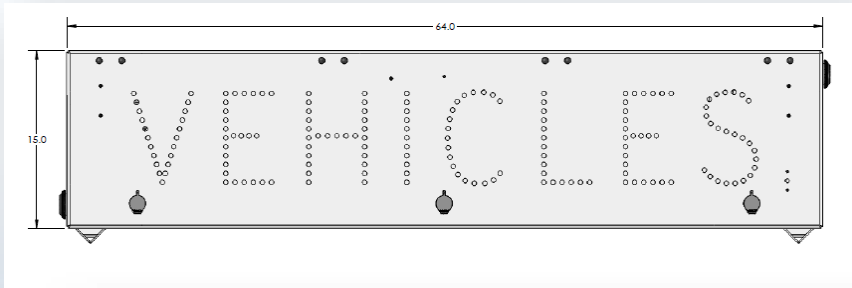
BOS/LCS Signs



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

Project Design

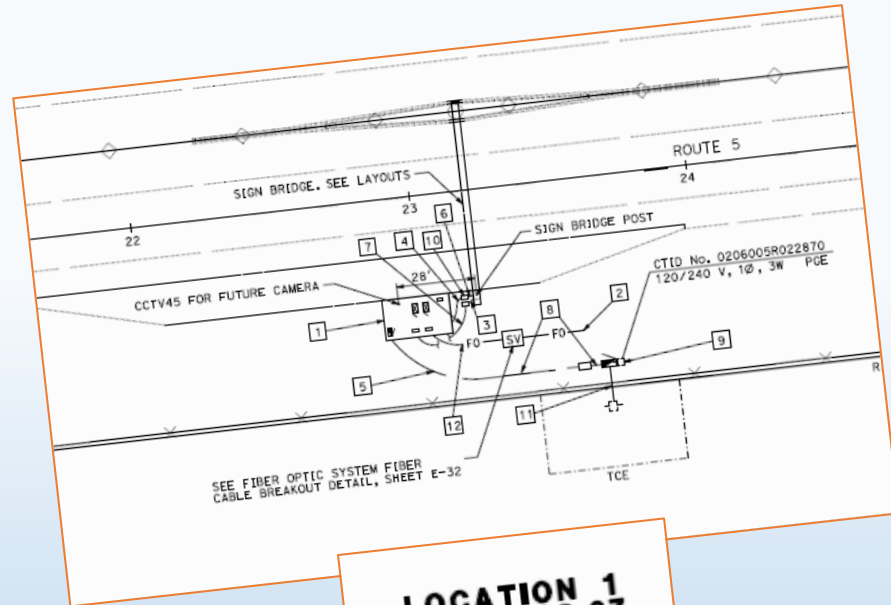
BOS/LCS Signs



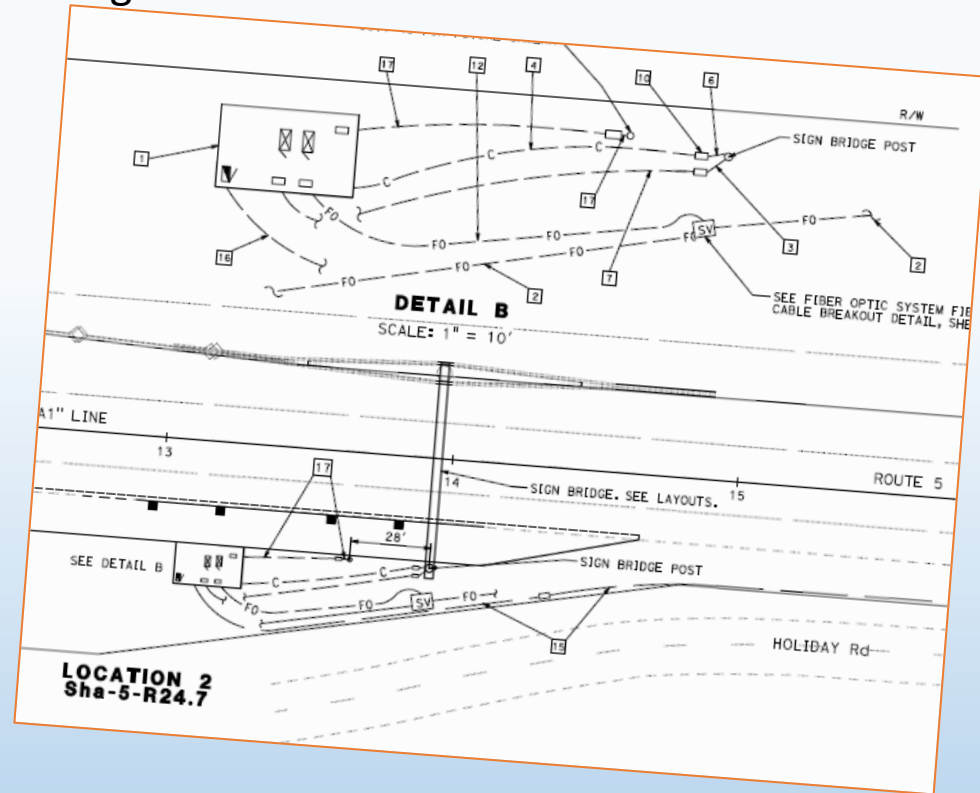
- Department furnished electronics due to specialty nature of project
- Blank Out Signs (BOS)
 - TCP/IP
 - NTCIP Compliant
 - Static text (Vehicles/Trucks)
- Lane Control Signs (LCS)
 - TCP/IP
 - NTCIP Compliant
 - Multiple indicators

Project Design

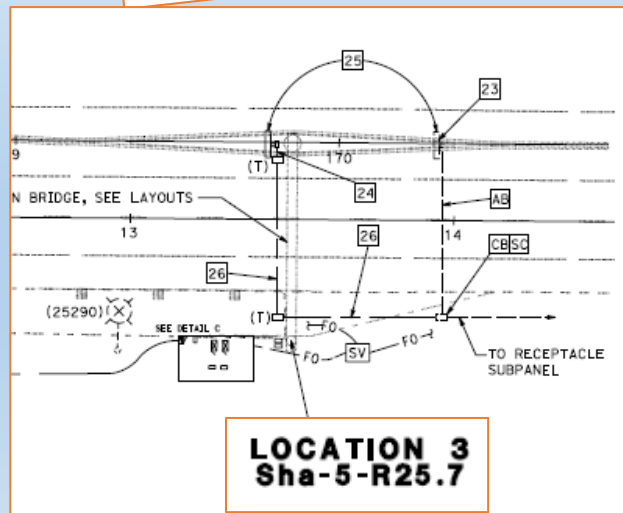
Final Design



LOCATION 1
Sha-5-R22.87



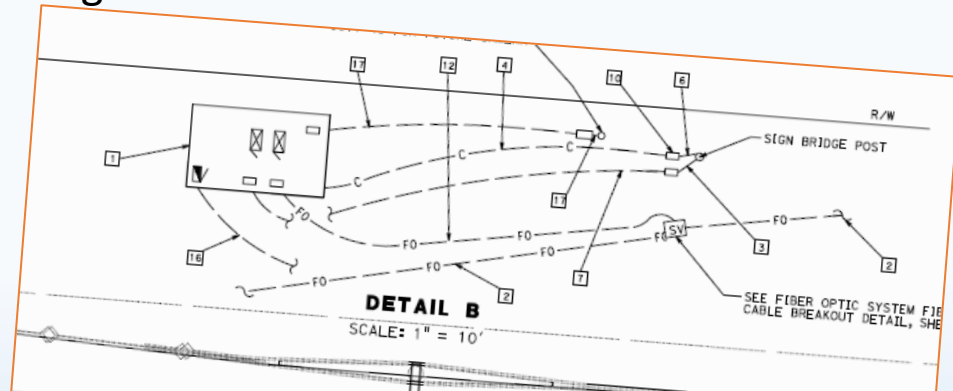
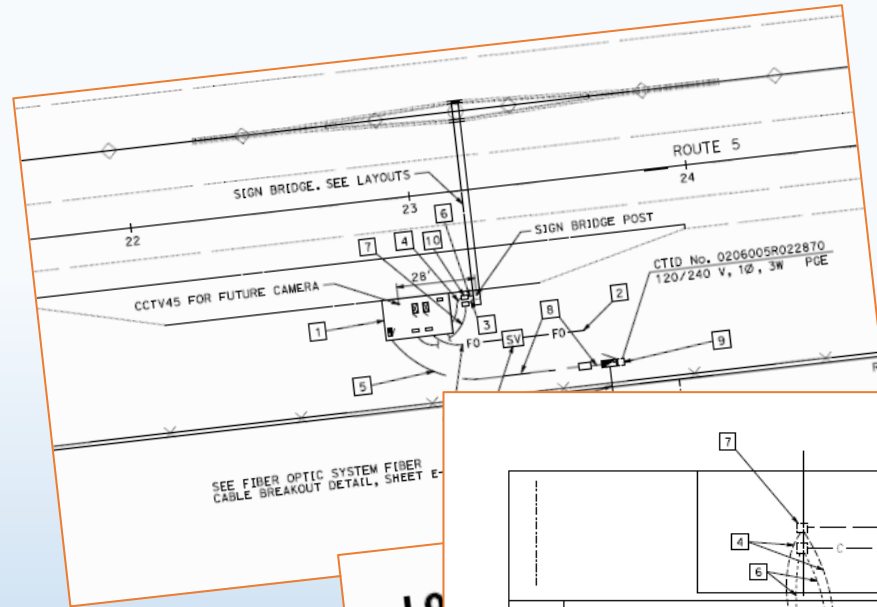
LOCATION 2
Sha-5-R24.7



LOCATION 3
Sha-5-R25.7

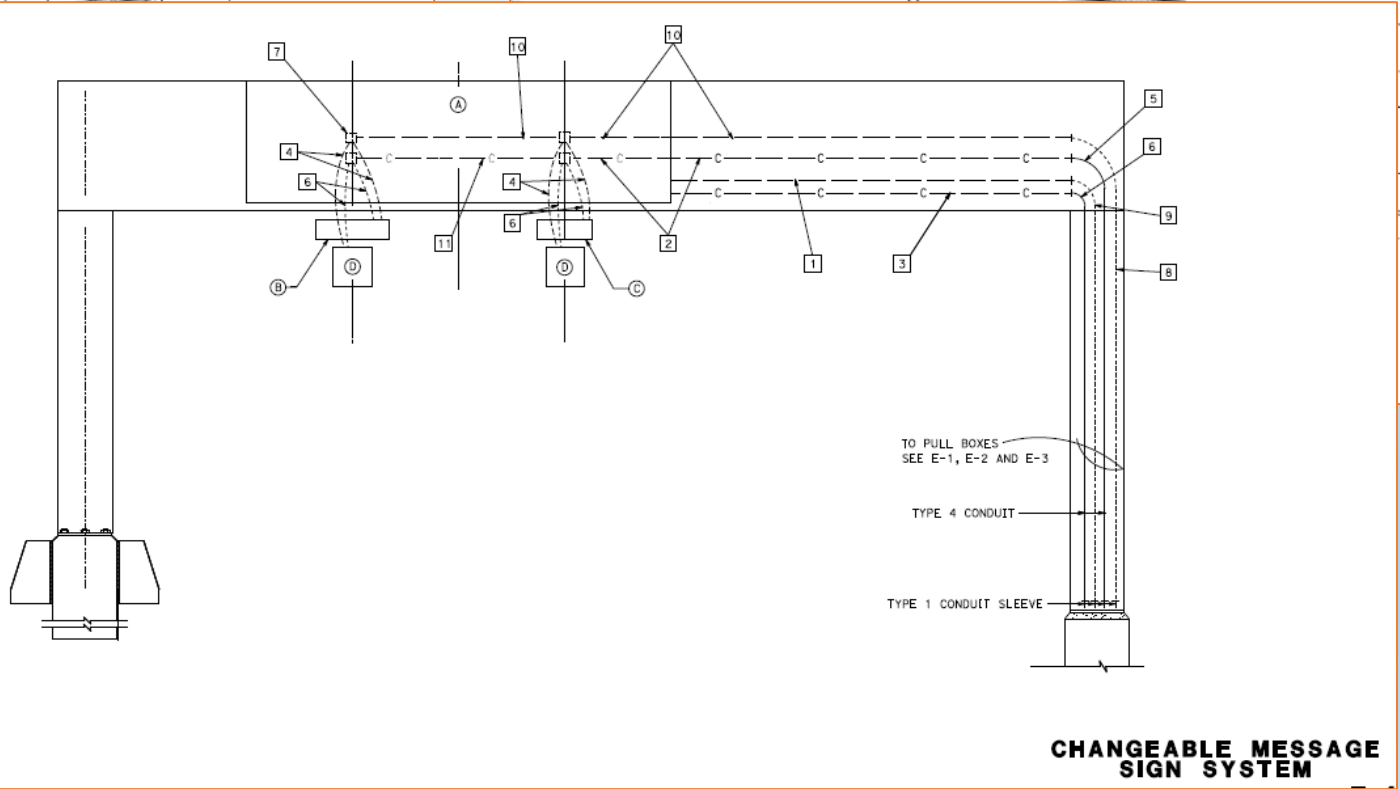
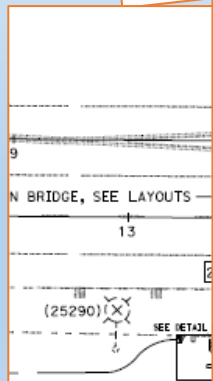
Project Design

Final Design



SEE FIBER OPTIC SYSTEM FIBER CABLE BREAKOUT DETAIL, SHEET E-

Lo Sh



PROJECT	SHEET	TOTAL
No.	No.	SHEETS
133	195	

A.P. ROBLES
E15293
No. 3-31-19
Exp. OFFICIAL
STATE OF CALIFORNIA

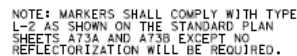
Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEET
02	Var	Var	Var	133	195

AP+ 02-21-18
 REGISTERED ELECTRICAL ENGINEER DATE
 03-15-18
 PLANS APPROVAL DATE

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.

REGISTERED PROFESSIONAL ENGINEER
 A.P. ROBLES
 No. E15293
 EXPIRES 3-31-19
 ELECTRICAL
 STATE OF CALIFORNIA

1. SPLICE VAULT TO BE PLACED ON A 12" BED OF $\frac{3}{4}$ " CRUSHED DRAIN ROCK.
2. INSTALL $\frac{3}{4}$ " X 8' COPPER CLAD GROUND ROD EXTENDING 2.5" ABOVE BOTTOM OF INSIDE OF SPLICE VAULT. EXOTHERMICALLY WELD #8 TRACER WIRE TO GROUND ROD.



SAFETY LATCH

DIAMOND PLATE SURFACE

48"

78"

48"

DRAIN ROCK.

WHITE (NON-REFLECTIVE) TARGET PLATE WITH BLACK SERIES D LETTERS

TYPE L-2 (CA)

A73A

A73B

CLASS 2 METAL POST

NOTE: MARKERS SHALL COMPLY WITH TYPE L-2 MODIFIED WITH A SNOW POLE BRACKET. PLACE MARKER 2" OUTSIDE PULL BOX PAVING ON SIDE AWAY FROM TRAFFIC. SEE PULL BOX PAVING DETAIL.

NOTE: MARKERS SHALL COMPLY WITH TYPE L-2 AS SHOWN ON THE STANDARD PLAN SHEETS A73A AND A73B EXCEPT NO REFLECTORIZATION WILL BE REQUIRED.

MARK COVER "ITS NODE"

12" Min

No. 6 PULL BOX

12"

EXTENSION (Typ)

SEAL AROUND CONDUIT WITH MORTAR (Typ)

1" GROUT

6" Min

CLEAN CRUSHED ROCK SUMP

1" PVC DRAIN

1" Min

3" Max

2" Min

Diagram of a 24 inch x 24 inch PB target plate. The plate is labeled "PB" and "TARGET PLATE FACING TRAFFIC". It is backed by 2 inch HMA. The dimensions are 24" x 24".

NOTE: APPLIES TO ALL INSTALLATIONS
IN UNPAVED AREAS

Technical drawing of a 48 inch x 48 inch square rack assembly. The drawing shows a central 12 inch diameter sump with four 16 inch x 4.5 inch knockouts (Typ) around it. The rack is made of 4 total galvanized pulling irons. Dimensions include 12 inch, 27 inch, and 78 inch for the main structure, and 8 inch, 16 inch, and 48 inch for the rack sections. A note points to "SEE NOTE 2".

APPROVED FOR ELECTRICAL WORK ONLY

PROJECT NUMBER & PHASE 02-1300-0032-1 EA 02-4F7B0

ELECTRICAL DETAILS

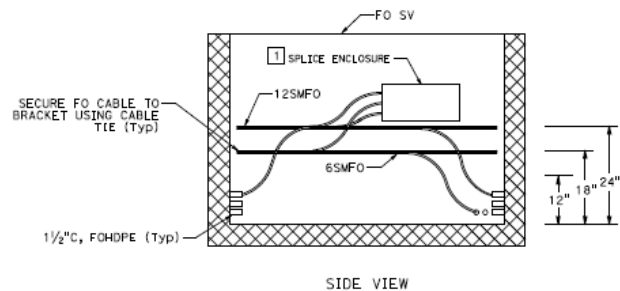
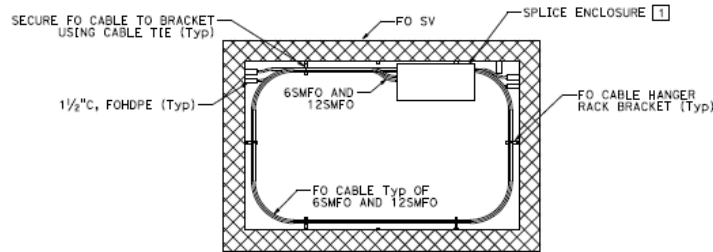
NO SCALE 84 **ED-1**

Project Design

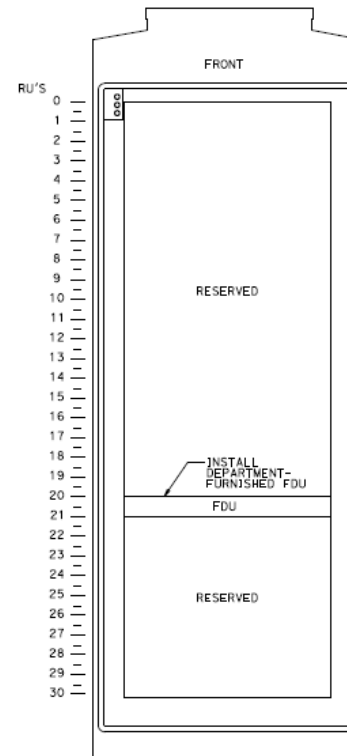
Final Design

LEGEND (THIS SHEET):

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



12 SMFO TO 6 SMFO
MIDSPAN FUSION SPLICED



ITS EQUIPMENT CABINET LAYOUT

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

REGISTERED ELECTRICAL ENGINEER DATE 02-21-18
 REGISTERED PROFESSIONAL ENGINEER DATE 03-31-18
 PLANS APPROVAL DATE 03-15-18

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.

ART
 A.P. ROBLES
 E15293
 3-31-18
 BETHUN
 STATE OF CALIFORNIA

ELECTRICAL DETAILS
 NO SCALE

ED-4

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

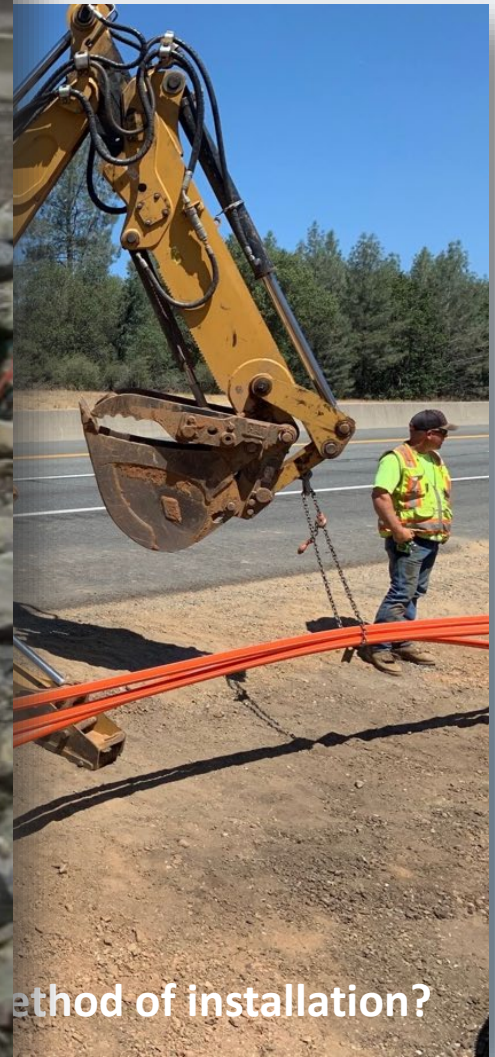
Construction

Fiber Optic



Approved method of installation?

Construction



Construction

Fiber Optic



Construction

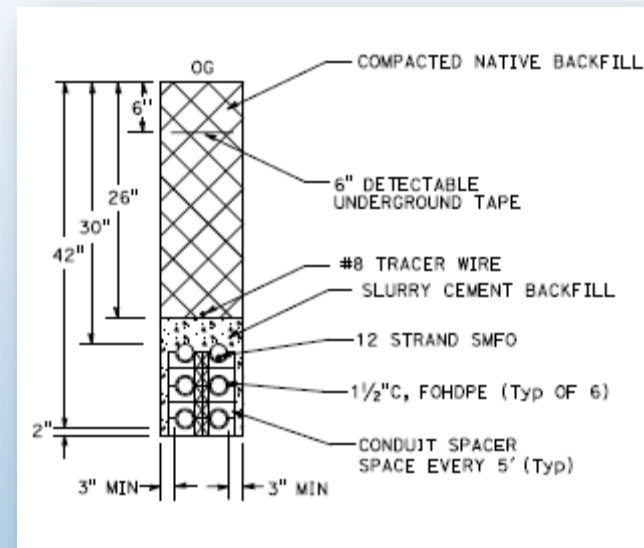
Fiber Optic



Excavator pulling/dragging conduit

Construction

Fiber Optic



Construction

Fiber Optic



Creative Installation Aides



Construction

Fiber Optic



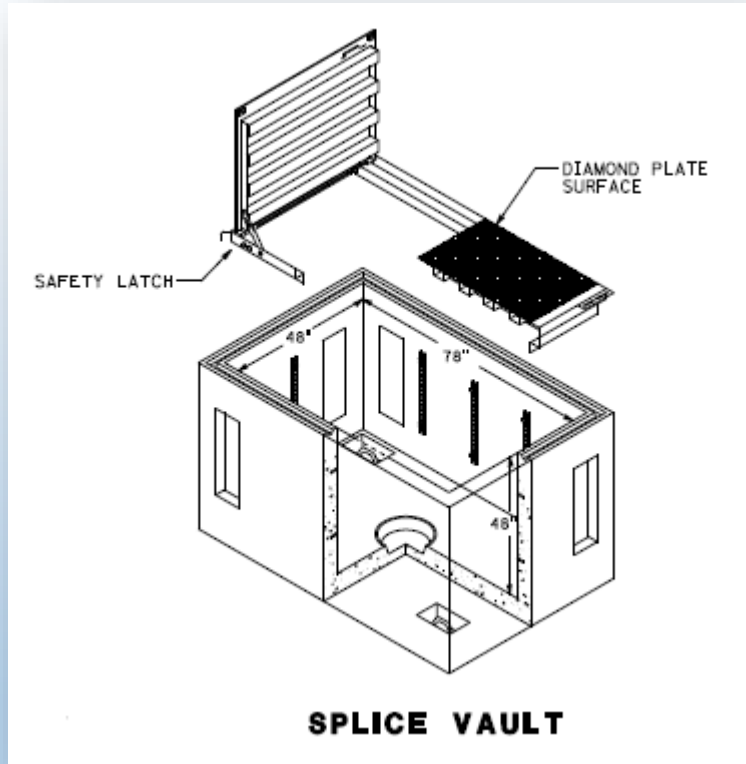
Construction

Fiber Optic



Construction

Fiber Optic



Construction

Sign Testing/Validating

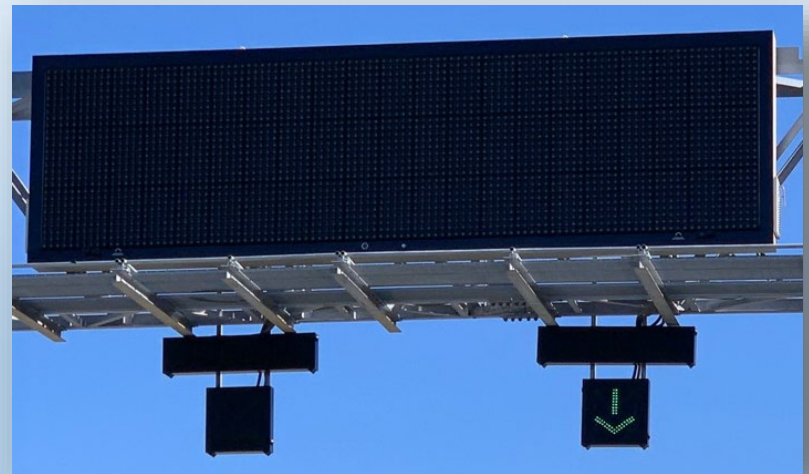
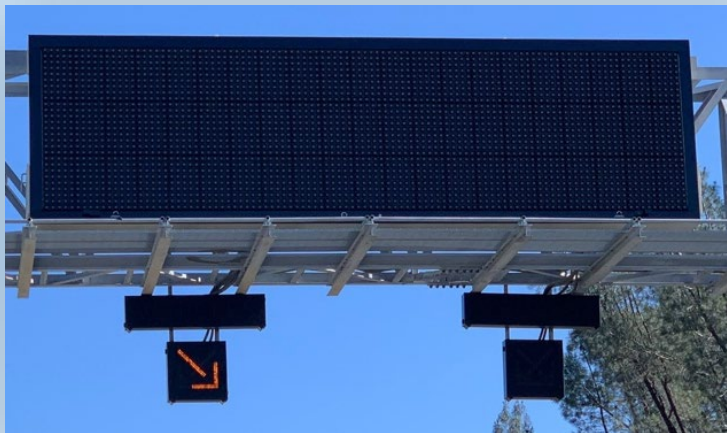
- Highway Electrical contractor lacked experience with electronics
 - Trained contractor how to terminate CAT5/RJ-45



Construction

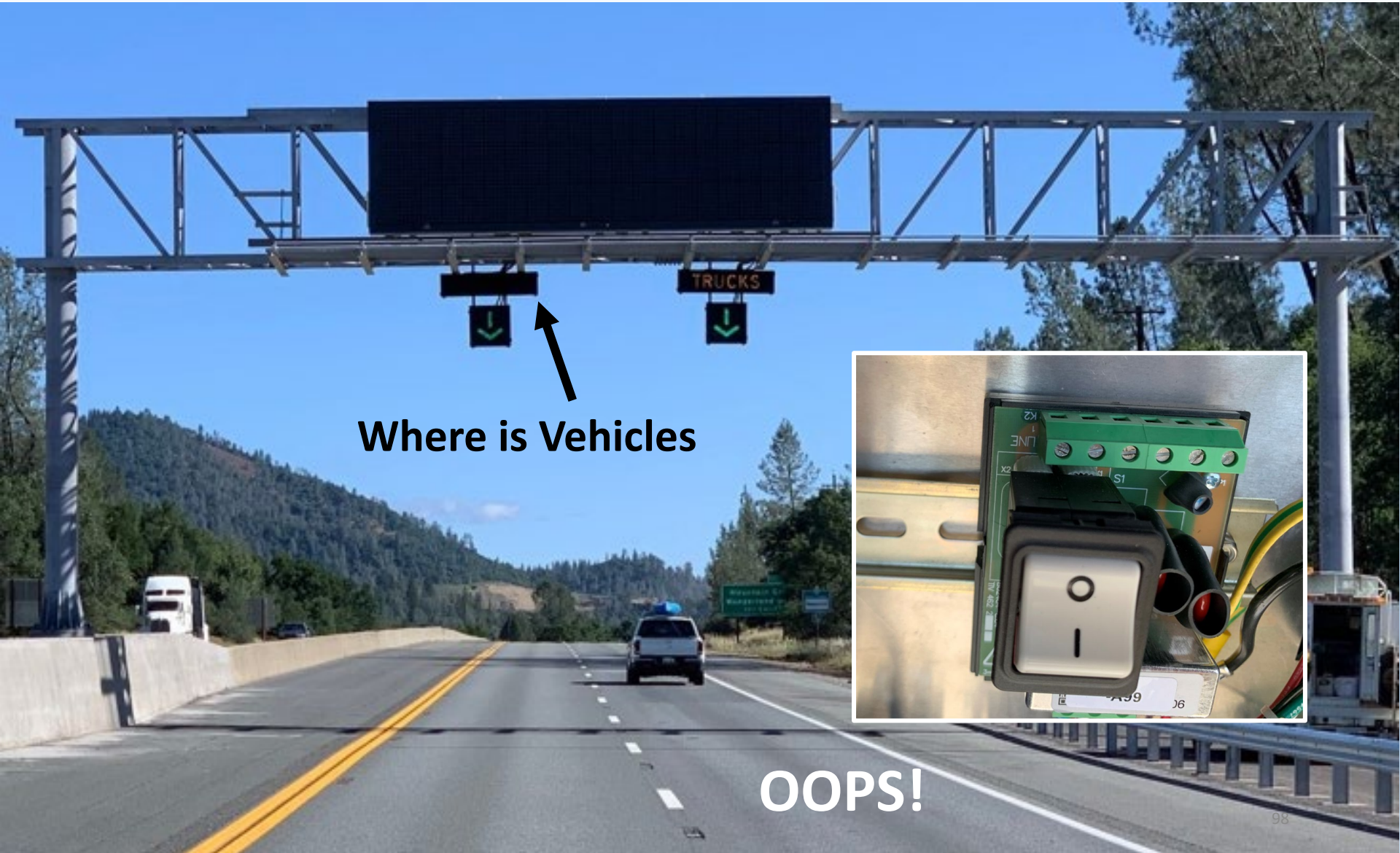
Sign Testing/Validating

- 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

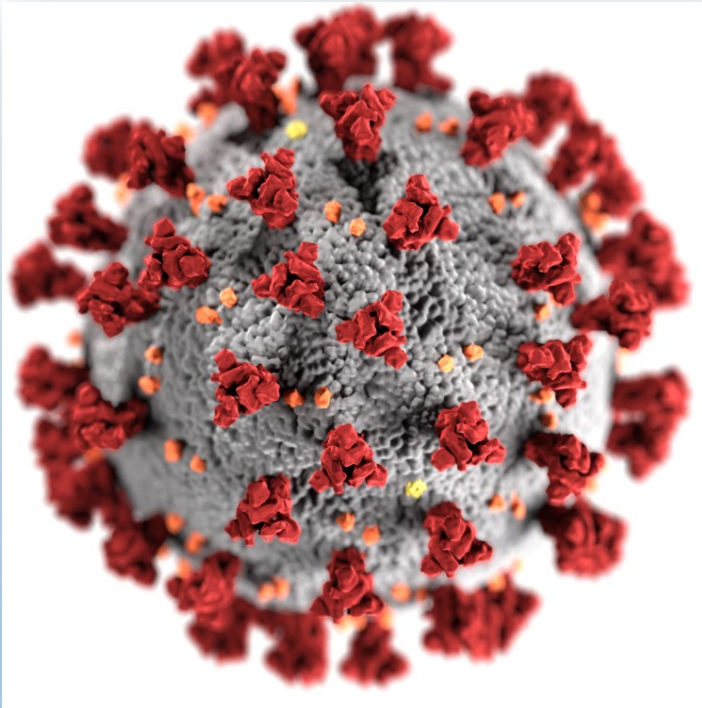
Fiber Install/Testing



Construction

COVID-19

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



Construction

COVID-19

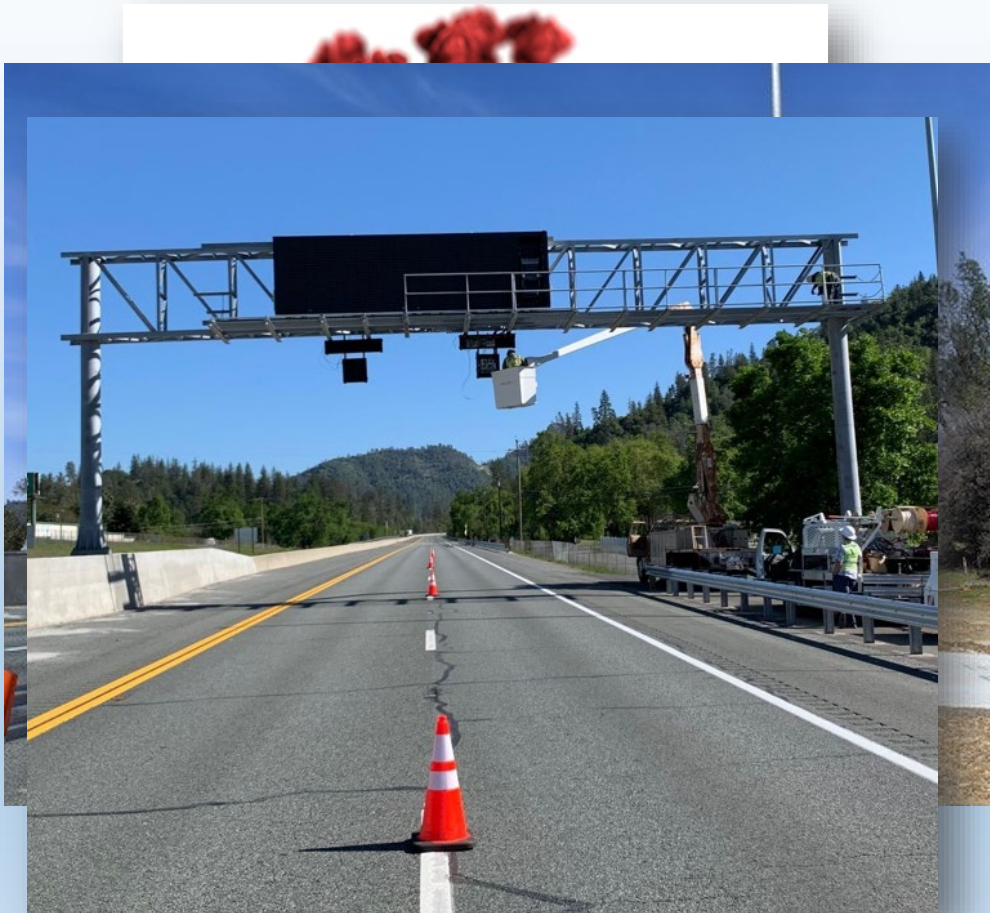
- COVID-19
 - Teleworking
 - Added layer of communication of delays
 - Manufacturing shutdowns
 - Construction Project delayed



Construction

COVID-19

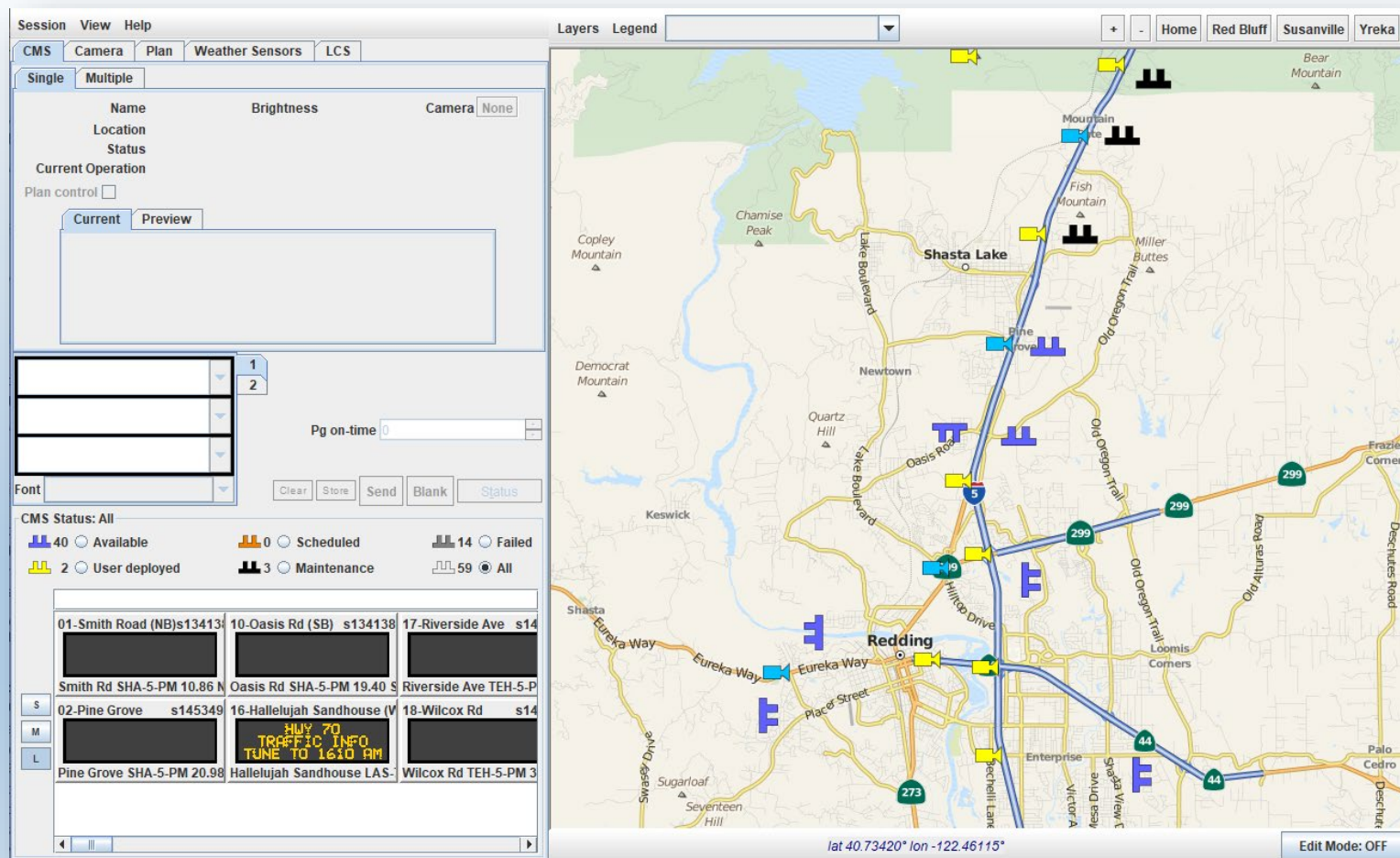
- COVID-19
 - Teleworking
 - Added layer of communication of delays
 - Manufacturing shutdowns
 - Construction Project delayed
 - Downturn in traffic
 - Could stand on Interstate 5



Integration/System Turnup

Central Systems

- Intelligent Roadway Information System (IRIS)

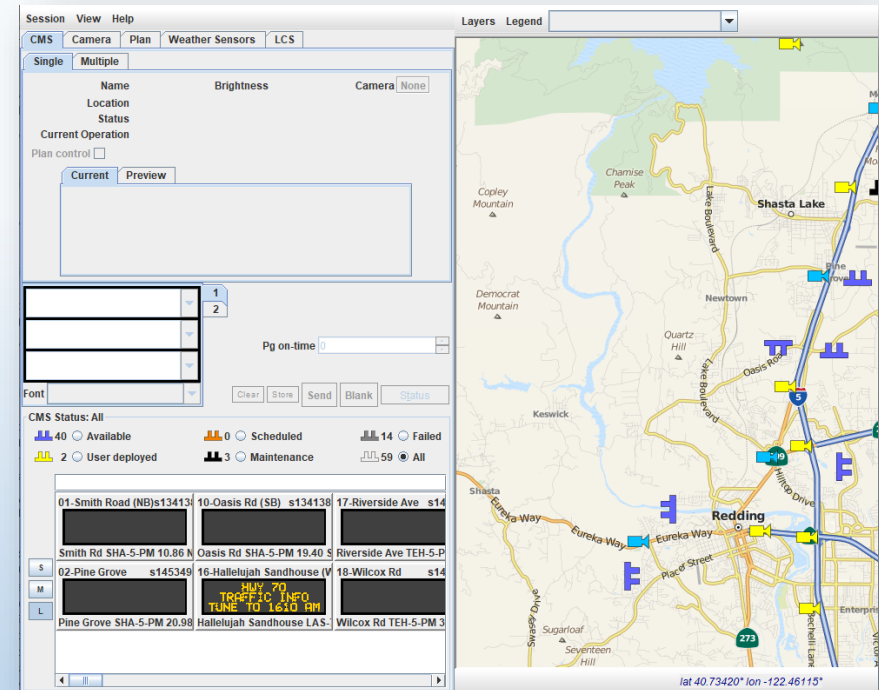


Integration/System Turnup

Central Systems

- Intelligent Roadway Information System (IRIS)

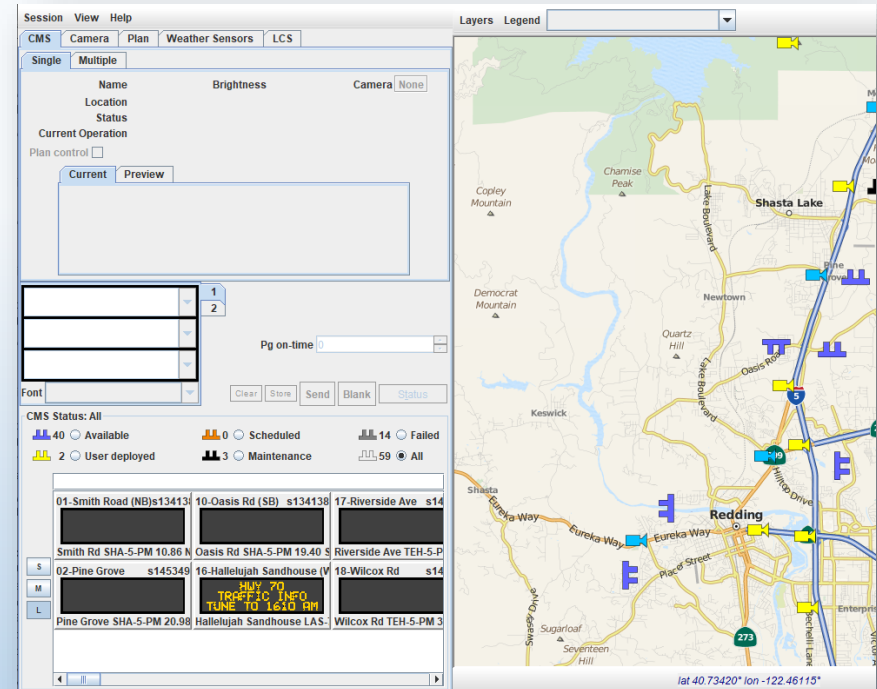
- Open-source Advanced Traffic Management System (ATMS)
- Developed by Minnesota DOT IRIS
 - 2007-Present
- Modified and deployed by Advanced Highway Maintenance and Construction Technology (AHMCT) for Caltrans
 - 2007-2011 – D10 Pilot Project
 - 2011-2014 – D1,D2, D5 Deployment
- Maintained and enhanced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



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

Status	Protocol
	NTCIP Class A
	NTCIP Class A
	NTCIP Class A
	NTCIP Class A
	NTCIP Class A
	NTCIP Class A
	Cohu PTZ
	Cohu PTZ

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”

The image displays three screenshots from the IRIS software interface:

- Selected Lane-Use Control Signal:** A window showing details for a signal named *NMtnGteBOS* at the location *North Mountain Gate BOS Trucks*. The status is *None*. It features two signal heads: a left head with a yellow 'V' and a right head with a yellow 'T'. Below each head is a dropdown menu.
- NTCIP Class A Table:** A table with a header row containing 'Protocol' and 'Class A'. It shows three rows, all with 'Class A' in the second column.
- LCS Arrays Table:** A table titled 'LCS Arrays' with two columns: 'LCS Array' and 'Location'. It lists six arrays and their corresponding locations.

Protocol	Class A
Class A	Class A
Class A	Class A

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

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

Plans and Schedules

Action Plans

Day Plans

Plan Phases

Plan Name	Description	Sync Actions	Sticky	Active	Default Phase
Fawndale	Chain Control System	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	0-SYSTEM OFF

Default Phase

CreateDelete

Schedule

CMS Actions

Beacon Actions

Lane Actions

Meter Actions

Sign Group/Sign	Phase	Quick Message	Activate Beacon	Activation Priority	Run-Time Priority	Auto-blank (min)
BLANK	0-SYSTEM OFF	BLANK	<input type="checkbox"/>	SCHEDULED	SCHEDULED	0
V40	1-CLOSED	CC PACKAGE 1 SIGN 1	<input type="checkbox"/>	SCHEDULED	SCHEDULED	0
BOST001	1-CLOSED	TRUCKS	<input type="checkbox"/>	SCHEDULED	SCHEDULED	0
BOSV001	1-CLOSED	VEHICLES	<input type="checkbox"/>	SCHEDULED	SCHEDULED	0
LCS001	1-CLOSED	GREENA	<input type="checkbox"/>	SCHEDULED	SCHEDULED	0

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

The screenshot shows the 'Selected Action Plan' window in the Centra software. The plan is named 'Fawndale' and is described as 'Chain Control System CMS 15'. It has 0 Beacons, 0 Lane Markings, and 0 Ramp Meters. The plan status is 'Active' and was last updated on 05-05-2022 at 10:41:59. The phase is set to '0-SYSTEM OFF'. Below this, there are radio buttons for 'Action Plan Status: All', 'CMS', 'Beacon', and 'Meter'. A dropdown menu is open, showing options: '0-SYSTEM OFF', '1-CLOSED', '2-NO TRKS', '3-TS', '4-VS', '5-CC', '6-CC NO TRKS', and '7-SYS TEST'. The '6-CC NO TRKS' option is selected. Below the dropdown, there is a table of system elements.

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

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



Selected Action Plan

Plan Name *Fawndale*

Description *Chain Control System*

CMS 15

Beacons 0

Lane Markings 0

Ramp Meters 0

Plan Status *Active*

Plan Status Updated 05-05-2022 10:41:59

Phase 0-SYSTEM OFF

Action Plan Status: All

1 CMS

0 Beacon

0 Meter

0-SYSTEM OFF

1-CLOSED

2-NO TRKS

3-TS

4-VS

5-CC

6-CC NO TRKS

7-SYS TEST

Fawndale -- Chain Control

MtnGateBOS

Mountain Gate BOS Trucks

MtnGateLCS

Mountain Gate LCS Lane 2

NMtnGteBOS

North Mountain Gate BOS Trucks

NMtnGteLCS

North Mountain Gate LCS Lane 2

WnldrLndBOS

Wonderland BOS Trucks

WnldrLndLCS

Wonderland LCS Lane 2

Shasta Lake

Fish Mountain

Miller Buttes

Oregon Trail

Shasta Lake

Fish Mountain

Miller Buttes

Oregon Trail

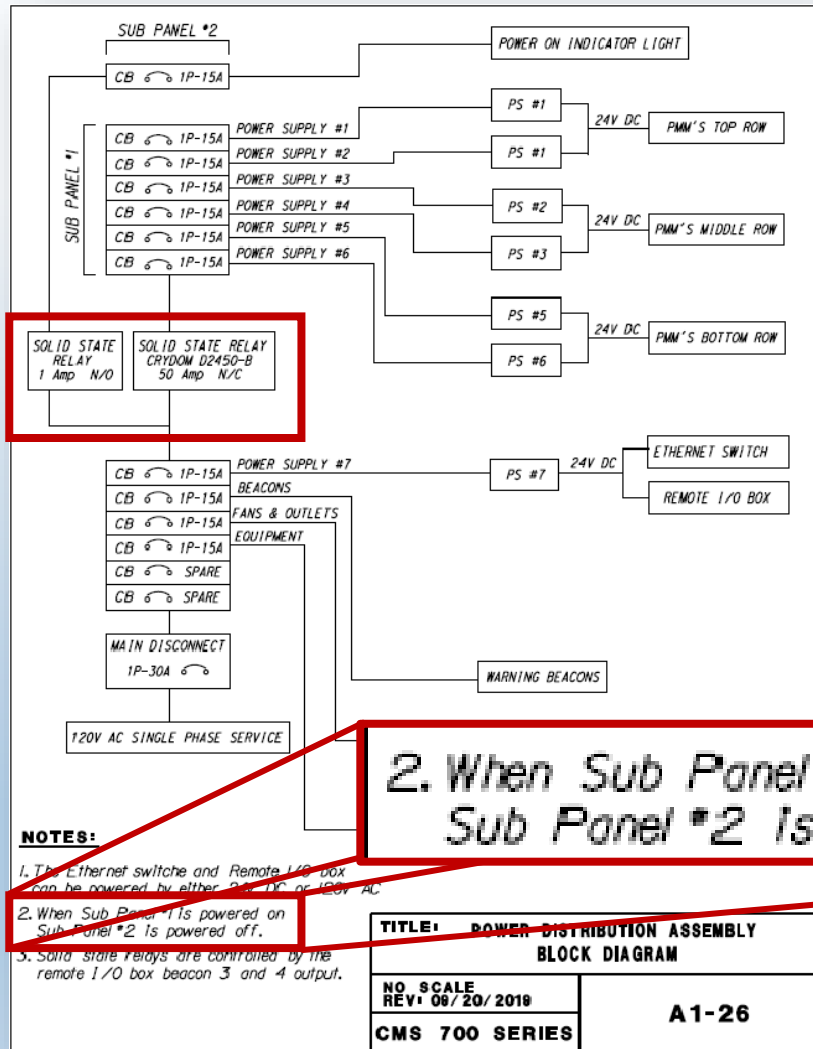
Integration/System Turnup

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

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
 - Power saving “feature”
 - Results in ~15 second delay when is sent to sign after extended

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



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

Selected Action Plan

Plan Name *Fawndale*

Description *Chain Control System*

CMS 15

Beacons 0

Lane Markings 0

Ramp Meters 0

Plan Status *Active*

Plan Status Updated *05-05-2022 10:41:59*

Phase **0-SYSTEM OFF**

Action Plan Status: All

0-SYSTEM OFF

1-CLOSED

2-NO TRKS

3-TS

4-VS

5-CC

6-CC NO TRKS

7-SYS TEST

Fawndale -- Chain Control

Lane ☐ 1 ☒ All

Time ☐

Active ☐

MtnGateBOS

MT

Mountain Gate BOS Trucks

MtnGateLCS

↓ ↓

Mountain Gate LCS Lane 2

NMtnGteBOS

MT

North Mountain Gate BOS Trucks

NMtnGteLCS

↓ ↓

North Mountain Gate LCS Lane 2

WndrLndBOS

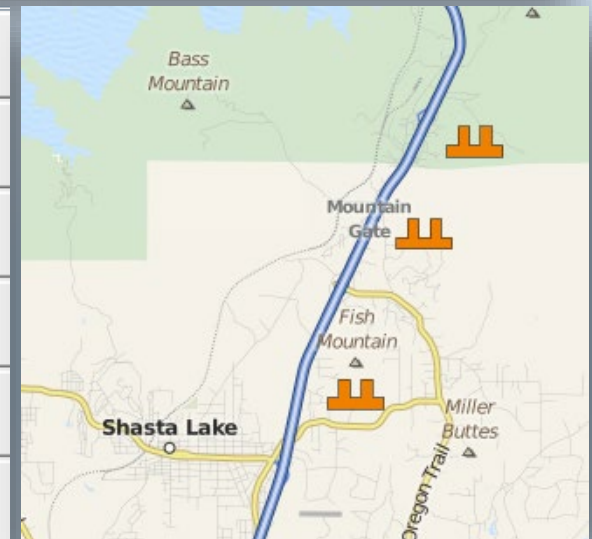
MT

Wonderland BOS Trucks

WndrLndLCS

↓ ↓

Wonderland LCS Lane 2



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

2020/2021 Kicking the Tires



Season One Operations

2020/2021 Kicking the Tires



Season One Operations

2020/2021 Kicking the Tires

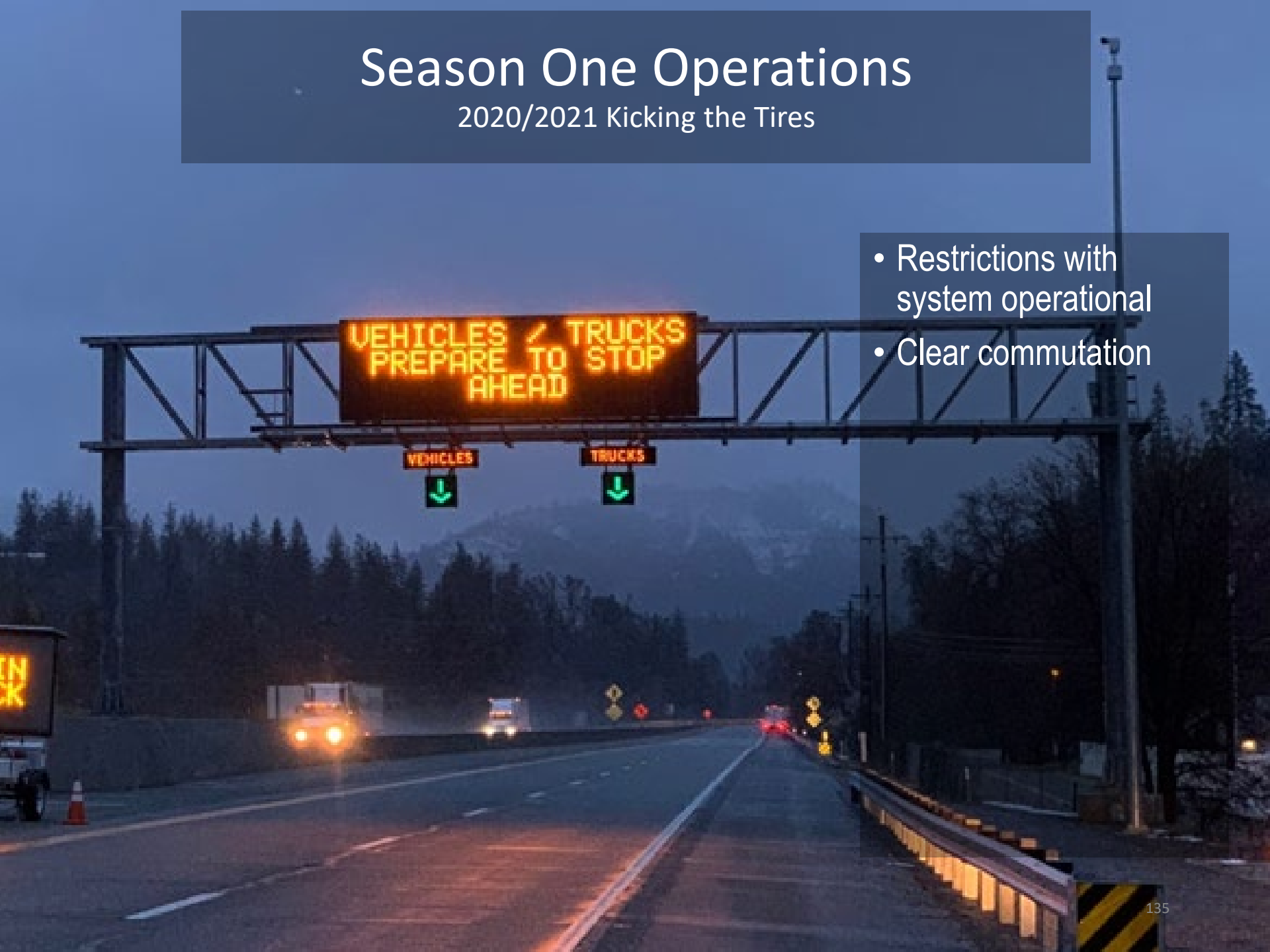
- Restrictions with system operational



Season One Operations

2020/2021 Kicking the Tires

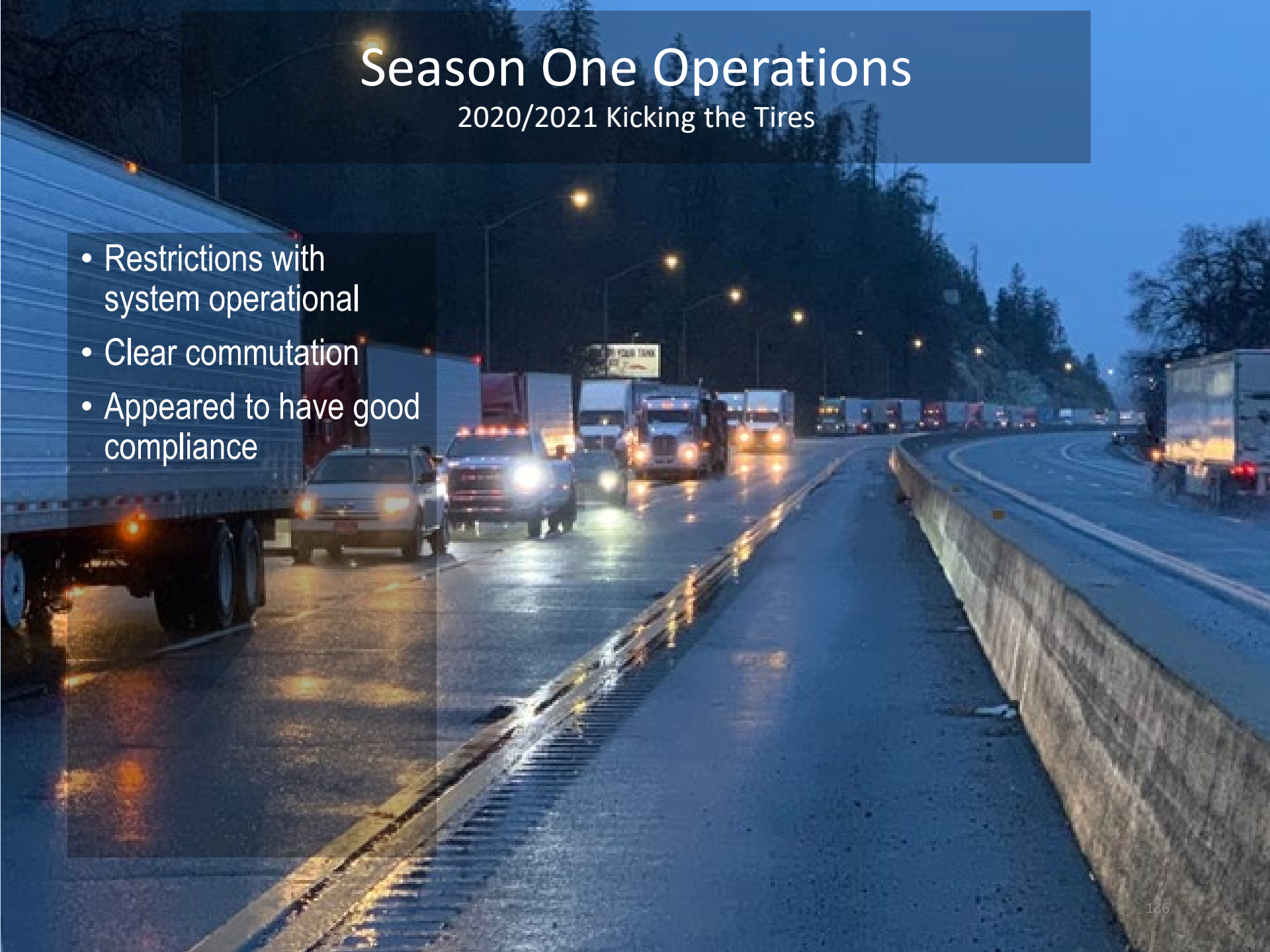
- Restrictions with system operational
- Clear commutation



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

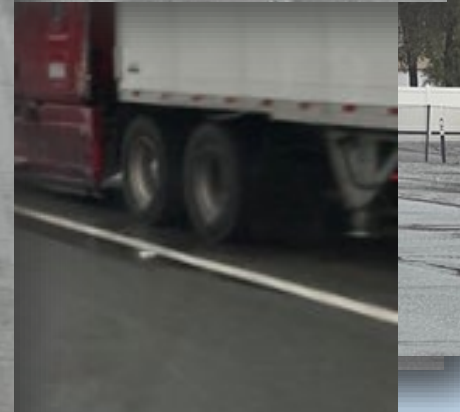
- District had five winter events requiring restrictions (Dec)
 - Only one event closed I5
- Where is the queue
 - Shoulders
 - Onramps



Season Two Operations

2021/2022

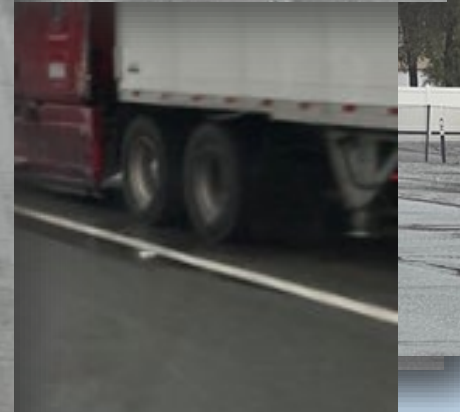
- District had five winter events requiring restrictions (Dec)
 - Only one event closed I5
- Where is the queue
 - Shoulders
 - Onramps
 - Truck stops



Season Two Operations

2021/2022

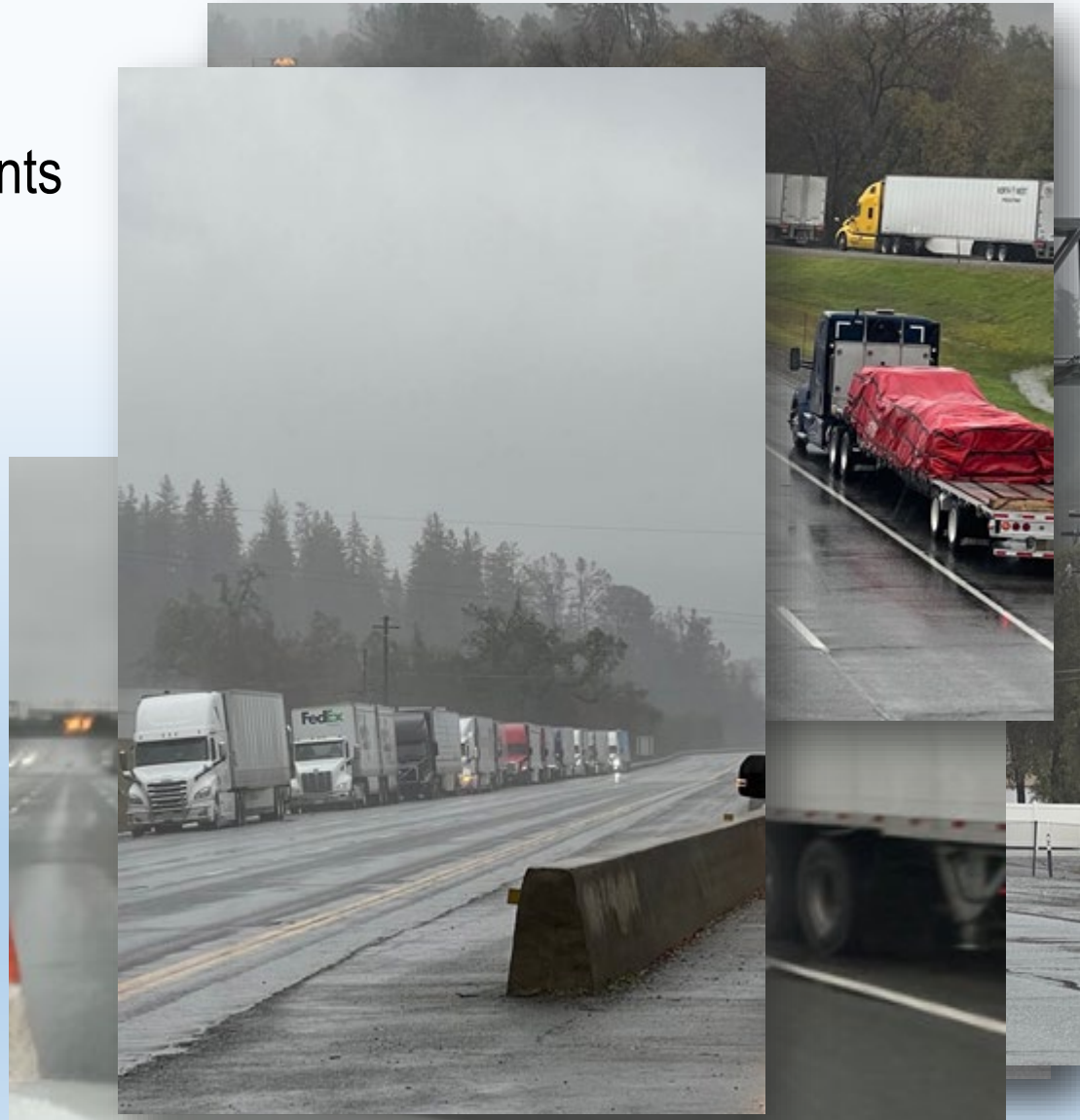
- District had five winter events requiring restrictions (Dec)
 - Only one event closed I5
- Where is the queue
 - Shoulders
 - Onramps
 - Truck stops
 - Rest areas



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)

Lessons Learned

COMMUNICATION

Lessons Learned

COMMUNICATION

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COMMUNICATION

Lessons Learned

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Lessons Learned

- Communication

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



Lessons Learned

- Communication

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

- Sizing and Brightness of BOS/LCS



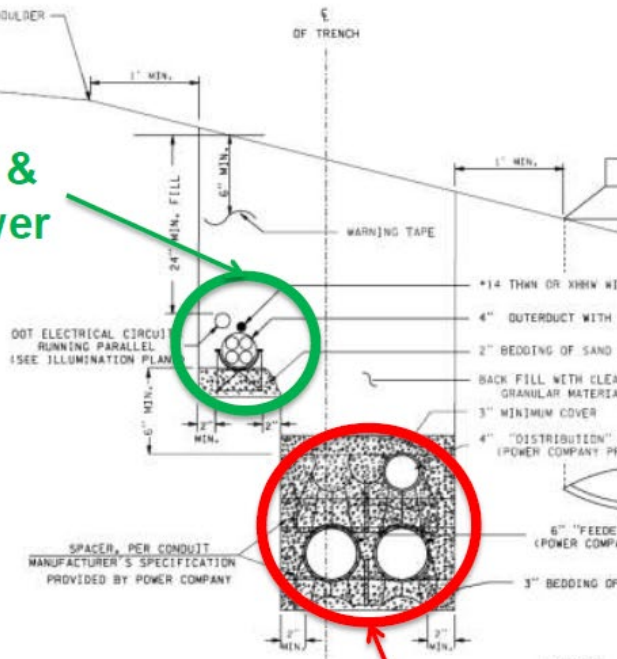
Lessons Learned

Joint Utility Company / DOT Fiber Trench

WSDOT Fiber & 120V – 480V Power

POWER CONDUIT AND DRAINAGE FEATURES
BE CLOSER THAN 6" MINIMUM. SEE SPECIAL
VISIONS FOR CONFLICT RESOLUTION PROVISIONS.

LE 1206+40 RT	STA - LE 1257+00 RT
LE 1206+46 RT	STA - LE 1257+65 RT
LE 1206+54 RT	STA - LE 1261+41 RT
LE 1210+34 RT	STA - LE 1261+75 RT
LE 1210+49 RT	STA - LE 1263+61 RT
LE 1224+31 RT	STA - LE 1264+75 RT
LE 1226+00 RT	STA - LE 1267+00 RT
LE 1229+50 RT	STA - LE 1267+91 RT
LE 1232+30 RT	STA - LE 1270+00 RT
LE 1233+00 RT	STA - LE 1272+91 RT
LE 1234+00 RT	STA - LE 1273+06 RT
LE 1235+00 RT	STA - LE 1299+09 RT
LE 1236+17 RT	STA - LE 1300+00 RT
LE 1239+48 RT	STA - LE 1303+50 RT
LE 1242+00 RT	STA - LE 1306+14 RT
LE 1243+87 RT	STA - LE 1308+06 RT
LE 1244+68 RT	STA - LE 1310+00 RT
LE 1246+65 RT	STA - LE 1312+85 RT
LE 1247+50 RT	STA - LE 1313+00 RT
LE 1250+00 RT	STA - LE 1315+68 RT
LE 1251+37 RT	STA - LE 1316+68 RT
LE 1252+50 RT	STA - LE 1318+68 RT
LE 1255+91 RT	



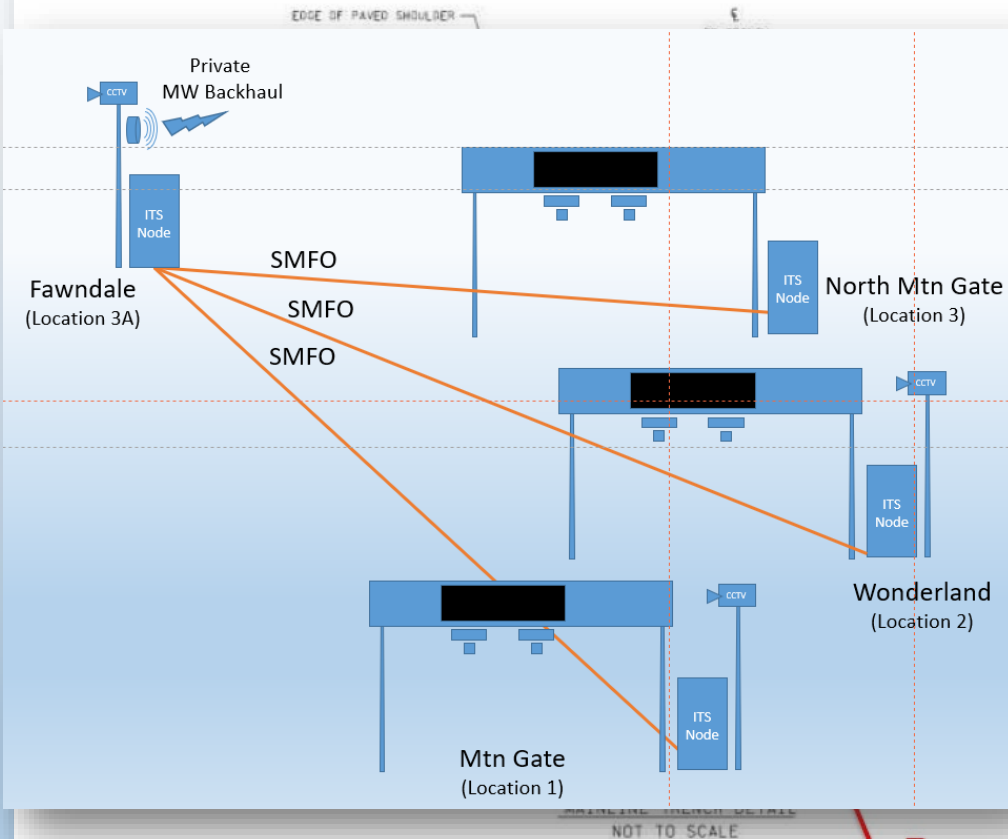
MAINLINE TRENCH DETAIL
NOT TO SCALE

**Power Company
Conduits**

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

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
- Communication backhaul is through single ITS Node
 - Whole system is down even if Fawndale loses power
 - Added CCO to help (future)

**Power Company
Conduits**

Lessons Learned

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

Lessons Learned

- Build in Flexibility During

- Concept
Changed by design committee
- Design
Changed by operational changes
- Construction
Changed by integration changes/needs
- Integration
Changed by central system requirements
- Operations
Changed by Maintenance / TMC staffing

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

**PLAN FOR IT AND BUILD FLEXIBILITY
INTO EVERY STAGE**

Questions

