The National Academies of
SCIENCES · ENGINEERING · MEDICINE

TRANSPORTATION RESEARCH BOARD

TRB Webinar: Implementing and Evaluating Wildlife Crossings

April 14, 2022

3:00- 4:30 PM Eastern

@NASEMTRB
#TRBwebinar

PDH Certification Information:

- 1.5 Professional Development Hours (PDH) – see follow-up email for instructions
- You must attend the entire webinar to be eligible to receive PDH credits
- Questions? Contact Beth Ewoldsen at Bewoldsen@nas.edu

#TRBwebinar

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Providers Program. Credit earned on completion of this program will be reported to RCEP. A certificate of completion will be issued to participants that have registered and attended the entire session. As such, it does not include content that may be deemed or construed to be an approval or endorsement by RCEP.

RCEP

REGISTERED CONTINUING EDUCATION PROGRAM

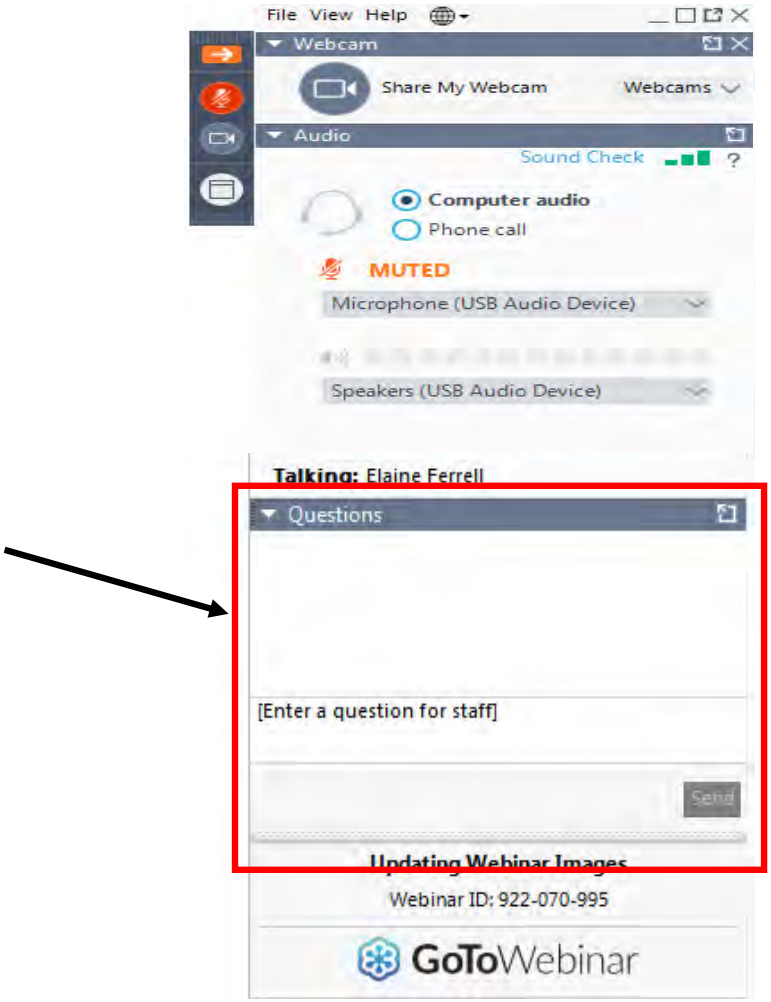
Learning Objectives

- Make objective engineering and economic decisions to implement effective wildlife crossings
- Identify engineering solutions to meet environmental and safety needs for wildlife crossings at large scales
- Determine the effectiveness of different crossing structure systems at large scales

#TRBwebinar

Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



#TRBwebinar

Frasier Shilling
fmshilling@ucdavis.edu
University of California, Davis

Andrew Runk
arunk@conteches.com
Contech Engineered Solutions

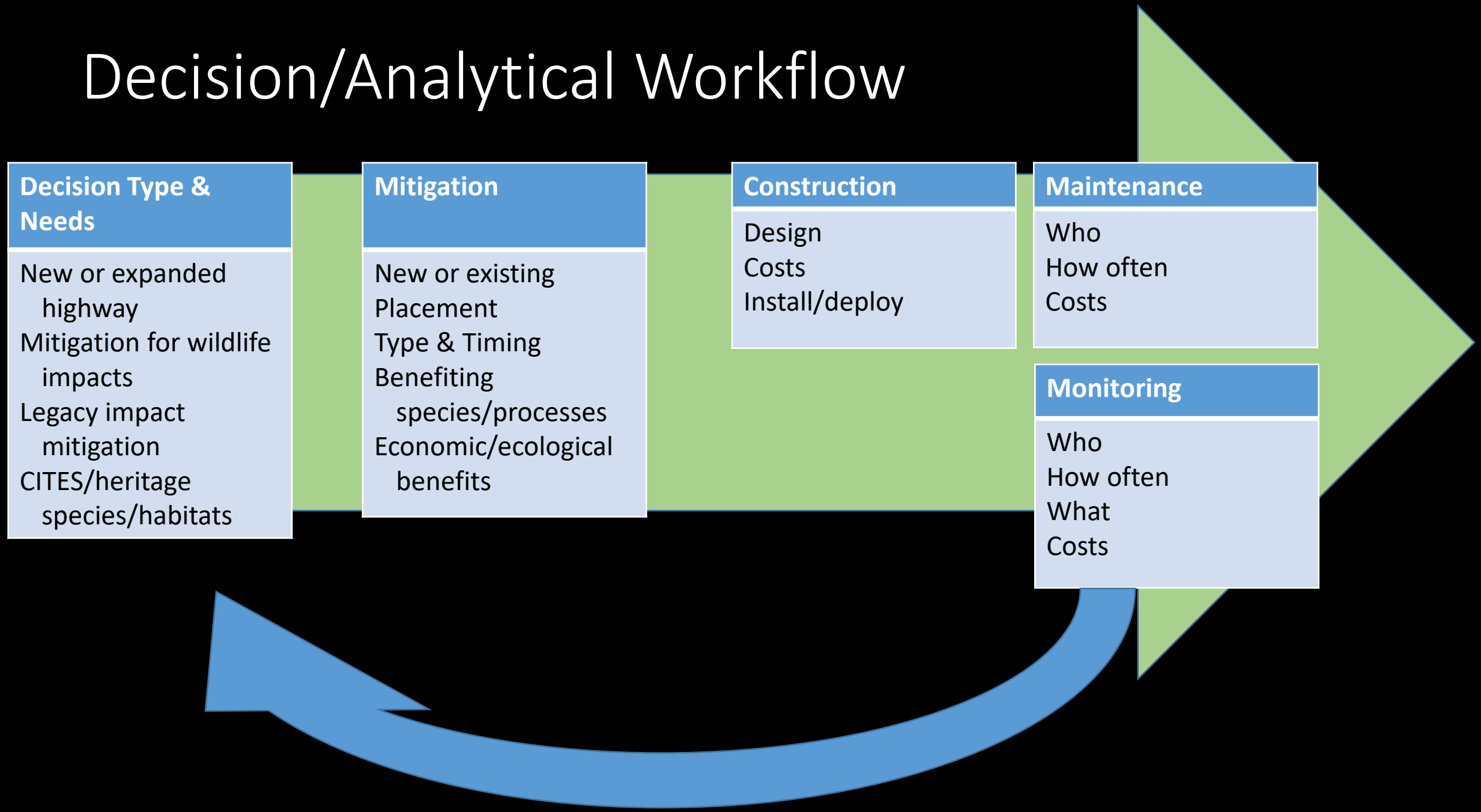
Glen Kalis
kalisgl@wsdot.wa.gov
Washington State Department of Transportation

Decision-Support for Wildlife Crossing Implementation and Evaluation

TRB Webinar, 4/14/2022

Fraser Shilling, UC Davis (Organizer)
Andrew Runk, ConTech Engineered Solutions
Glen Kalisz, WSDOT

Decision/Analytical Workflow



Contemporary Context

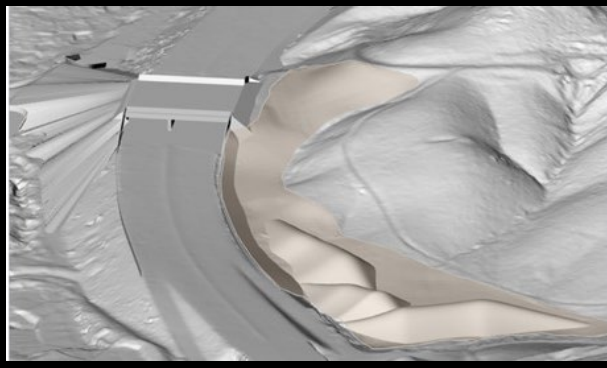
International, National, State and Local scientists, wildlife agencies, NGOs, and hunting groups have been warning of threats to resident and migratory wildlife.

Federal and state governments have recently stepped up with legislative and appropriated funding support for improving wildlife connectivity.

What is needed: Decision-support for systematic delivery of connectivity solutions

Systematic Delivery of Connectivity Solutions

Fraser Shilling, Road Ecology Center: "*Planning and Designing Crossings for Wildlife at Scale*"



Andrew Runk, California Bridge Consultant for Contech Engineering Solutions: "*Prefabricated Land Bridges and Wildlife Crossing Solutions*"

Glen Kalisz, Habitat Connectivity Lead for WSDOT: "*Monitoring a Large Wildlife Crossing Structure System*"

Fraser Shilling

Director, Road Ecology Center; Senior Ecologist Dudek

Member TRB-AEP70

Lead Organizer, International Conference on Ecology and Transportation

https://roadecology.ucdavis.edu

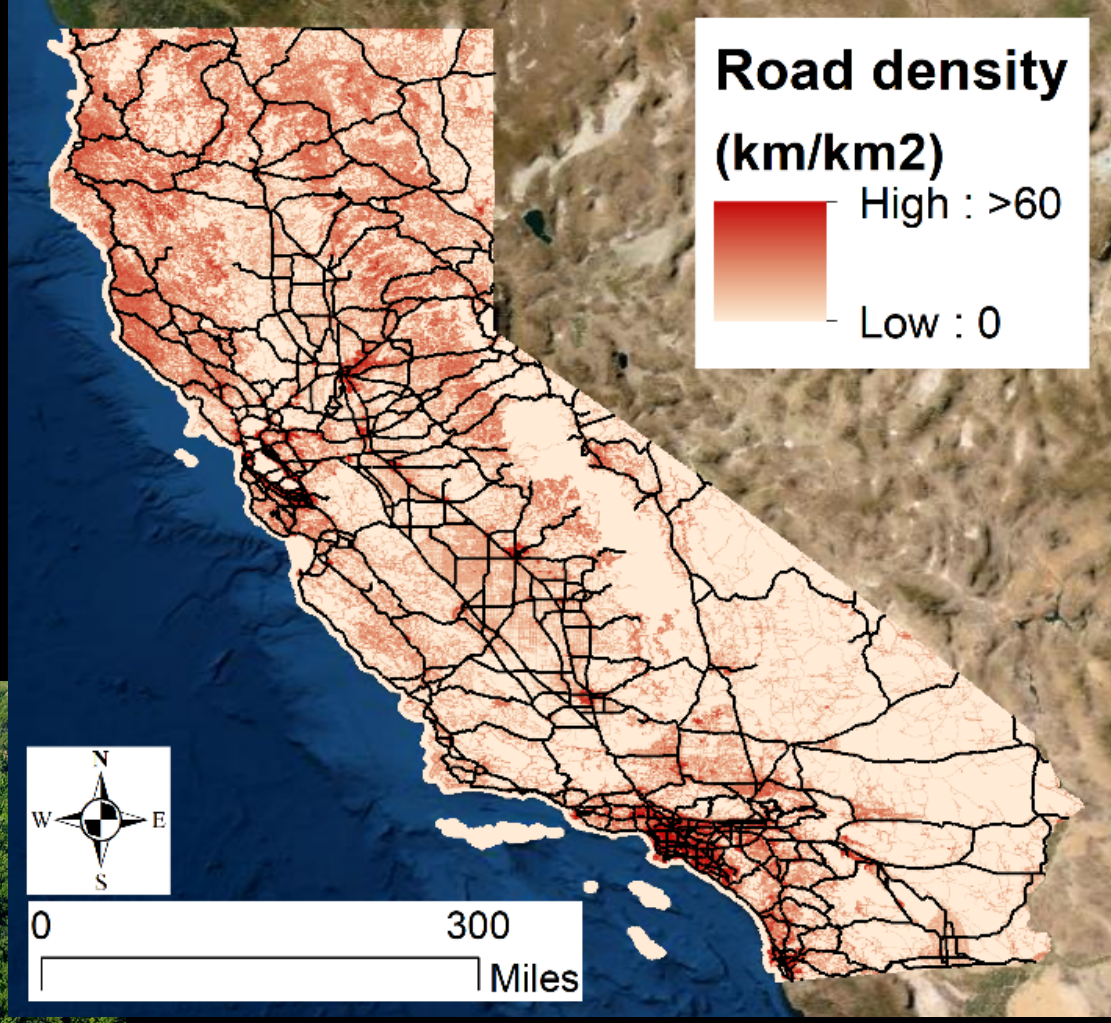
Thanks to: UC Davis: Autumn Iverson, Dave Waetjen, Graham Porter, Cameron Denney, Sean McDowell, Winston Vickers, Brock Ortega (Dudek), Norris Dodd (Aztec), Andrew Runk (Contech Engineering), Julie Kintsch (Eco-Resolutions), Clark Stevens (SMMRCD), Glen Kalisz and others (WSDOT)

National Center for Sustainable Transportation, Institute of Transportation Studies (UCD), Pew Charitable Trust, Caltrans, USDOT,

Volunteer-observers of the California Roadkill Observation System

Problems

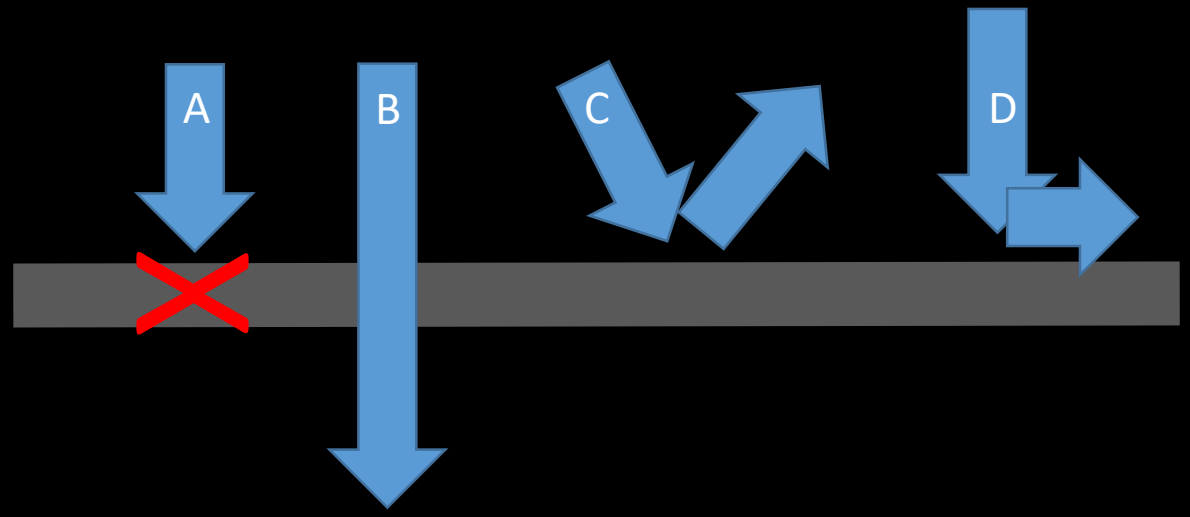
Roads and human presence everywhere



Problems

Impacts to Wildlife Connectivity

A) Attempt to cross – injury/mortality (barrier)
B) Attempt to cross – success (connectivity)
C) Fear (barrier)
D) Attraction



Problems

Wildlife need to move for day-to-day needs and for climate adaptation, but…

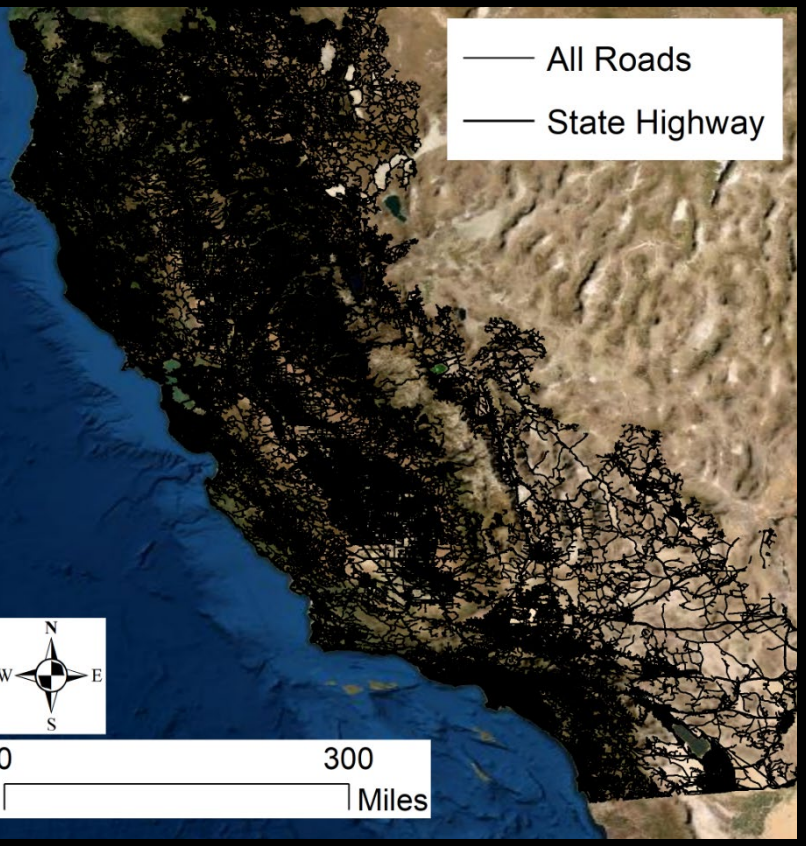


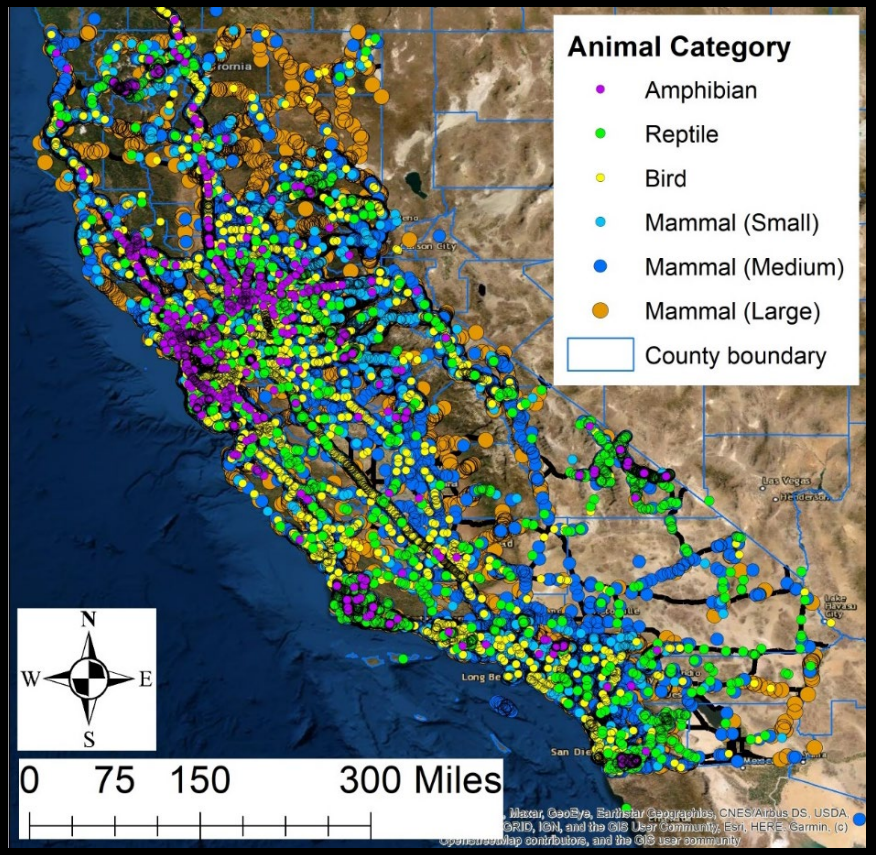


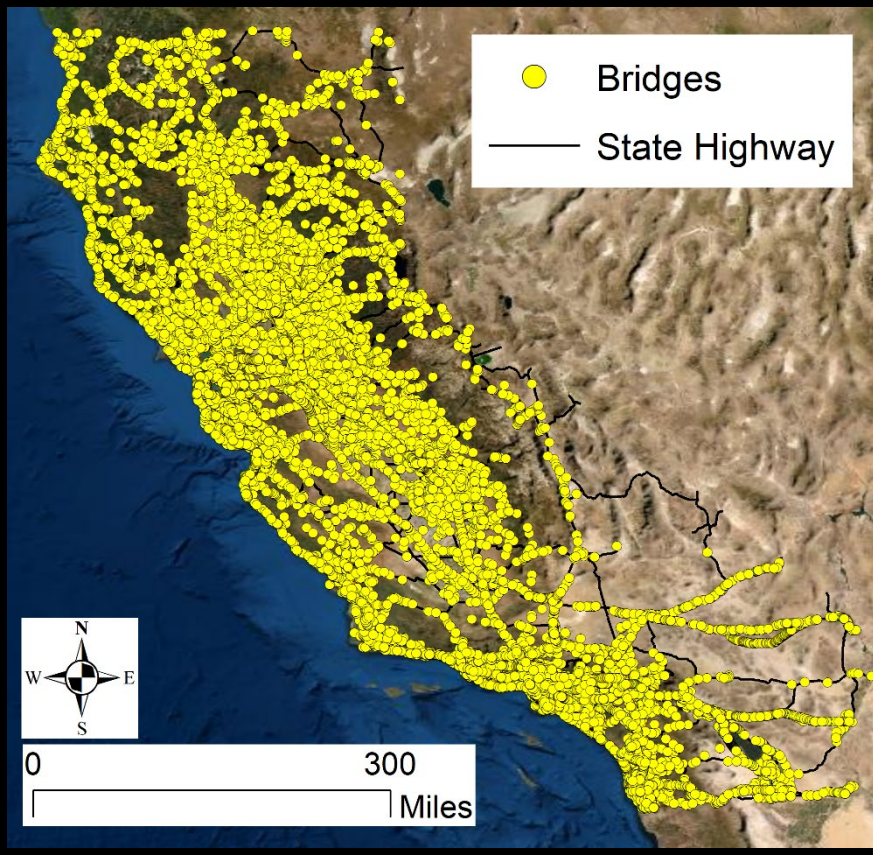


Problems

Wildlife impacted everywhere … but there are opportunities



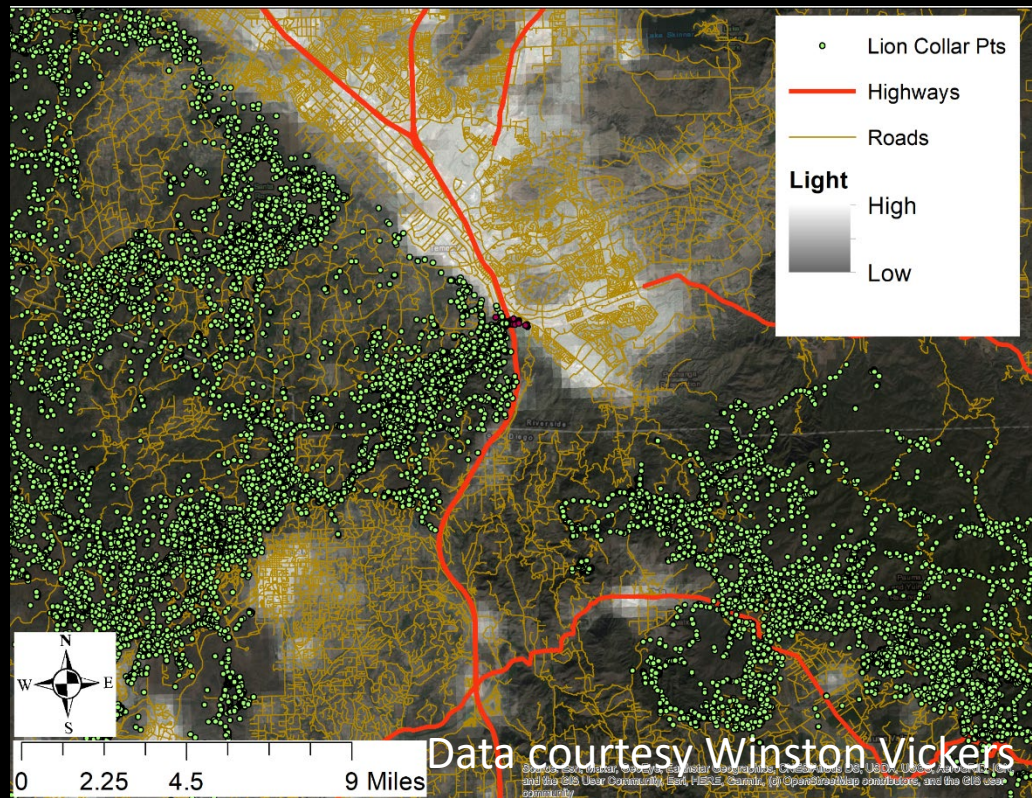




Solutions: Deciding Where to Act

Wildlife-vehicle collisions

Ecological barriers



Data courtesy Winston Vickers

Solutions: Deciding Where to Act

<u>Example: I-5</u>

Important freight corridor

1,381 miles

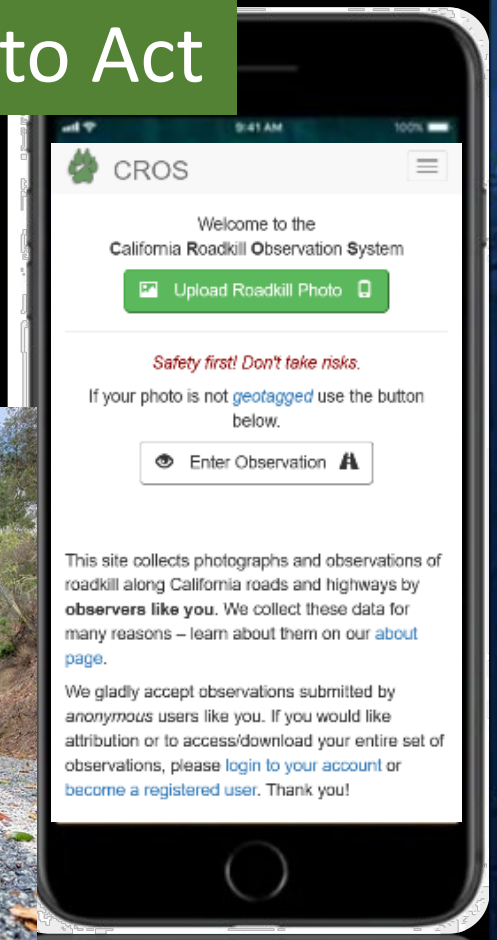
Critical ecological barrier: Tehachapis, Central Valley, Sacramento River Corridor, Klamath-Siskiyou-Cascades, Southern Cascades, Willamette Valley, SW Washington

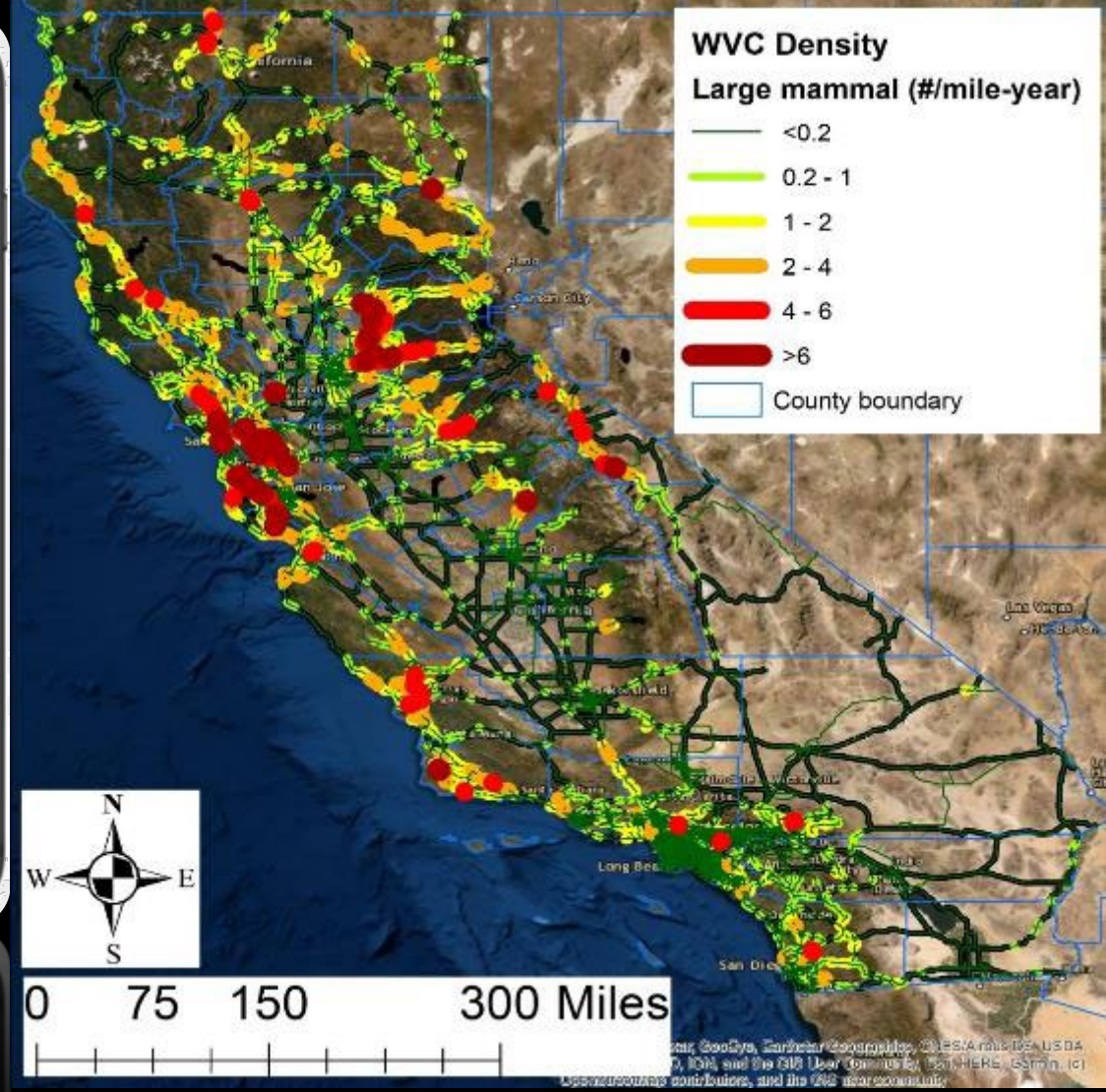
Wildlands Network and Road Ecology Center partnering to address this continental-scale barrier

Source: Wikipedia

Solutions: Deciding Where to Act

Merav Vonshak





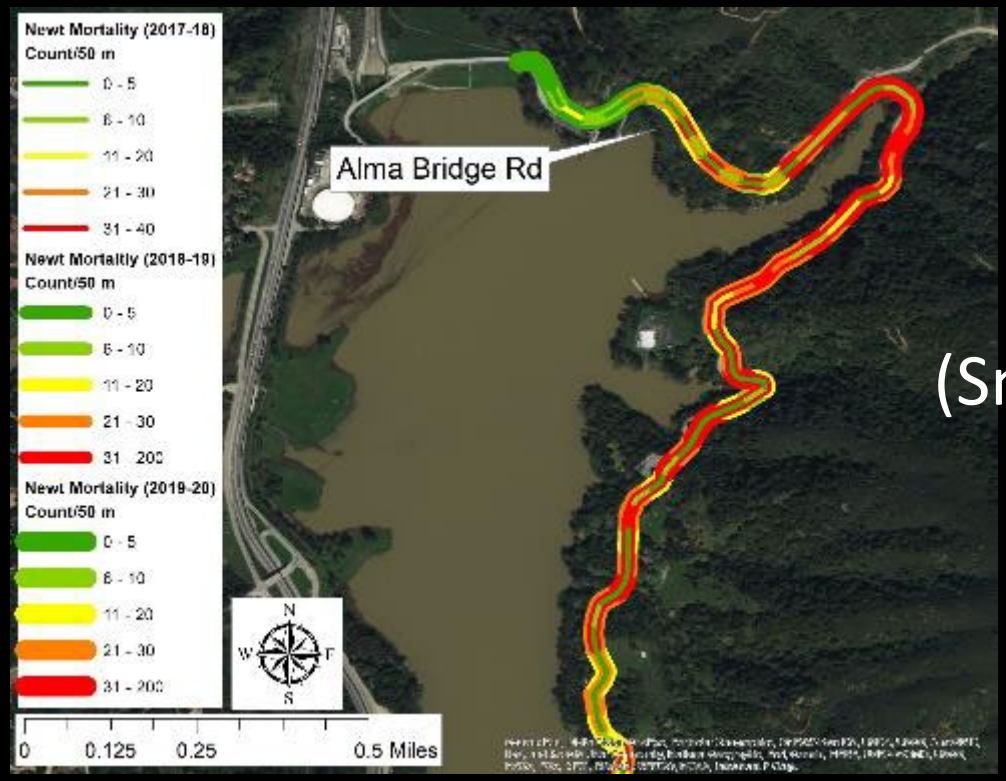
Data Collection: California Roadkill Observation System (https://wildlifecrossing.net/California)

Other big data states: OH, MO, ID, IA

Shilling and Waetjen (2015), Waetjen and Shilling (2017), Tiedemann et al. (2019)

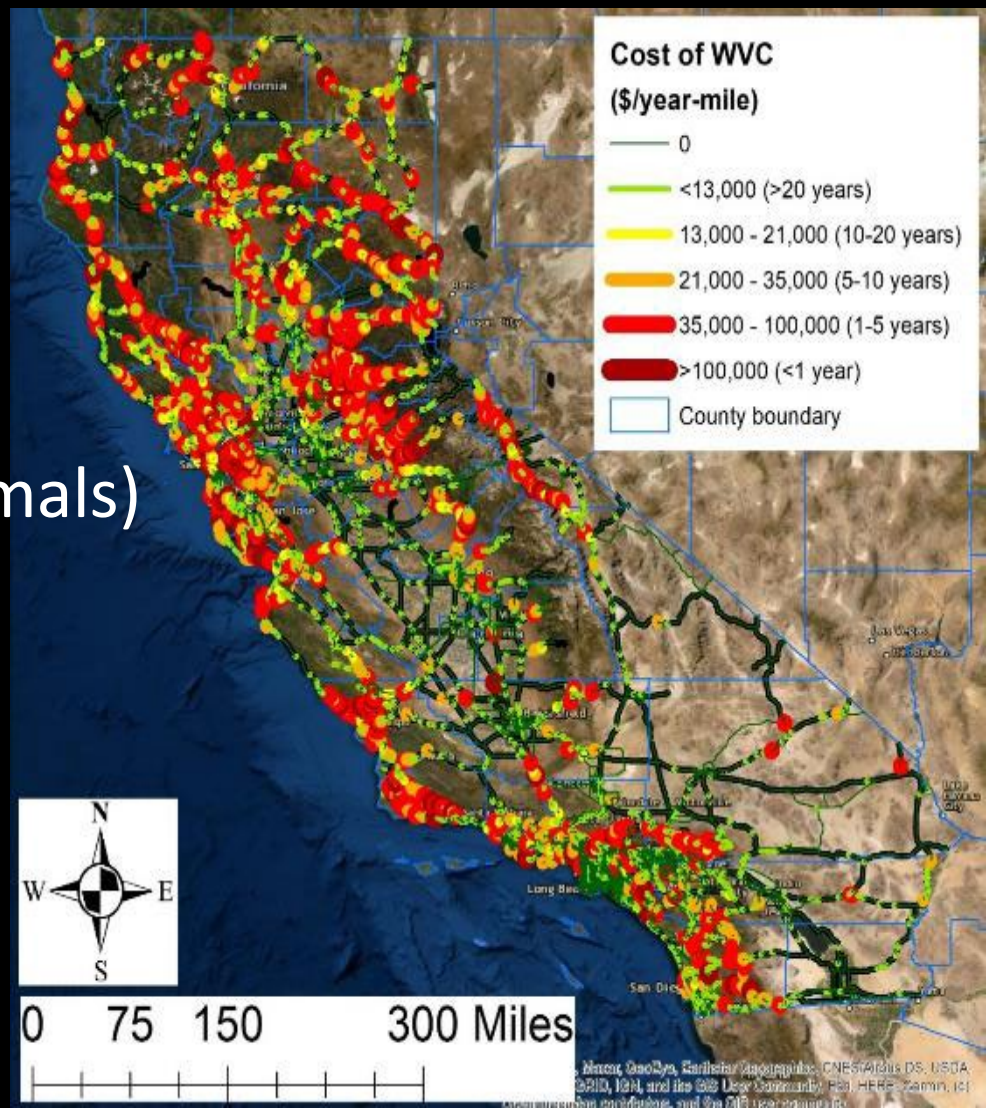
Solutions: Deciding Where to Act

Data to Decisions: Wildlife Crossing Calculator
(https://wildlifecrossingcalculator.org)



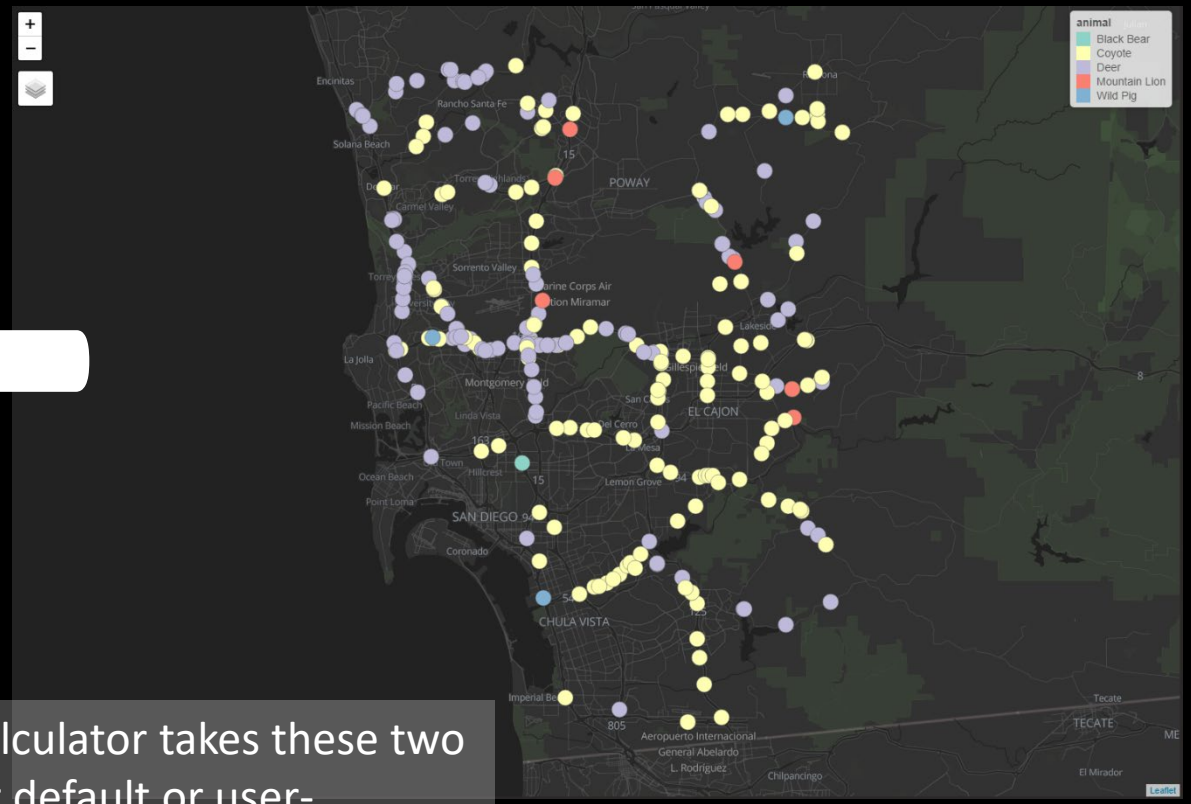
(Small amphibians)

(Large mammals)



Solutions: Deciding Where to Act - Economics

Data to Decisions: Wildlife Crossing Calculator (https://wildlifecrossingcalculator.org)



The Wildlife Crossing Calculator takes these two layers, along with either default or user-provided Crash Costs

Porter et al. (in prep)

Solutions: Deciding Where to Act

	A	B	C	D
1	Group	Severity	Cost	State
40	FHWA	K	10414947.98	MT
41	FHWA	A	603913.63	MT
42	FHWA	B	183019.94	MT
43	FHWA	C	115774.7	MT
44	FHWA	O	10977.95	MT

Crash severity = $$

Incident_ID	Year	Severity	Animal	g
	2020	A	Pronghorn	(
123457	2021	O	Deer	(-120.9170612635114, 38.67528282233594)

Wildlife value loss = $$

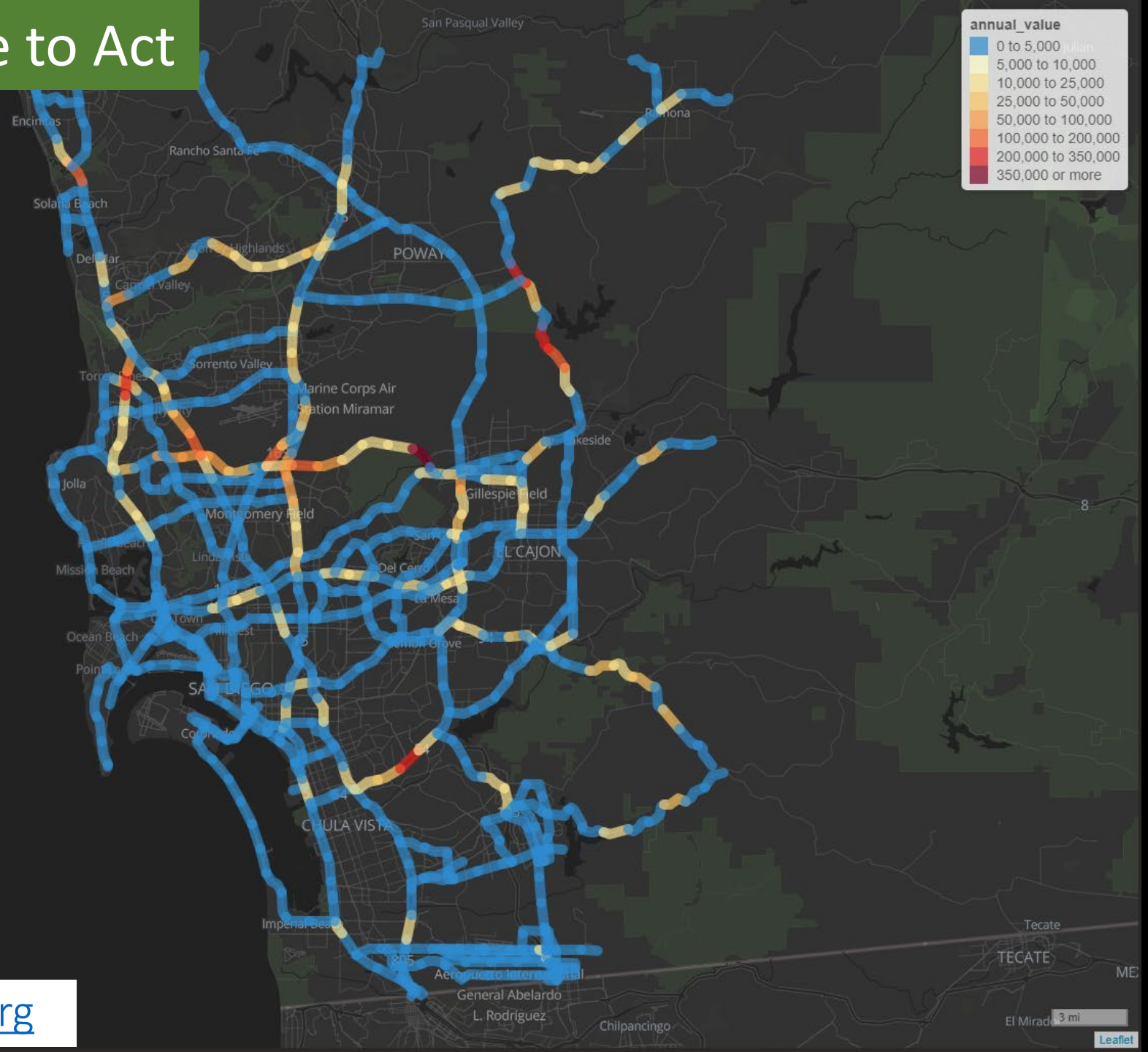
	A	B	C	D
1	Group	animal	Cost	Size
53	Restitution	Mountain Bighorn Sheep	30000	Large
54	Restitution	Elk	8000	Large
55	Restitution	Moose	6000	Large
56	Restitution	Mountain Goat	6000	Large
57	Restitution	Deer	8000	Large
58		Pronghorn	2000	Large

https://wildlifecrossingcalculator.org

Finding the Total Costs of Crashes

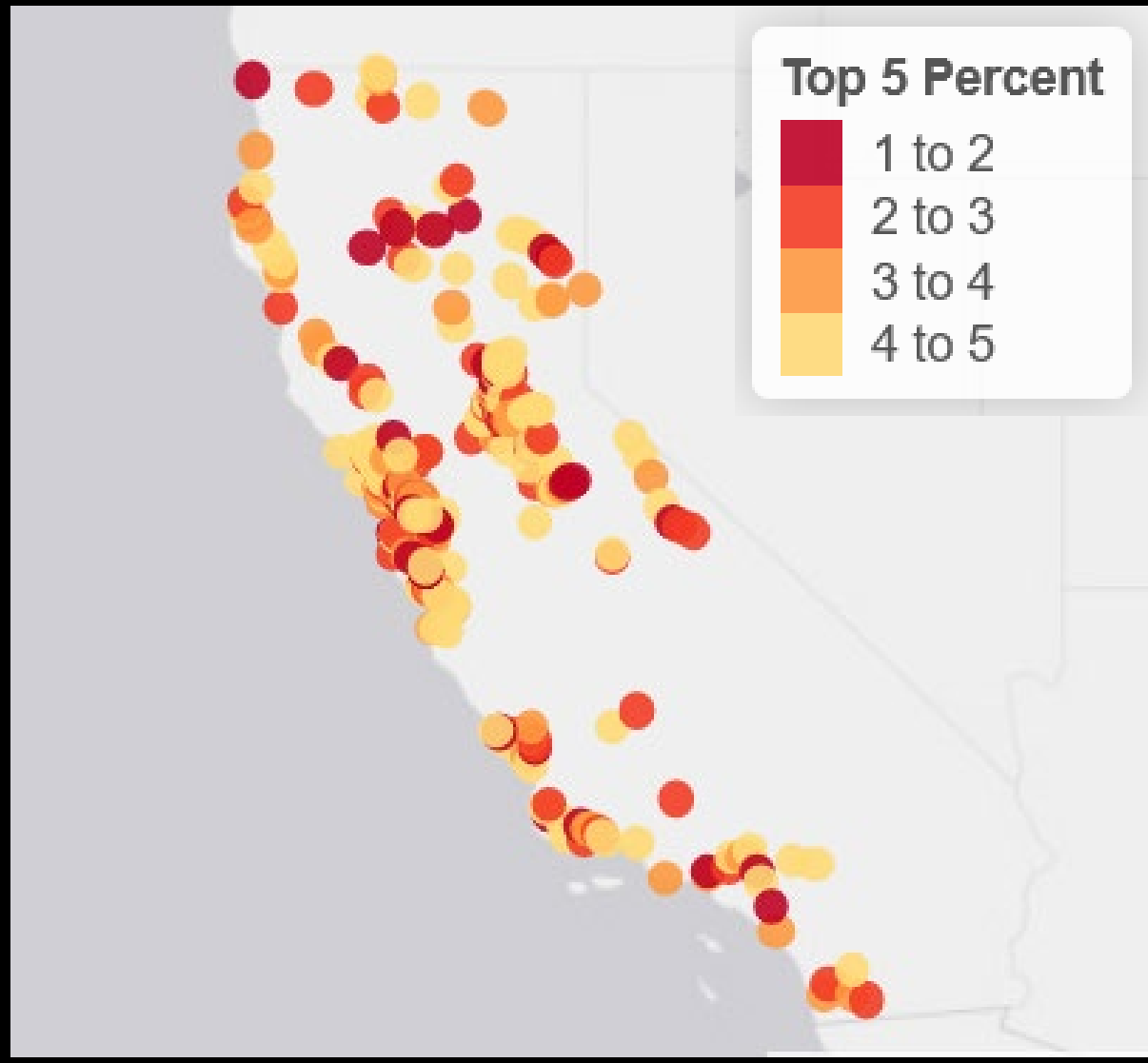
Solutions: Deciding Where to Act

Calculate annual total crash costs within each road segment.



https://wildlifecrossingcalculator.org

Solutions: Deciding Where to Act



https://wildlifecrossingcalculator.org

Mitigation Project Planning

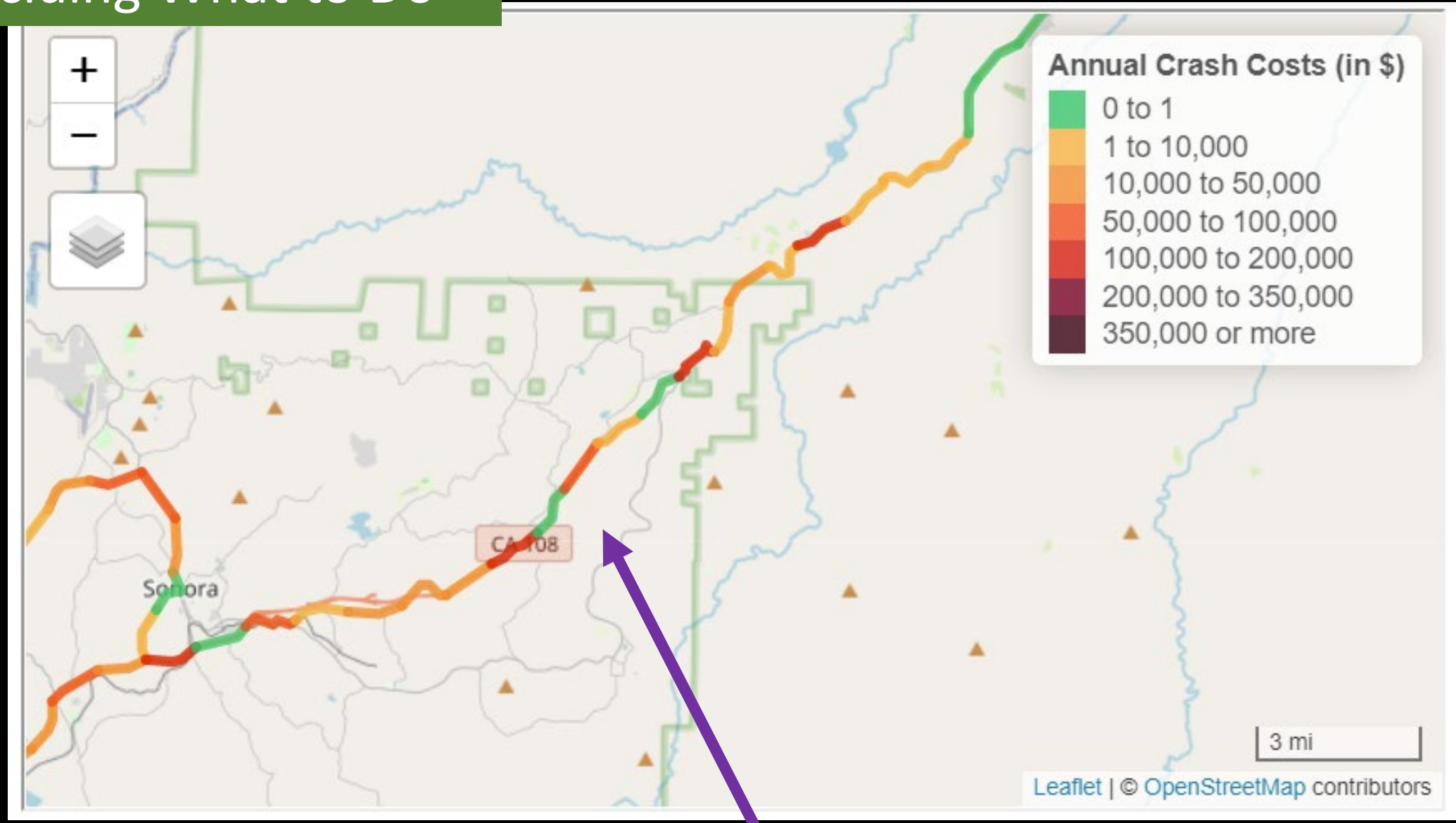
WVC economic values associated with each road segment.

Use these values to run benefit-cost analyses to see if mitigation is economically “worth” doing.

Perform a **Net Present Value** calculation to achieve quantitative assessment of project costs compared with benefits.

https://wildlifecrossingcalculator.org

Solutions: Deciding What to Do



Example Study Area (SR 108)

https://wildlifecrossingcalculator.org

Solutions: Deciding What to Do

Mitigation Feature	Cost (in 2020 $)
Overpass	300 / sq. ft.
Overpass Maintenance	15 / sq. ft. / yr
Fencing	10 / ft.
Fencing Maintenance	1 / ft. / yr

Mitigation Feature	Lifespan
Overpass	50
Fencing	25

Annual Crash Costs

$962,929

What type of mitigation do you want to use?

68,000 How many **feet** of fencing do you want?

How many **feet** long is your underpass (culvert)

How many **feet** wide is your underpass (culvert)

How many **feet** long is your underpass (bridge)

How many **feet** wide is your underpass (bridge)

125 How many **feet** long is your overpass (bridge)

80 How many **feet** wide is your overpass (bridge)

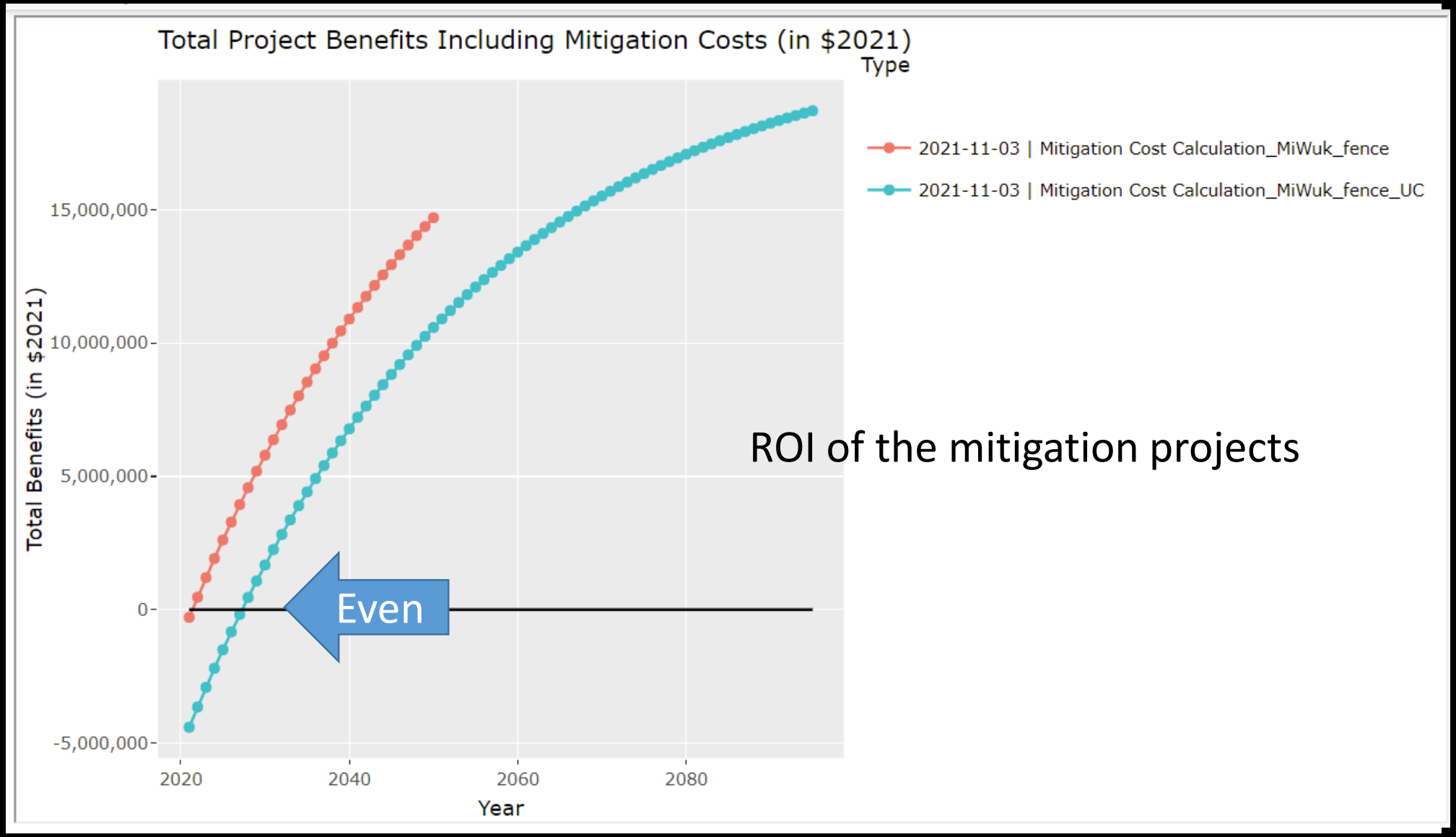
RUN

Total Costs for life-span of structures

Total Value for life-span of mitigation

https://wildlifecrossingcalculator.org

Solutions: Deciding What to Do



ROI of the mitigation projects

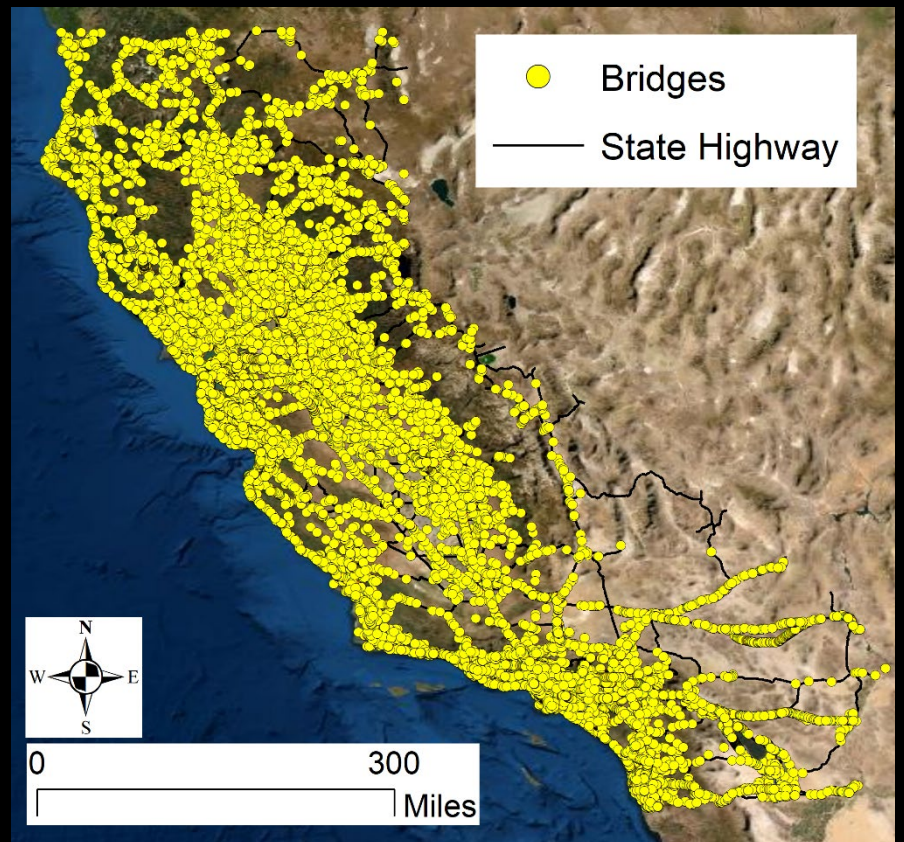
https://wildlifecrossingcalculator.org

Solutions: Deciding What to Build

Existing and New Diverse Crossings for Diverse Wildlife

Fencing to existing structures

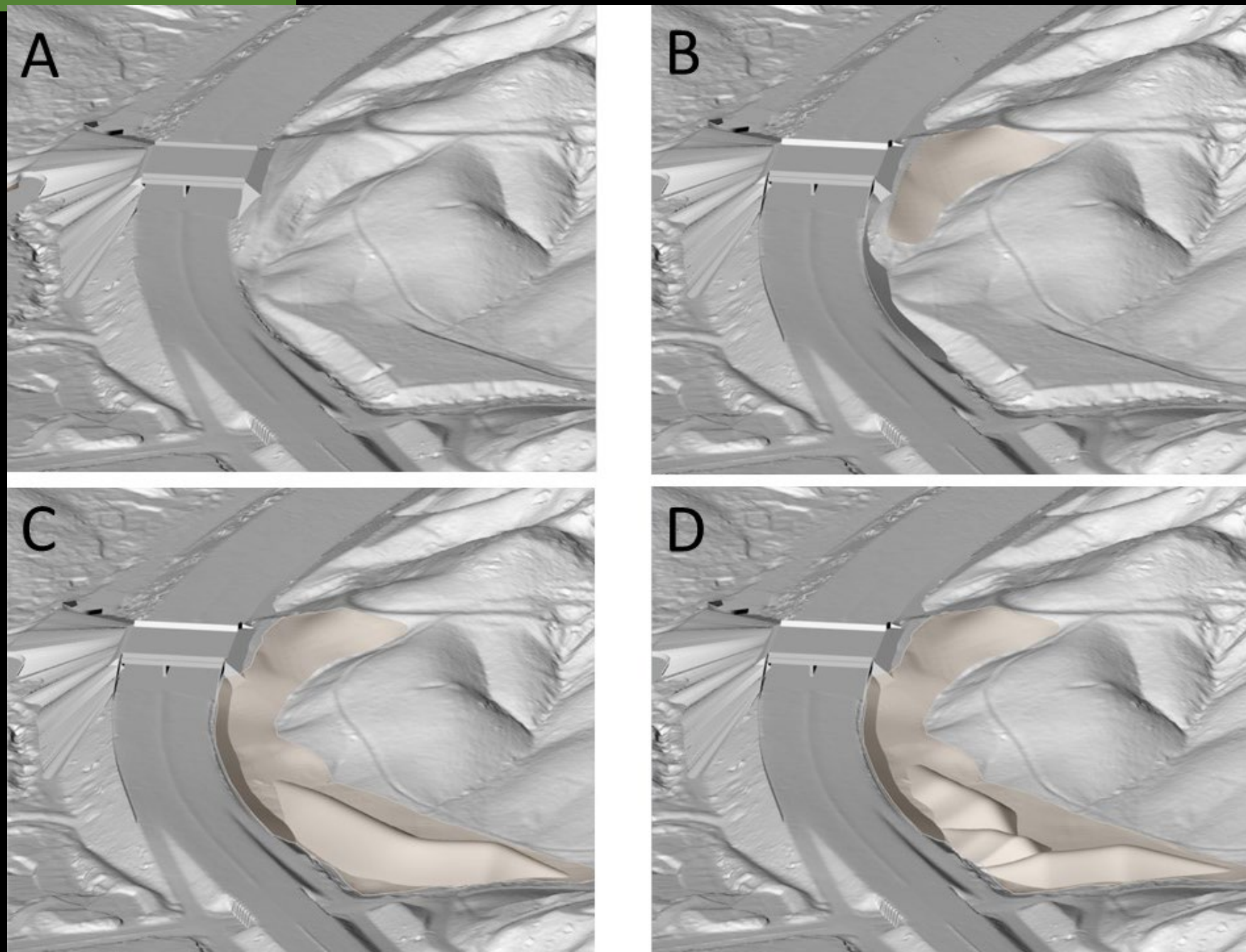
Tens of thousands of bridges that wildlife already use



Solutions: Deciding What to Build

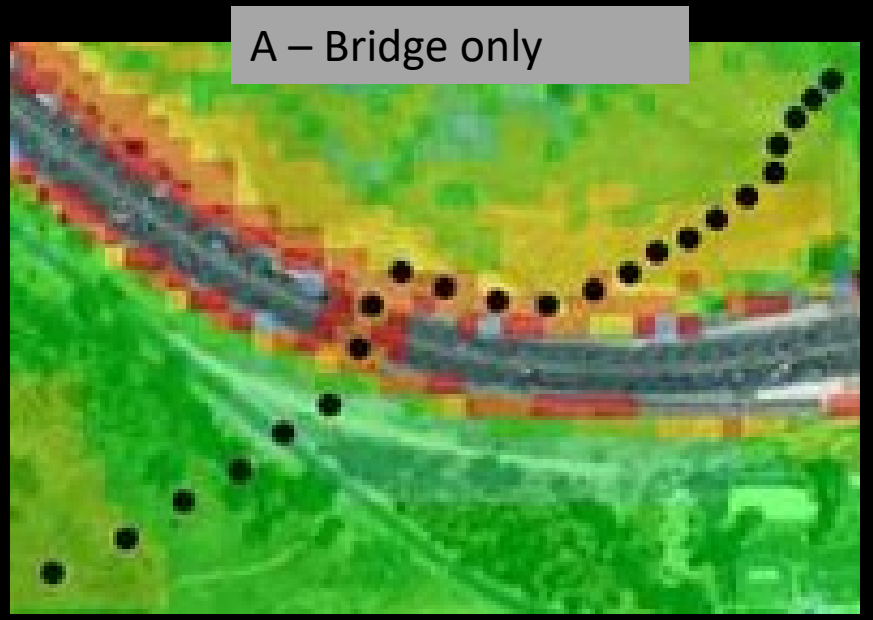
Design for the Largest Wildlife Crossing in the World: Wallis-Annenberg (US 101)

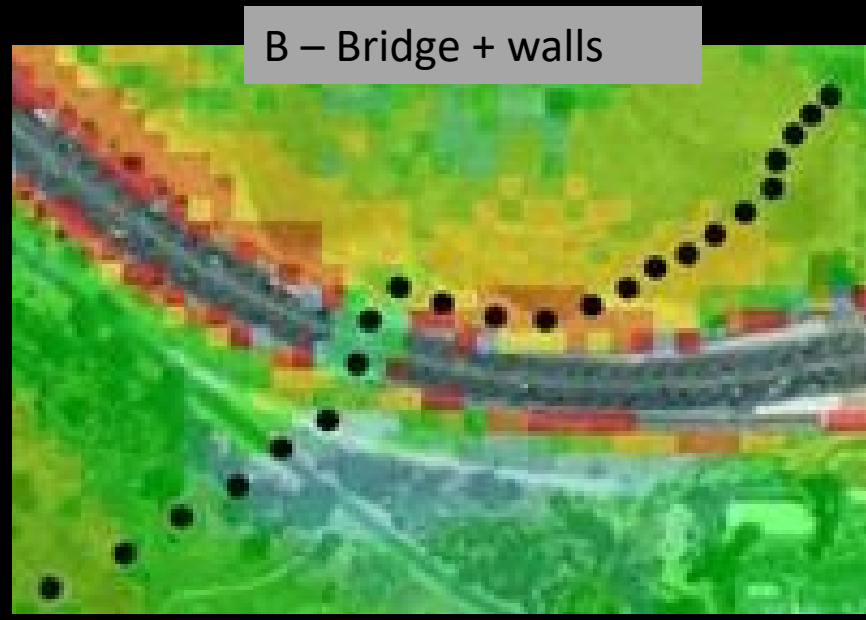
Shilling et al. (2022)
McDowell et al. (in prep)

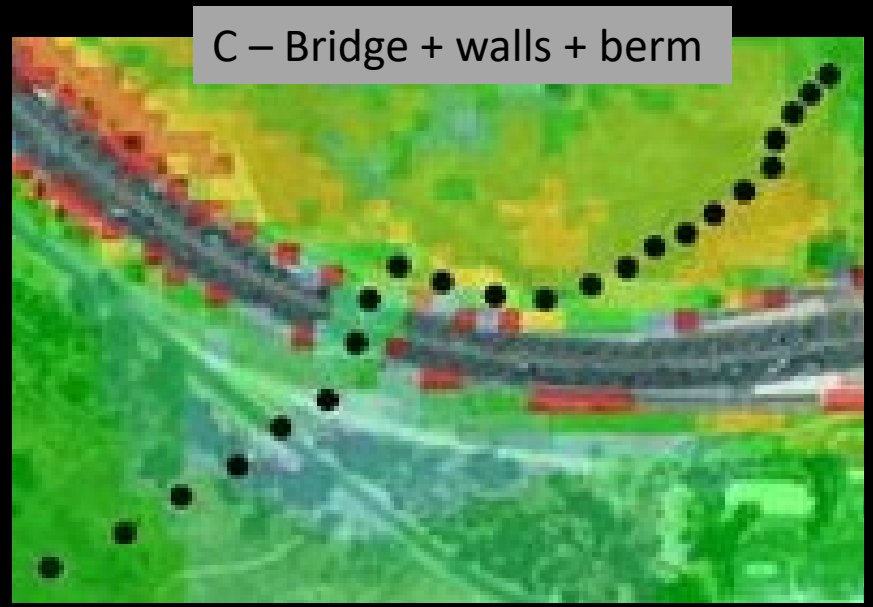


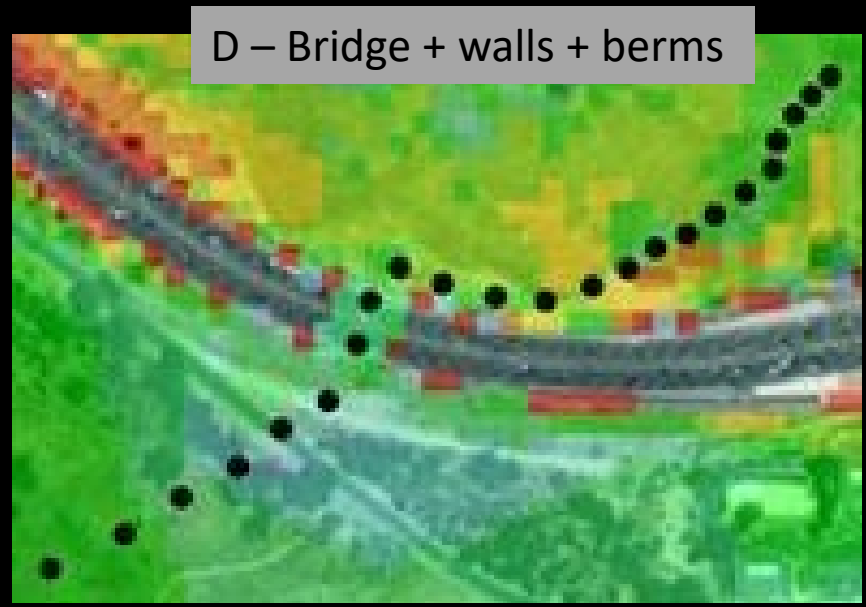
Solutions: Deciding What to Build

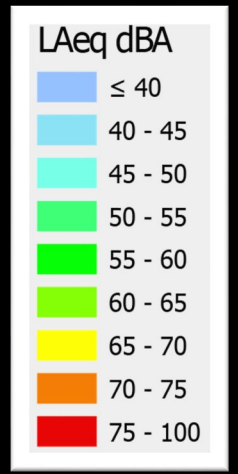
Designing Reduced Traffic Noise











Solutions: Deciding What to Build

Designing Reduced Traffic Glare

Contact

fmshilling@ucdavis.edu
https://roadecology.ucdavis.edu

Courtesy Winston Vickers, UC Davis

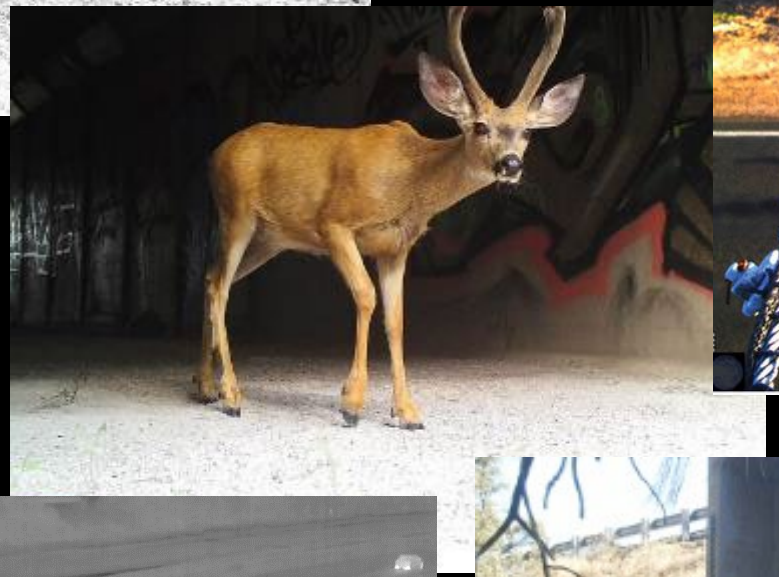
And now …

Andrew Runk, California Bridge Consultant for Contech Engineering Solutions: "*Prefabricated Land Bridges and Wildlife Crossing Solutions*"

Solutions

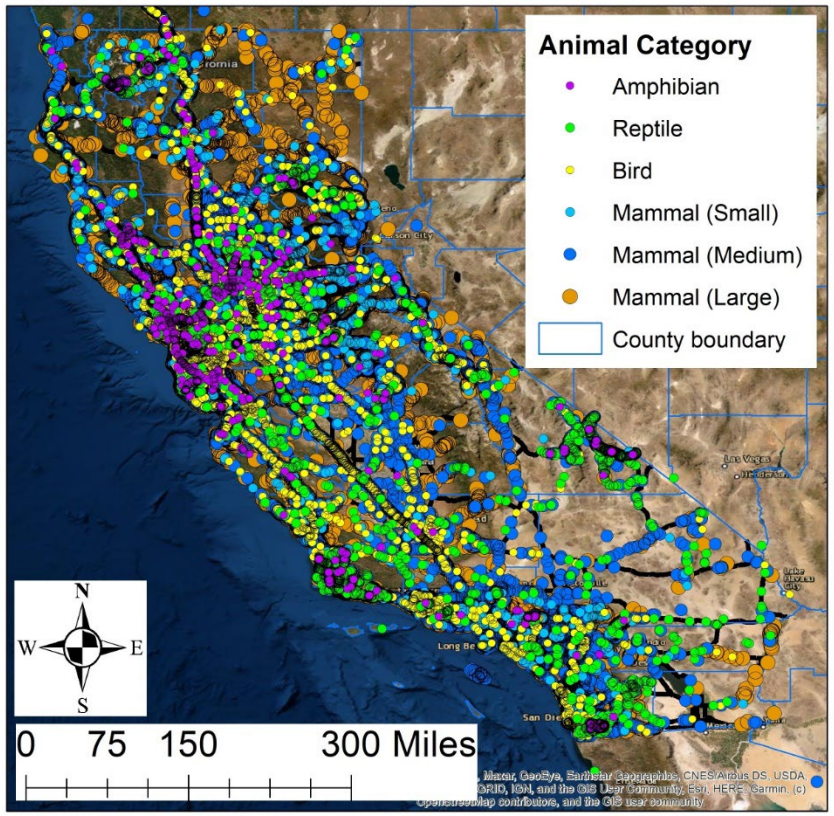
Wildlife Crossings

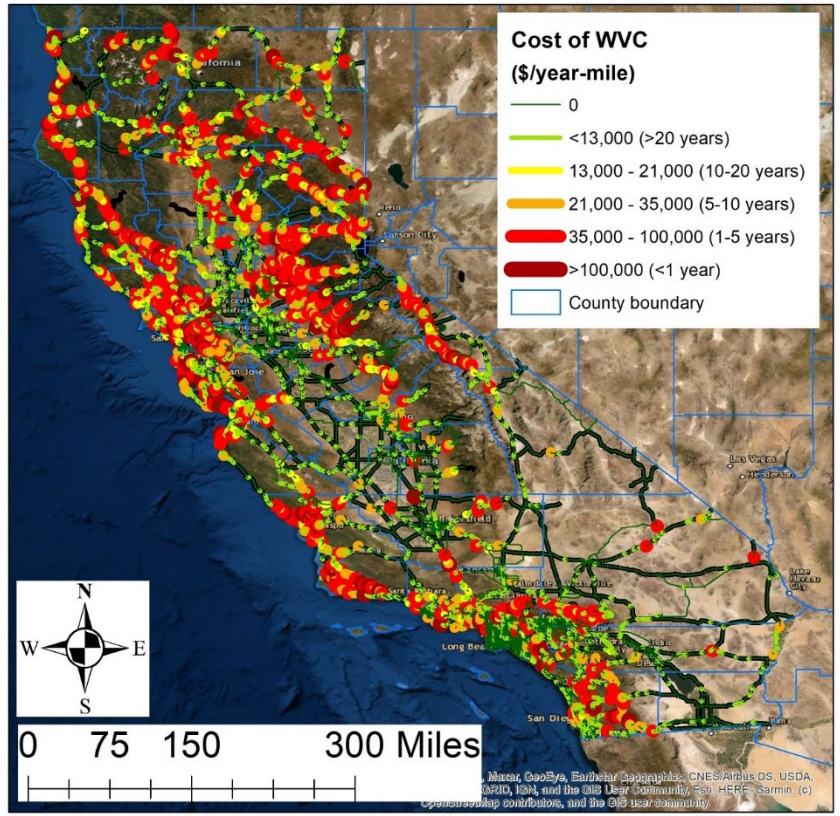
We need many more wildlife crossings in California for climate adaptation

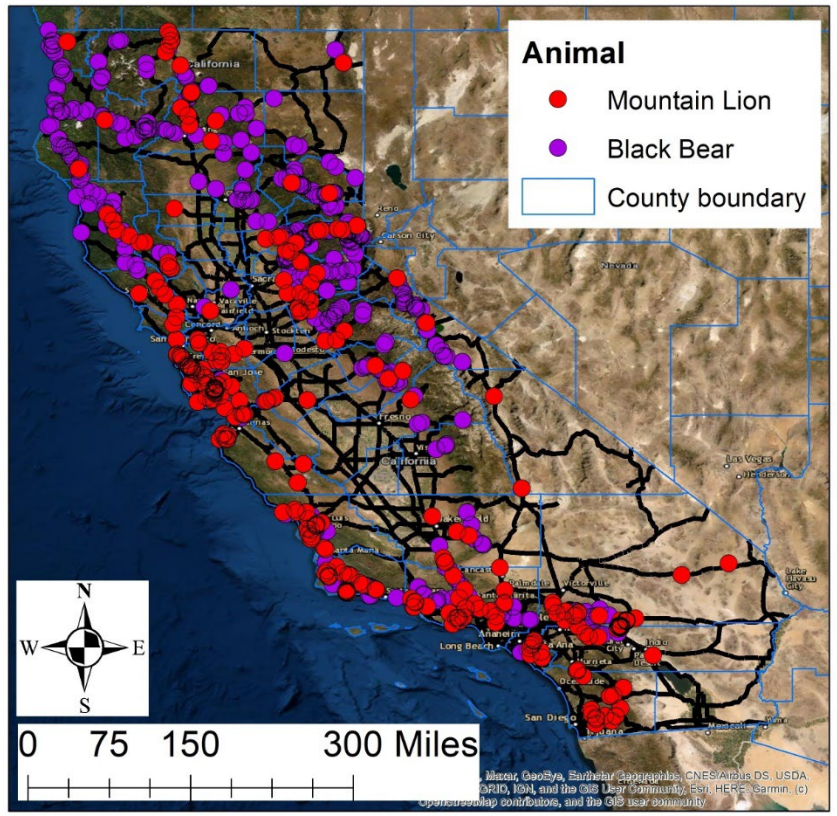


Wildlife Mortality

- Species
- Locations







Prefabricated Structures

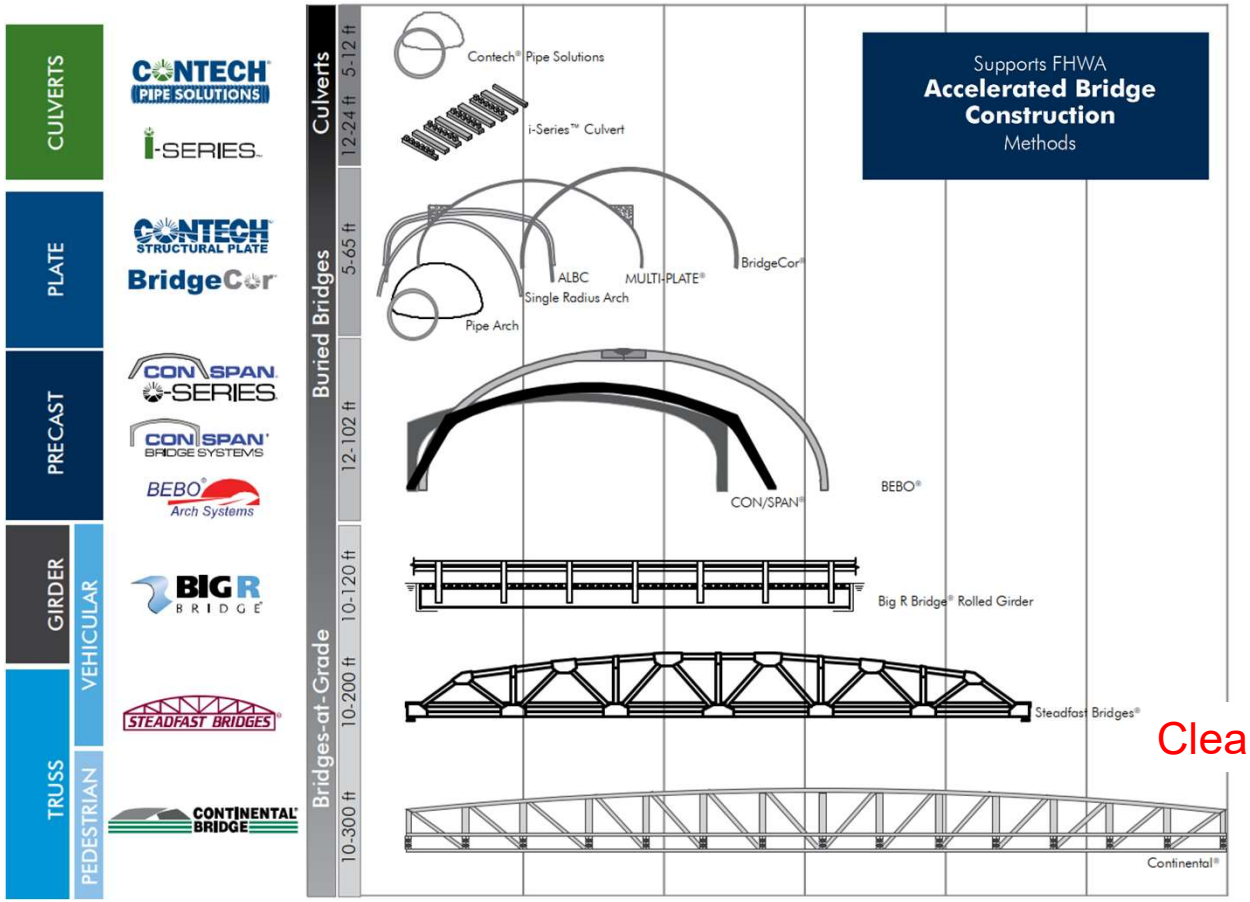
- Andy Runk
- Regional Bridge Consultant, California
- Contech Engineered Solutions
- Andrew.runk@conteches.com
- 303-241-8154

- www.conteches.com

Agenda

- Introduction
- Federal Initiatives
- Prefabricated Elements
- Solution Overview
- Case Study
- Tools and Support

Clear Span Bridges



Clear spans to 300’

U.S. Department of Transportation
Federal Highway Administration

Accelerated Bridge Program

Connection Details for Prefabricated Bridge Elements and Systems

March 30, 2009

Publication No. FHWA-IF-09-010

U.S.Department of Transportation
Federal Highway Administration

Priority, Market Ready Technologies and Innovations

HIGHWAYS FOR LIFE
Accelerating Innovation for the American Driving Experience.

Figure 2.4.3-1 depicts a proprietary arch system call the Con/Span® Bridge System. This system, including the arch elements, the spandrel walls, the wingwalls and the footings, can be completely made with precast concrete elements. The connections shown in Figure 2.4.3-1 are described in the following sections.

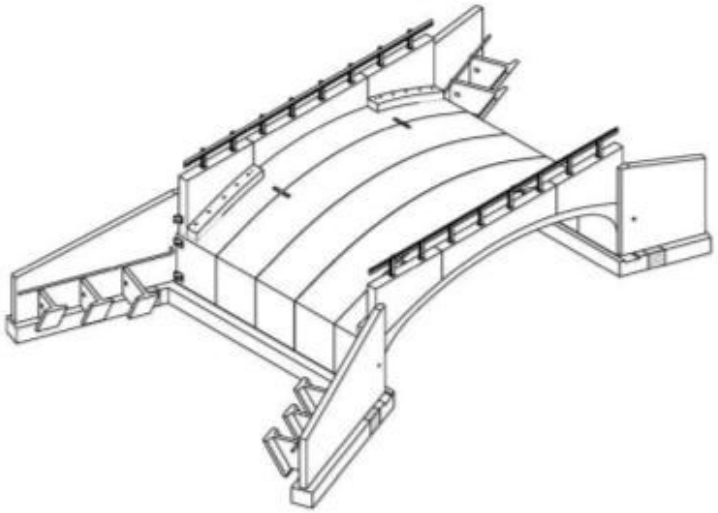


Figure 2.4.3-1 Con/Span® Bridge System

Page 2-181

"Prefabricated elements of a bridge produced off-site can be assembled quickly, and can reduce design time and cost, minimize forming, minimize lane closure time and/or possibly eliminate the need for a temporary bridge."

U.S. Department of Transportation
Federal Highway Administration

Accelerated Bridge Program

Accelerated Bridge Construction (ABC):

- ABC is bridge construction that uses innovative planning, design, materials, and construction methods in a safe and cost-effective manner to reduce the onsite construction time that occurs when building new bridges or replacing and rehabilitating existing bridges

Prefabricated Bridge Elements and Systems

- PBES are structural components of a bridge that are built offsite, or near-site of a bridge and include features that reduce the onsite construction time and the mobility impact time that occurs when building new bridges or rehabilitating or replacing existing bridges relative to conventional construction methods.

Accelerated Bridge Process

It All Starts with Collaborative Solution Development

- Feasibility Studies
- Estimating
- Design
- Permitting
- Construction/Fabrication

Quality Controlled Manufacturing
While Site is Being Prepared

Accelerated Bridge Process

Efficient Logistics and Assembly

Backfill and Completion

Modular Components

PRECAST FOUNDATION

PRECAST ARCH UNIT

PRECAST HEADWALL

PRECAST WINGWALL

TWIN LEAF CONSTRUCTION

CURVED ALIGNMENT

Prefab vs. Conventional

US 12 Wildcat Creek Rapid Bridge Replacement

Owner: WSDOT Engineer: Stantec Contractor: Graham

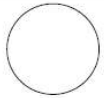
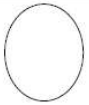
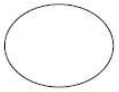
- Eliminated long term maintenance cost
- Increased safety with limited/no freeze concerns & deck maintenance
- OPENED IN 17 DAYS!

Buried Bridge

- Resulted in $2 Million in Savings
- Reduced Traffic Impact by 3 Months
- Reduced the project footprint and tree removal
- Avoided Pile-Driving & Associated Impacts

Structural Steel or Aluminum Plate

Structural Plate Standard Shapes

Shapes		Sizes=Span x Rise
Round		5′ to 50′-6″
Vertical Ellipse		4′-8″ x 5′-2″ to 25′ x 27′-8″
Underpass		12′-2″ x 11′-0″ to 20′-4″ x 17′-9″
Pipe-Arch		6′-1″ x 4′-7″ to 20′-7″ x 13′-2″
Horizontal Ellipse		7′-4″ x 5′-6″ to 14′-11″ x 11′-2″
Arch (single radius)		6′ x 1′-10″ to 54′-4″ x 27′-2″
Arch (2-radius)		18′-5″ x 8′-4″ to 50′-7″ x 19′-11″
High-Profile *		20'-1 x 9'-1" to 65'-0" x 28'-2"
Box Culvert		8′-9″ x 2′-6″ to 35′-3″ x 13′-7″

MULTI-PLATE/ Aluminum Structural Plate

BridgeCor

Aluminum Box Culvert / BridgeCor

Lightweight, Bolted Plate Construction

FREIGHT ECONOMY

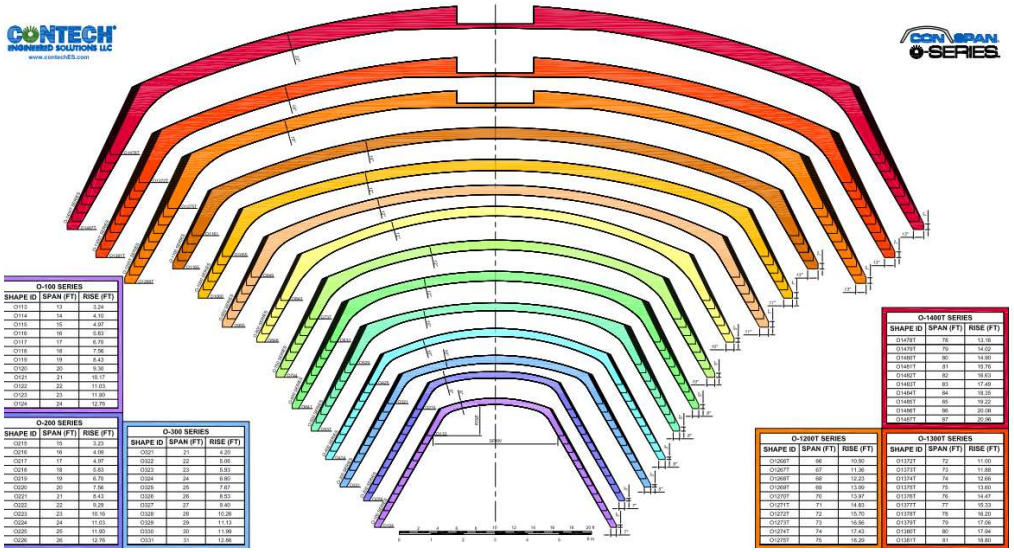
EFFICIENT ASSEMBLY

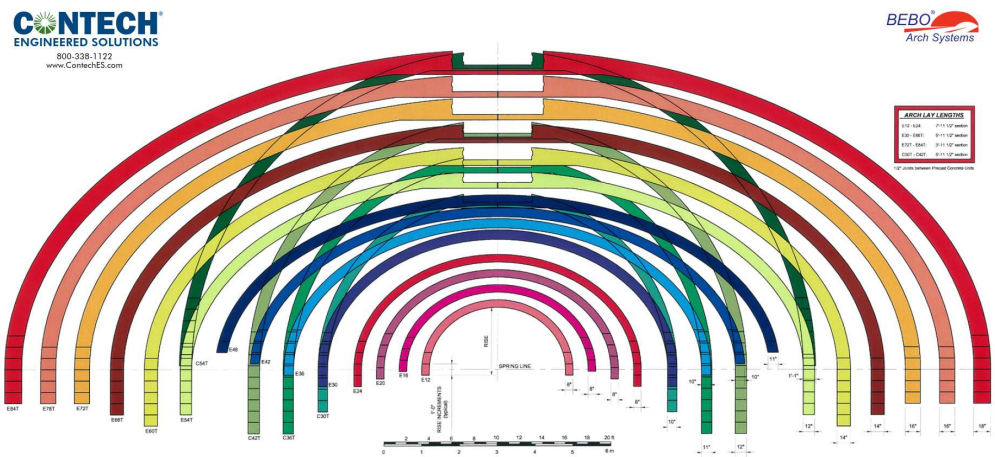
LIFT AND SET IN PLACE

HANDLES HIGHWAY LOADING

Precast – CON/SPAN and BEBO Concrete Arches

Precast Concrete Arch Systems



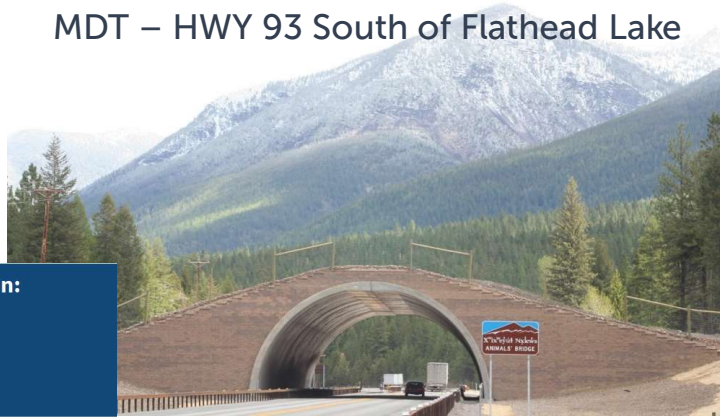


Truss Bridges – Pedestrian and Vehicular

Freight Economy / Simple Installation

Prefabricated Overcrossing Examples

MDT – HWY 93 South of Flathead Lake



Technical Description:

- Span: 54-ft.
- Rise: 24-.ft. 4-in.
- Length: 198-ft.

CDOT – SH9 South of Silverthorne

Technical Description:

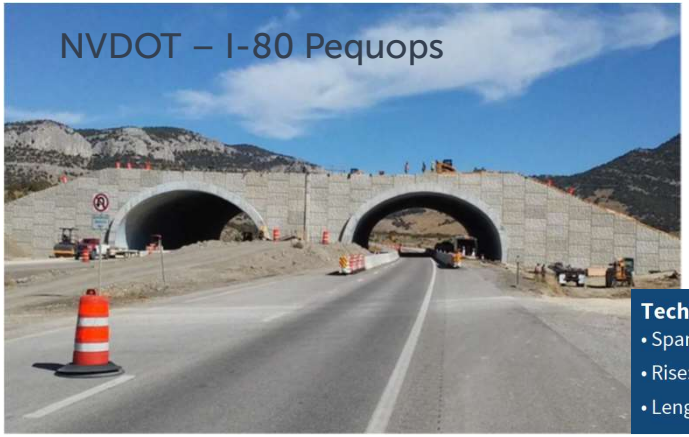
- 2 - 66' x 24' x 100' BEBO®
- 5 - 41' x 10'-7 7/8" x 66' CON/SPAN® O-Series®

Riverside County, CA – Clinton Keith

Technical Description:

- 60' x 22' x 109.63' BEBO® Bridge Concrete Arch System
- 66' x 24' x 109.63' BEBO® Bridge Concrete Arch System

NVDOT – I-80 Pequops



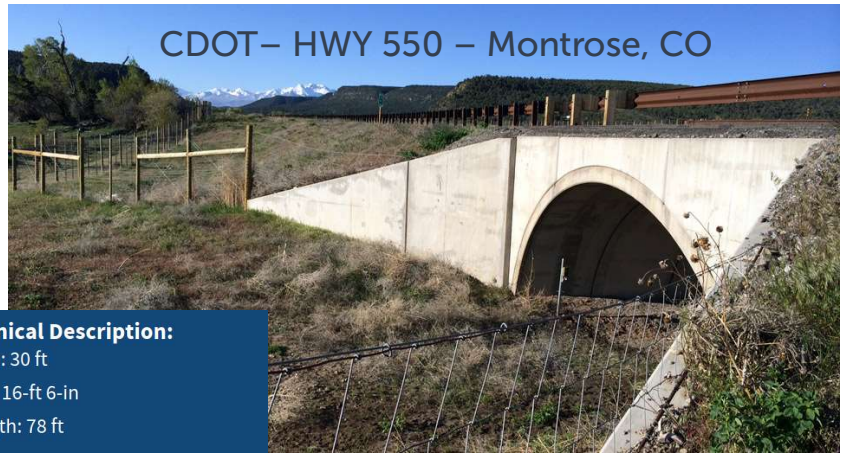
Technical Description:

- Span: 66'
- Rise: 26.5'
- Length: 200'

Prefabricated Undercrossing Examples

Technical Description:
- Span: 48 ft
- Rise: 11 ft
- Length: 50 ft

UDOT – I-70 Sevier County



CDOT– HWY 550 – Montrose, CO

Technical Description:
- Span: 30 ft
- Rise: 16-ft 6-in
- Length: 78 ft

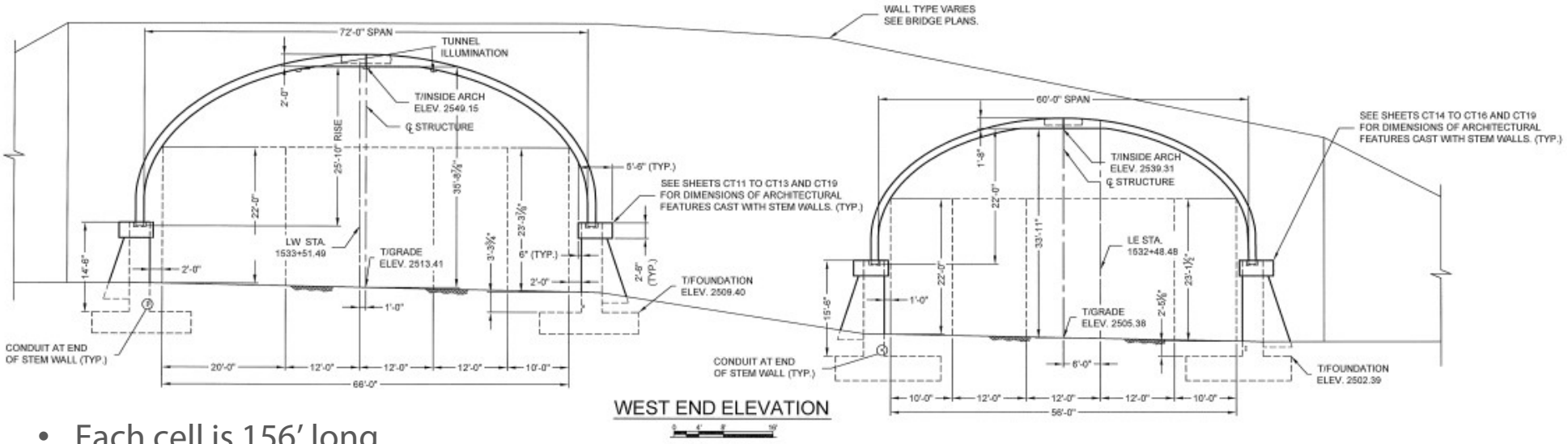
Technical Description:
- Span: 15.6 ft
- Rise: 10.5 ft
- Length: 94 ft

UDOT– US 191 – Monticello, UT

Structure assembled in 20 Hours!

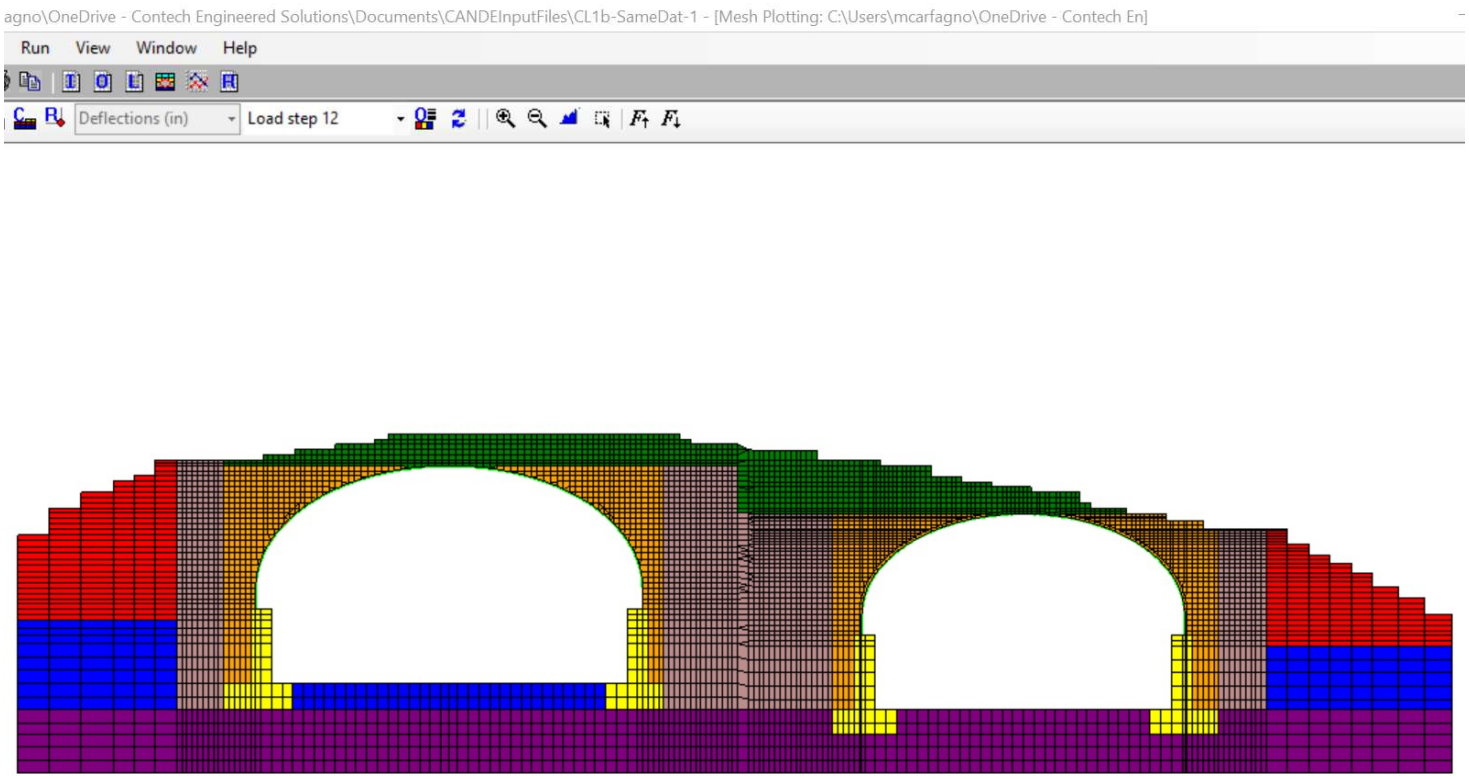
- I-90 Animal Crossing, Washington

West End Elevation



- Each cell is 156’ long
- Clearance box is 22’-0” tall for the full width of 66’ (3-12’ lanes + 10’ shoulder + 20’ chain-up) for the westbound structure.
- Eastbound structure is similar with 22’ tall clearance box for the full width of 56’ (3-12’ lanes + 2-10’ shoulders)
- In order to achieve the vertical clearance, the arch units were set on pedestal walls of varying heights – 14’-6” to 17’-6”.

CANDE Finite Element Model

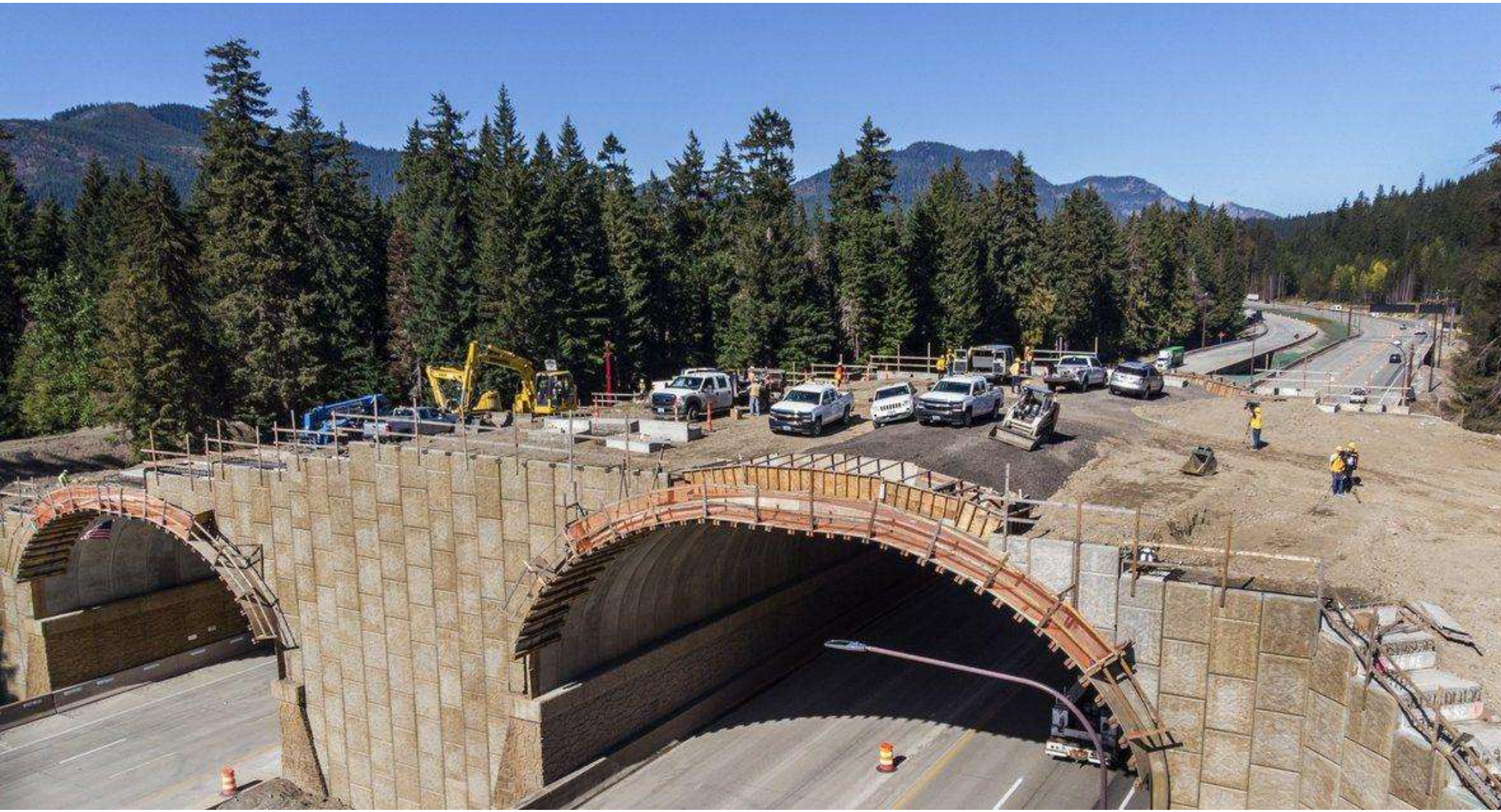


- CANDE Program uses the Finite Element method to model both the structure and the soil mass surrounding it capturing the nonlinear behavior of the structure, the soil and the soil-structure interface.
- Maximum soil cover is 6'-0" over 72' span
- Design live load was HL-93 (construction loading) or 320 psf snow load
- Seismic racking analysis per NCHRP Report 611: *Seismic Analysis and Design of Retaining Walls, Buried Structures, Slopes and Embankments*

I-90 Animal Crossing

BEBO
Precast
Concrete
Arches

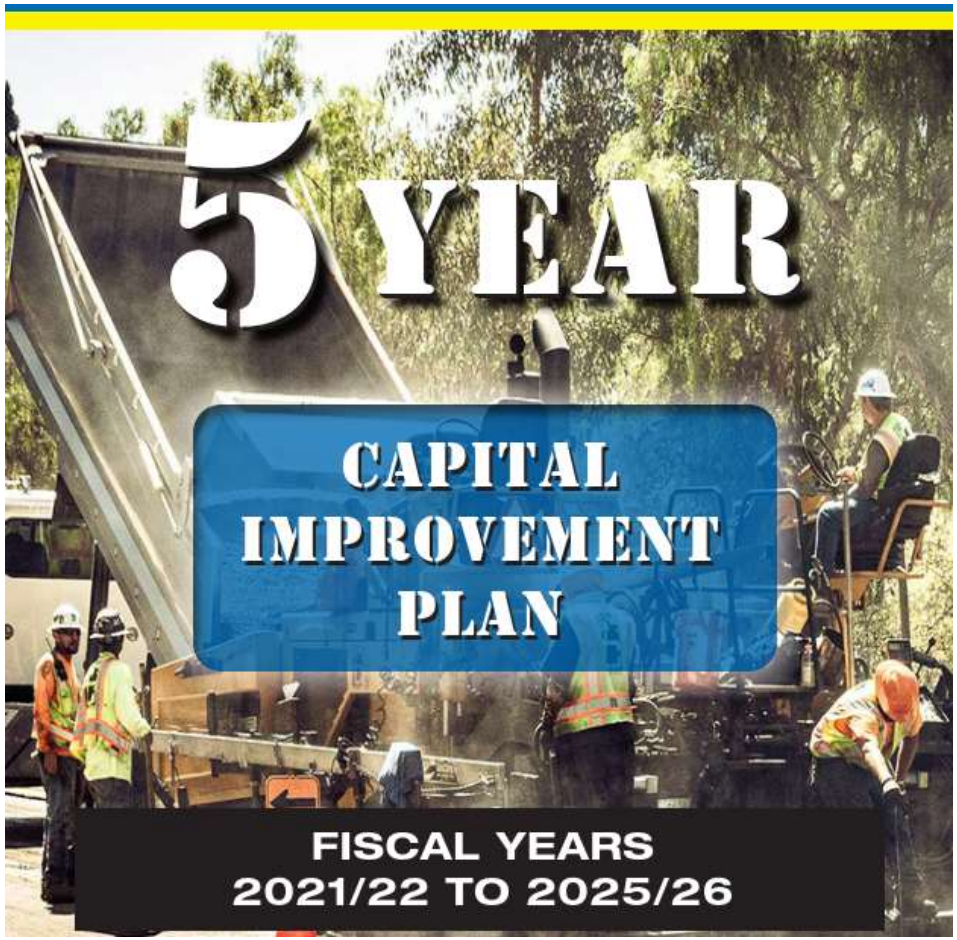

ATKINSON



Where and how to utilize prefabricated structures

Cost Effective Long-term Solution Development

- Prefabricated Structures save time and money and can enable agencies to complete more agency CIP projects.
- Save time and money on feasibly studies, engineering, material and construction.
- Contech can be utilized as a resource to develop estimates, feasibility planning, design and construction as a service.



Markets Served

Building Blocks to a Successful Project

Solution Development | Design Support | Installation

DYO ALBC

Design your own ALBC project.
Products:
Aluminum Box Culvert

DYO PRECAST

Design your own Precast project.
Products:
CON/SPAN

DYO TRUSS

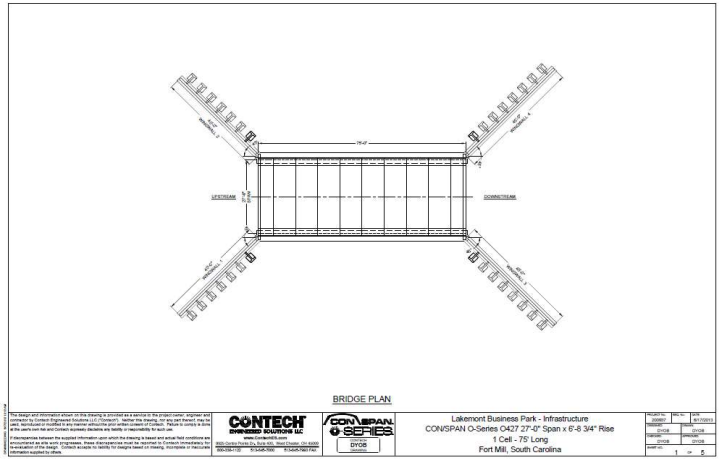
Design your on Truss project
Products:
Steadfast Continental

DYO MODULAR ROLLED GIRDER

Design your own Modular Rolled Girder
Products:
Big R EXPRESS Modular Rolled Girder

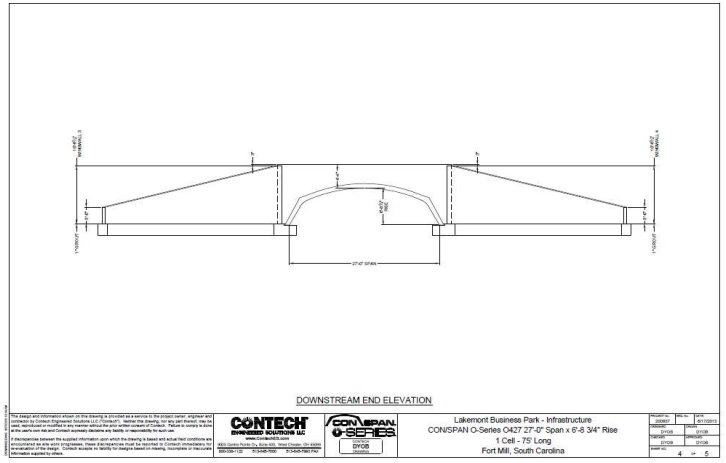
DYOB – Design Your Own Bridge

www.ContechES.com/DYOB



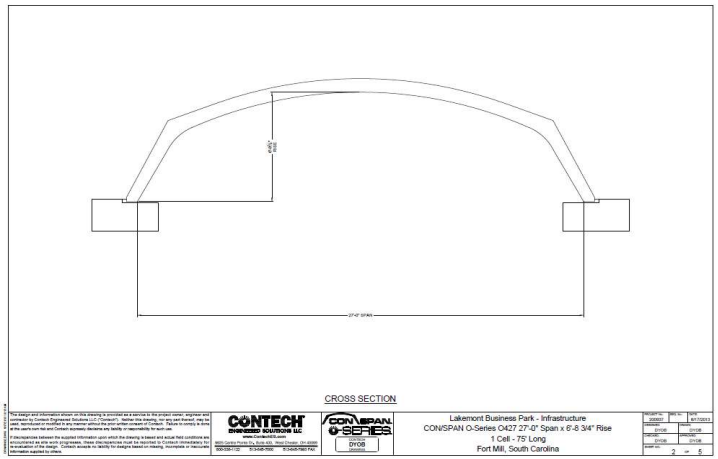
BRIDGE PLAN

Lakemont Business Park - Infrastructure
CON/SPAN O-Series O427 27'-0" Span x 6'-8 3/4" Rise
1 Cell - 75' Long
Fort Mill, South Carolina



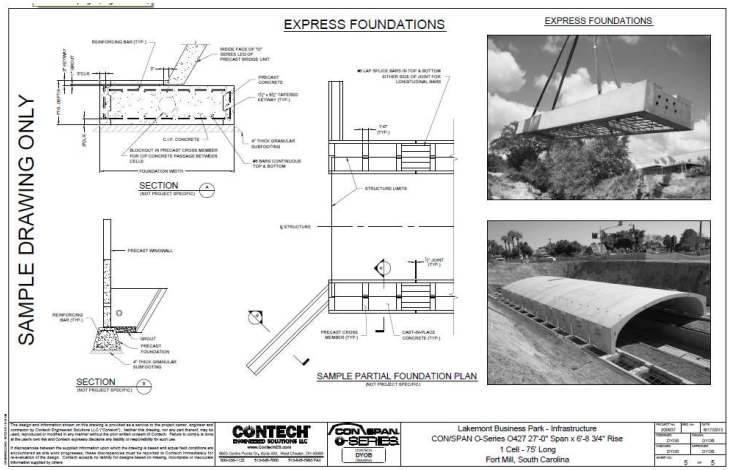
DOWNSTREAM END ELEVATION

Lakemont Business Park - Infrastructure
CON/SPAN O-Series O427 27'-0" Span x 6'-8 3/4" Rise
1 Cell - 75' Long
Fort Mill, South Carolina



CROSS SECTION

Lakemont Business Park - Infrastructure
CON/SPAN O-Series O427 27'-0" Span x 6'-8 3/4" Rise
1 Cell - 75' Long
Fort Mill, South Carolina



Lakemont Business Park - Infrastructure
CON/SPAN O-Series O427 27'-0" Span x 6'-8 3/4" Rise
1 Cell - 75' Long
Fort Mill, South Carolina

DYOB® at www.conteches.com

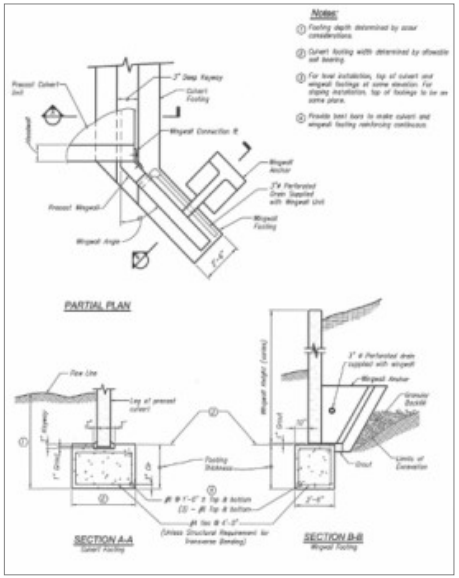
Rendering

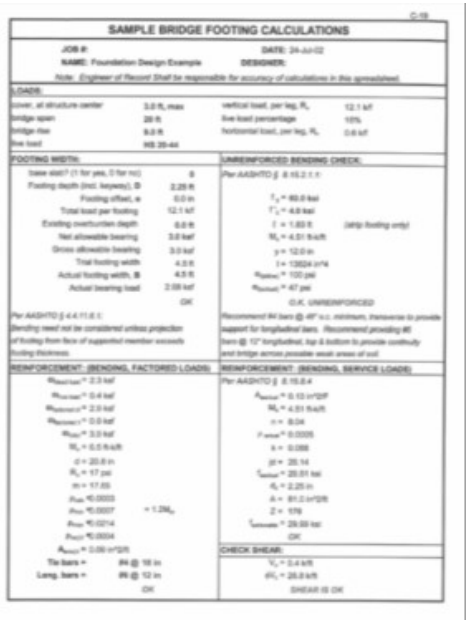
Completed Structure

Building Blocks to a Successful Project

Solution Development | **Design Support** | Installation

- Horizontal and vertical reactions
- Foundation sizing
- Foundation design calculations
- Foundation drawings





Building Blocks to a Successful Project

Solution Development | *Design Support* | **Installation**

- **Attending Pre-Bid Meetings**
- **Holding Preconstruction Meeting**
- **Technical Support Available (FC on all Precast Installations)**

Questions?

CROSSINGS. CULVERTS. BRIDGES. CONTECH.

Andy Runk
303-241-8154
Andrew.runk@conteches.com
www.conteches.com

Monitoring a Large Wildlife Crossing Structure System: Interstate 90, Snoqualmie Pass East

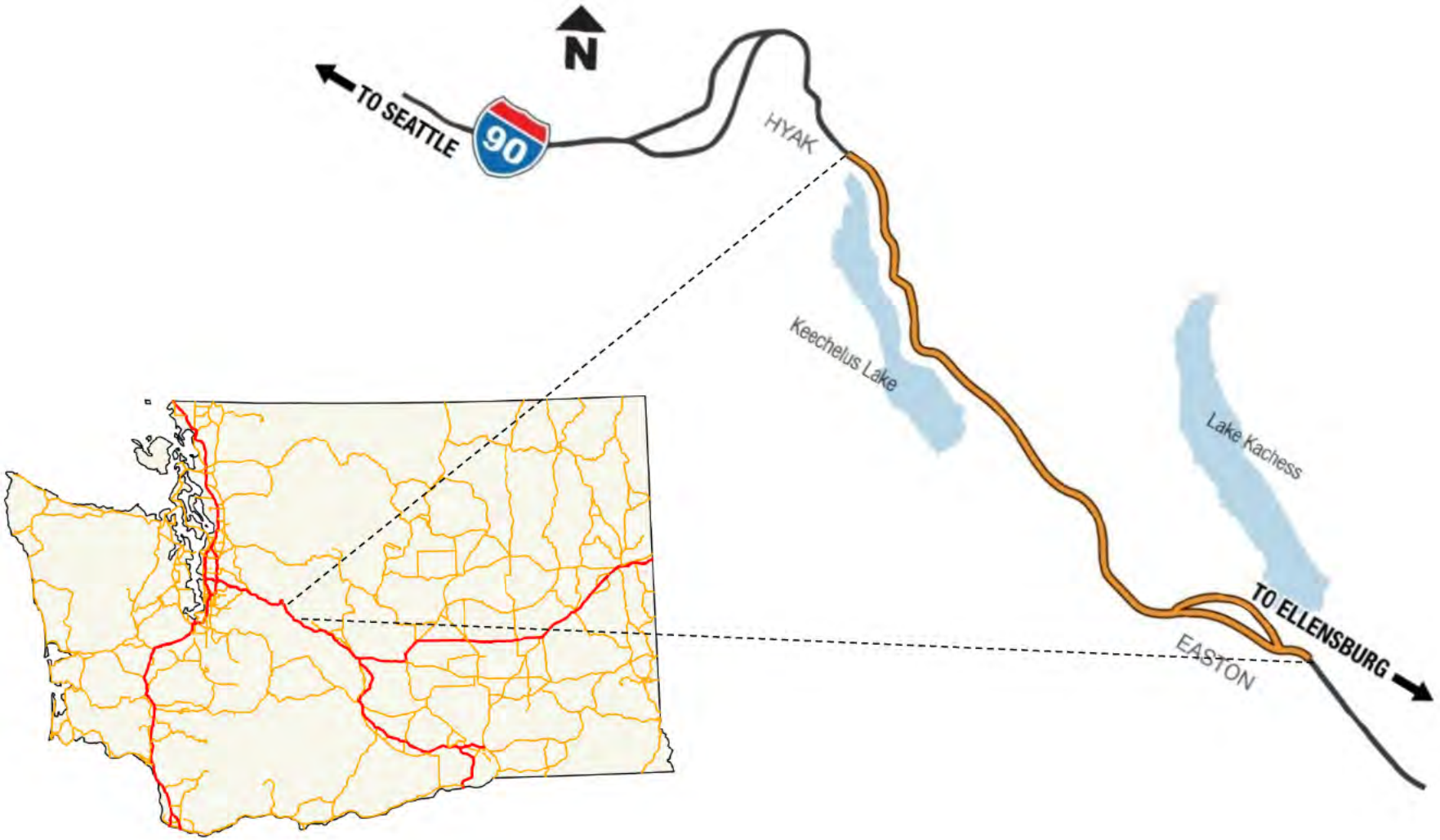
Glen Kalisz – Habitat Connectivity Biologist
With information provided by Mark Norman and Josh Zylstra

Roger Millar, Secretary of Transportation
Amy Scarton, Deputy Secretary of Transportation

April 14, 2022

I-90 SNOQUALMIE PASS EAST

Project Overview



I-90 SNOQUALMIE PASS EAST

Purpose and Need

Improve the highway

Structural Deficiencies – Replace deteriorating highway structures and travel lanes.

Traffic Volumes – Reduce traffic congestion by adding a new lane in each direction to accommodate projected traffic volumes for the next 20 years.

Protect the public

Avalanches – Reduce road closures and create a more reliable and safe highway.

Ecological Connectivity – Improve ecological connectivity across the highway and reduce risks of wildlife vehicle collisions.

Slope Instability - Stabilize rock slopes to minimize rock fall hazards, reduce lane closures and improve public safety.

Connectivity Emphasis Areas

Locations where WSDOT focused efforts to improve ecological connectivity by installing wildlife crossing structures.

[Cascades Crossroads](https://www.conservationnw.org/our-work/habitat/cascade-crossroads-film/)

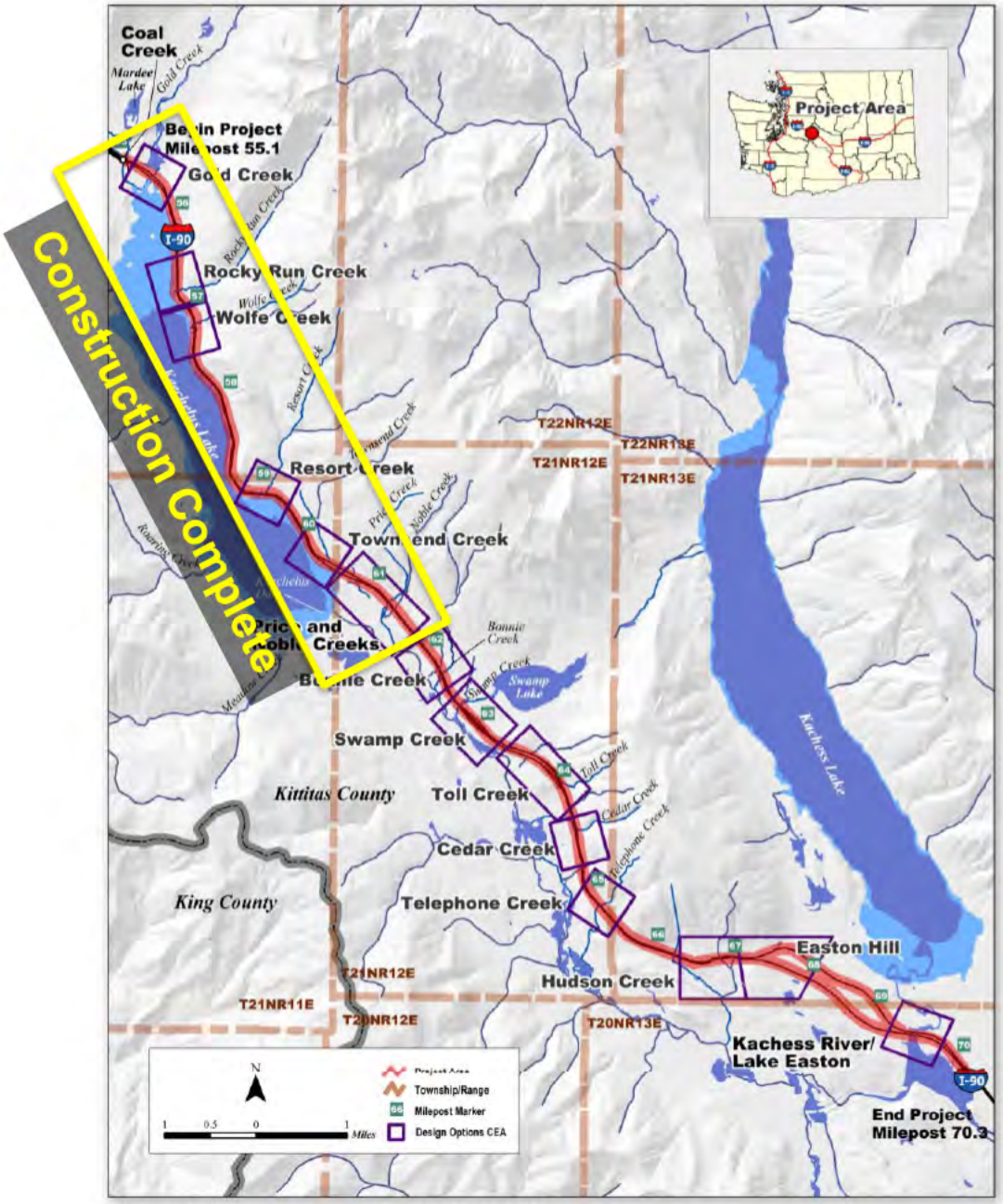
https://www.conservationnw.org/our-work/habitat/cascade-crossroads-film/

[Critter Crossings in the Cascades](https://www.tedgrudowski.com/news/2021/11/9/presentingi-90-snoqualmie-pass-east-critter-crossings-in-the-cascades)

https://www.tedgrudowski.com/news/2021/11/9/presentingi-90-snoqualmie-pass-east-critter-crossings-in-the-cascades

Connectivity Emphasis Areas in the Project Area
Exhibit 1-1

Connectivity Emphasis Areas



Connectivity Emphasis Areas in the Project Area
Exhibit 1-1

Wildlife Monitoring Activities

WSDOT monitors use of the crossing structures and tracks wildlife vehicle collisions to asses project performance and inform future phases.

- Remote cameras
  - Trail cameras
  - Networked thermal and HD cameras
- Roadkill data – Maintenance

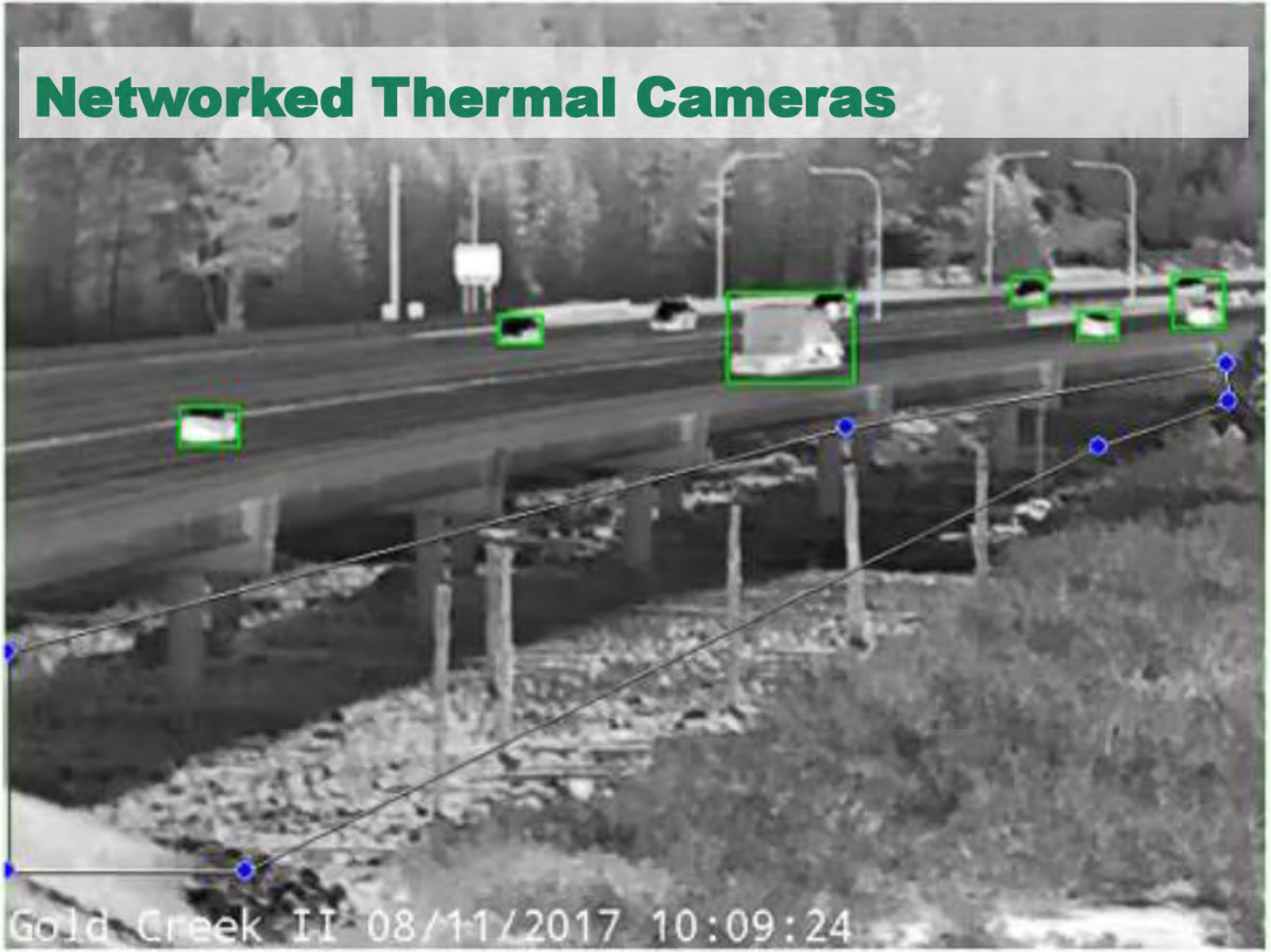
Trail Cameras

- Easy to deploy
- Trigger range of about 40’
- Flexible placement
- Self-contained
- Primary tool for pre-construction

Networked Thermal Cameras

- Long trigger range (tested to 1200')
- Detection context
- High detection reliability
- Real-time monitoring
- Greatly reduces travel time
- Customizable software – virtual trip lines and detection zones
- Pre-trigger capture

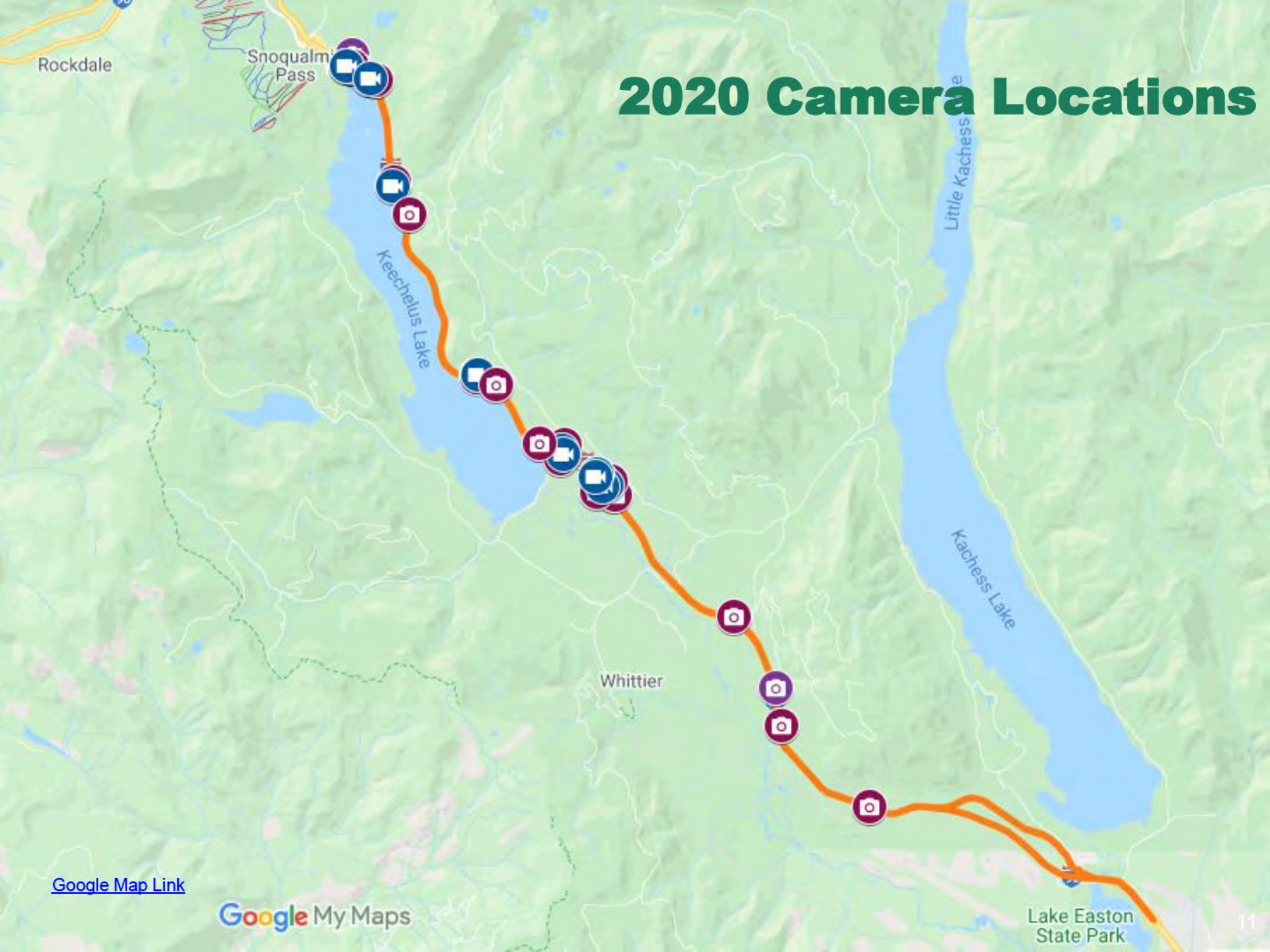
Networked Thermal Cameras



Network HD Cameras

- Full color 4k videos good for outreach
- Wide area coverage
- Pan, tilt, zoom capability
- Can be wired to use thermal camera's detection circuit to trigger on movement
- Real-time monitoring

2020 Camera Locations



Google Map Link


I-90 Snoqualmie Pass East
Hyak to Easton Project
WSDOT
Proposed Phase 1A and B (Completed)
Completed 2013
Proposed Phase 1C (Under Construction)
Scheduled Completion 2018
Proposed Phase 2A (Under Construction)
Scheduled Completion 2018
Proposed Phase 4 (Construction 2026-2029)
Proposed Phase 3 (Construction 2021-2025)
Phase 3A (Construction 2020-2021)
Keechelus Lake
Kachess Lake
Lake Easton

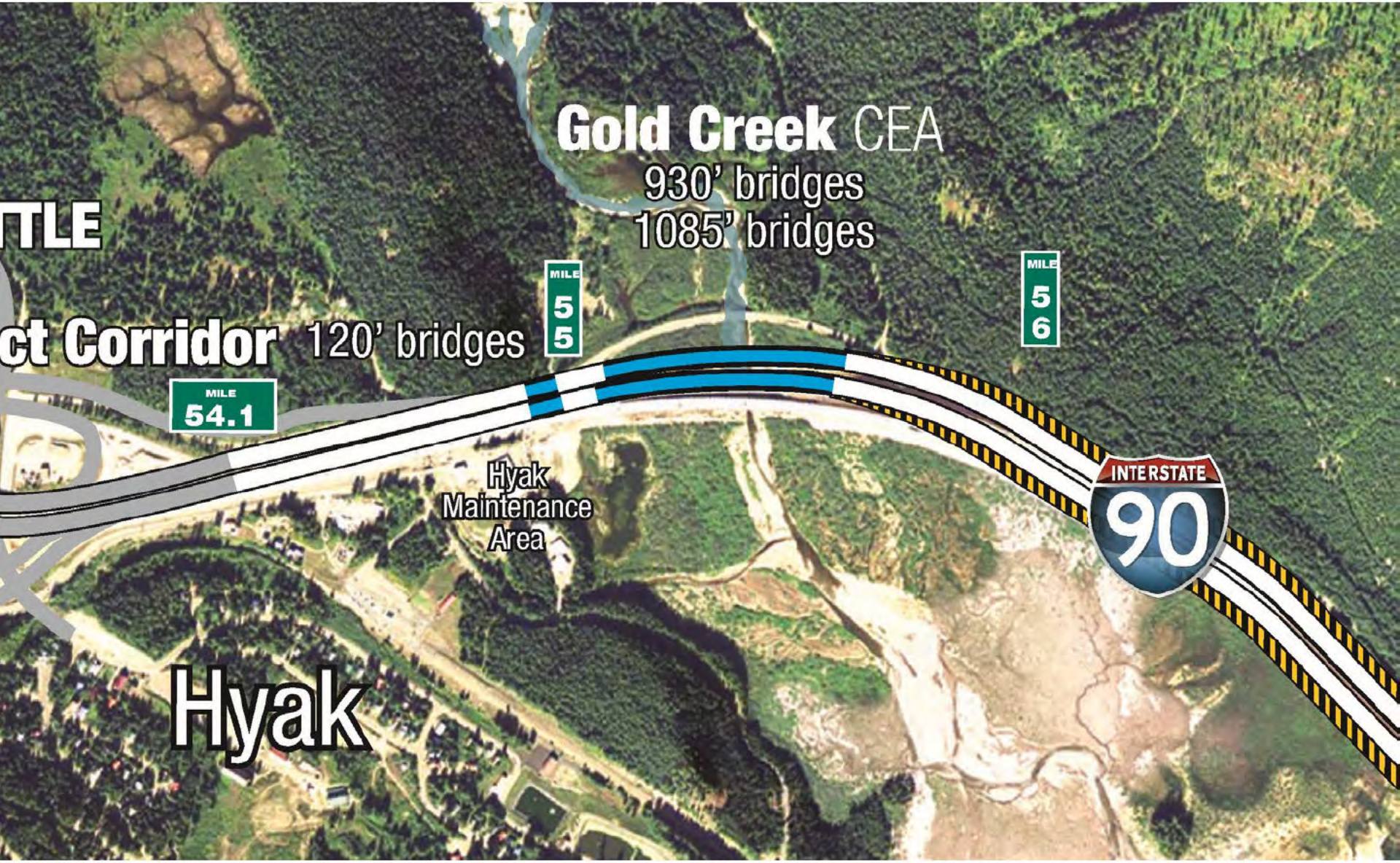
Complete

I-90 Snoqualmie Pass East
Hyak to Easton Project

Proposed **Phase 1A and B** (Completed) — Completed 2013

Proposed **Phase 1C** (Under Construction) — Scheduled Completion 2018

Proposed **Phase 2A** (Under Construction) — Scheduled Completion 2018

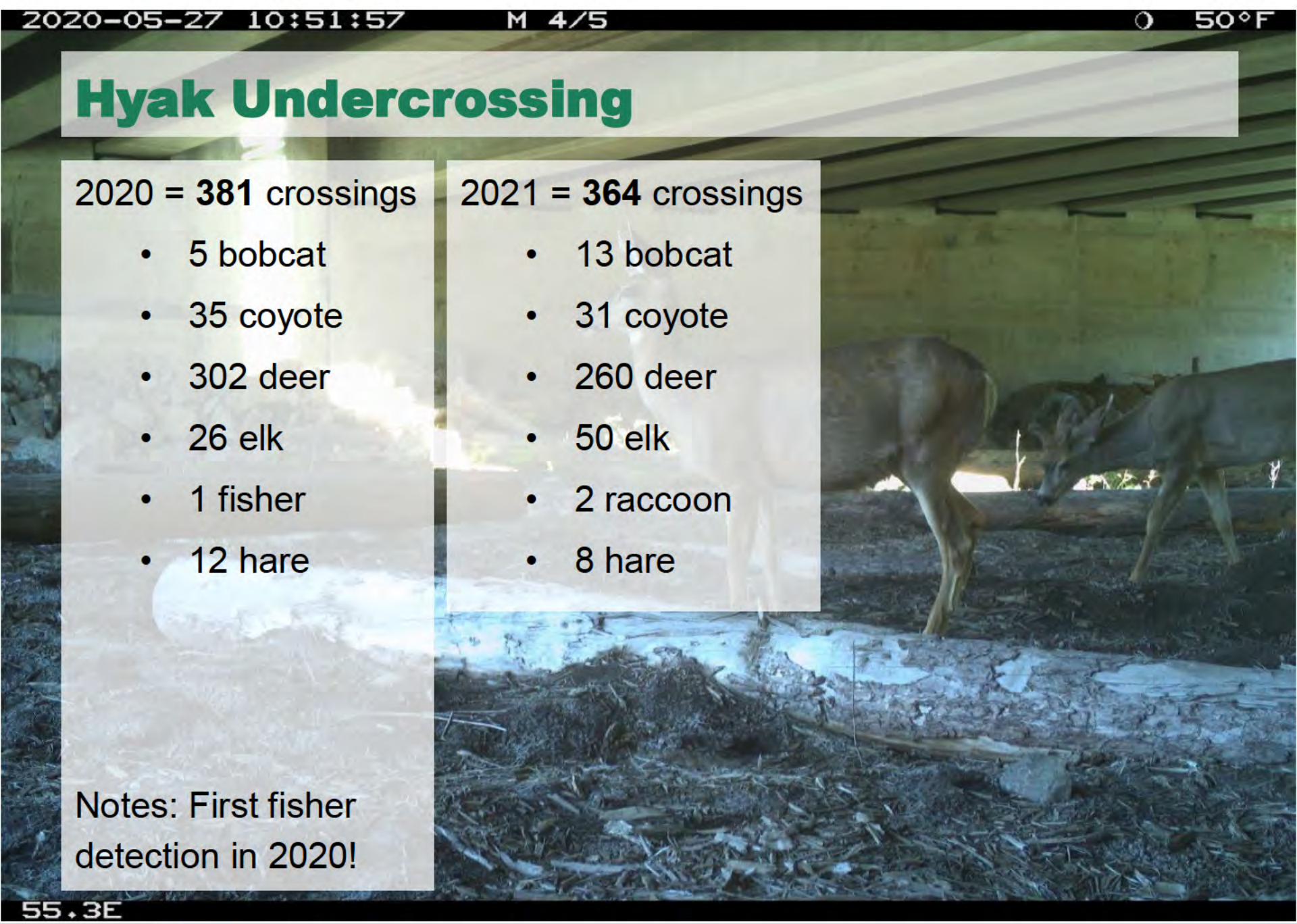

TTLE
ct Corridor
120' bridges
Gold Creek CEA
930' bridges
1085' bridges
MILE
54.1
MILE
55
MILE
56
Hyak
Maintenance
Area
INTERSTATE
90
Hyak

Hyak Undercrossing

120’ wide x 20’ high x 118’ long

Openness ratio: 20.34

Constructed: 2012
Planted: 2015
Fenced: 2019



Hyak Undercrossing

2020 = **381** crossings

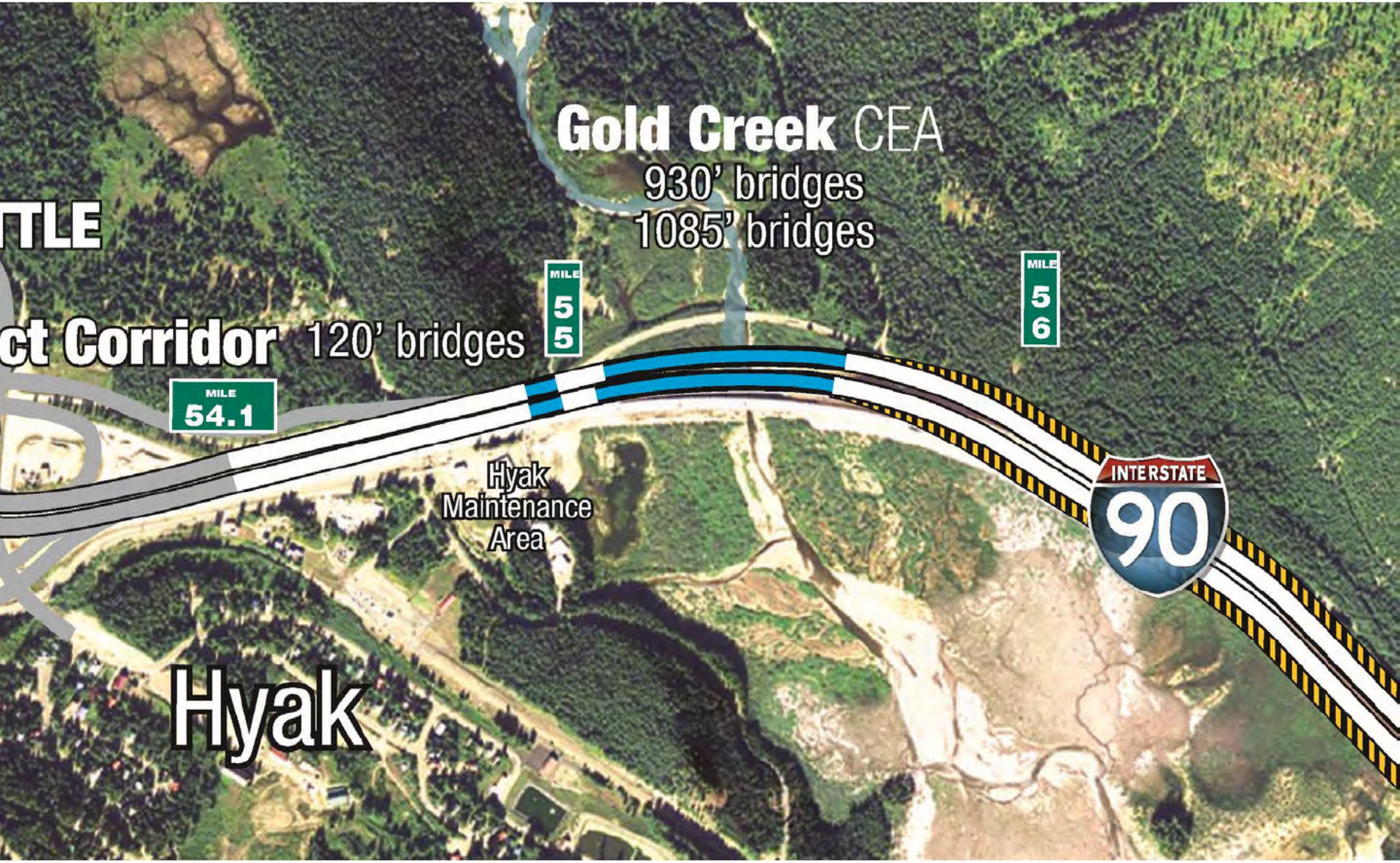
- 5 bobcat
- 35 coyote
- 302 deer
- 26 elk
- 1 fisher
- 12 hare

2021 = **364** crossings

- 13 bobcat
- 31 coyote
- 260 deer
- 50 elk
- 2 raccoon
- 8 hare

Notes: First fisher detection in 2020!

Hyak Undercrossing


TTLE
ct Corridor
120' bridges
MILE
54.1
Gold Creek CEA
930' bridges
1085' bridges
MILE
55
MILE
56
Hyak
Maintenance
Area
INTERSTATE
90
Hyak

Gold Creek Bridges

~1,000’ wide x 30’ high x 160’ long

Openness ratio: ~168.75

Constructed: 2012
Planted: 2015
Fenced: 2019

Gold Creek Bridges – Upper Keechelus Lake


2015-06-10 10:57:12 AM M 1/10
66°F
Gold Creek Bridges
2020 = 446 crossings
• 1 bobcat
• 79 coyote
• 293 deer
• 53 elk
• 2 hare
• 14 beaver
• 4 otter
2021 = 746 crossings
• 10 bobcat
• 79 coyote
• 473 deer
• 123 elk
• 6 hare
• 41 beaver
• 11 otter
• 1 black bear
GCBA11
RECONYX

Gold Creek Bridges

Gold Creek Bridges

I-90 Snoqualmie Pass East
Hyak to Easton Project

Proposed **Phase 1A and B** (Completed) — Completed 2013

Proposed **Phase 1C** (Under Construction) — Scheduled Completion 2018

Proposed **Phase 2A** (Under Construction) — Scheduled Completion 2018


Extended chain-up
MILE 57
Rocky Run Creek CEA
120' bridge
140' bridge
Wolfe Creek CEA
Oversized culverts
UNSTABLE SLOPES
MILE 58

Rocky Run Creek

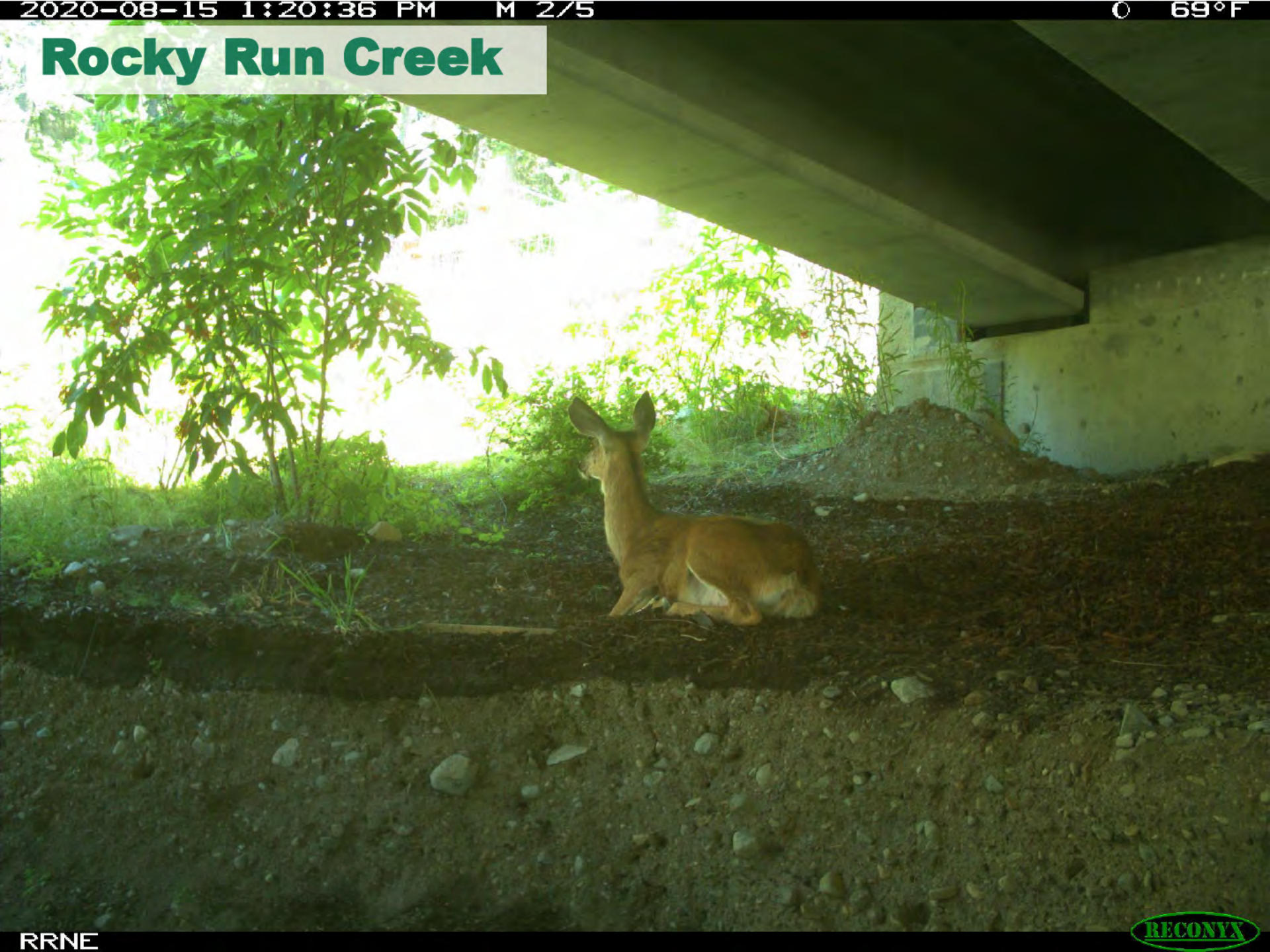
120’ wide x ~10’ high x 190’ long

Openness ratio: ~6.32

Constructed: 2012
Planted: 2015
Fenced: 2019

Rocky Run Creek Pre-Construction


Rocky Run Creek
Post-Construction
2020 = 281 crossings
• 245 deer
• 35 coyote
• 1 beaver
2021 = 322 crossings
• 270 deer
• 49 coyote
• 1 bobcat
• 2 raccoon


2020-08-15 1:20:36 PM M 2/5 69°F
Rocky Run Creek
RRNE
RECONYX

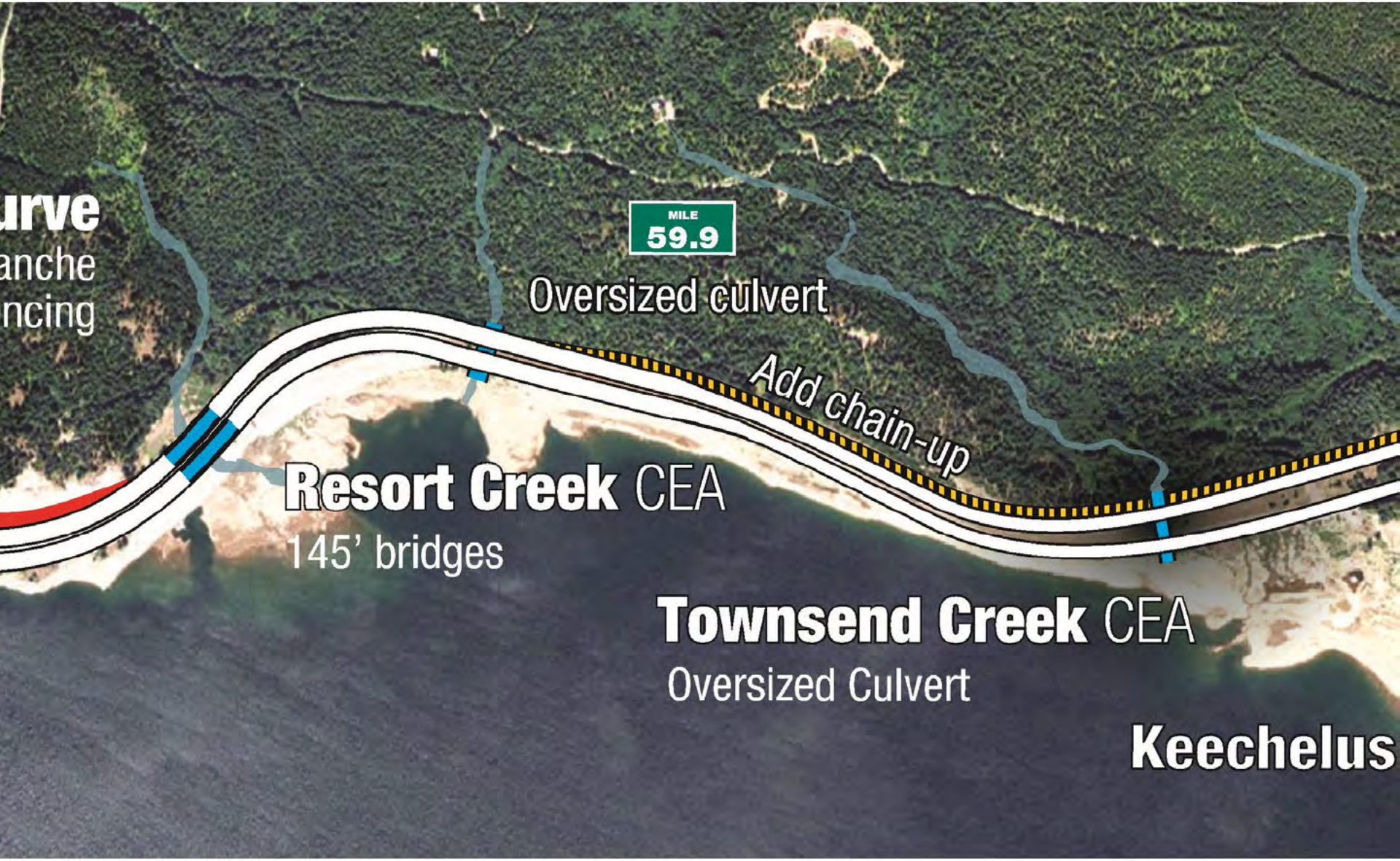
Rocky Run Creek

I-90 Snoqualmie Pass East
Hyak to Easton Project

Proposed **Phase 1A and B** (Completed) — Completed 2013

Proposed **Phase 1C** (Under Construction) — Scheduled Completion 2018

Proposed **Phase 2A** (Under Construction) — Scheduled Completion 2018


urve
anche
ncing
MILE
59.9
Oversized culvert
Add chain-up
Resort Creek CEA
145' bridges
Townsend Creek CEA
Oversized Culvert
Keechelus

Resort Creek

140’ wide x 30’ high x 163’ long

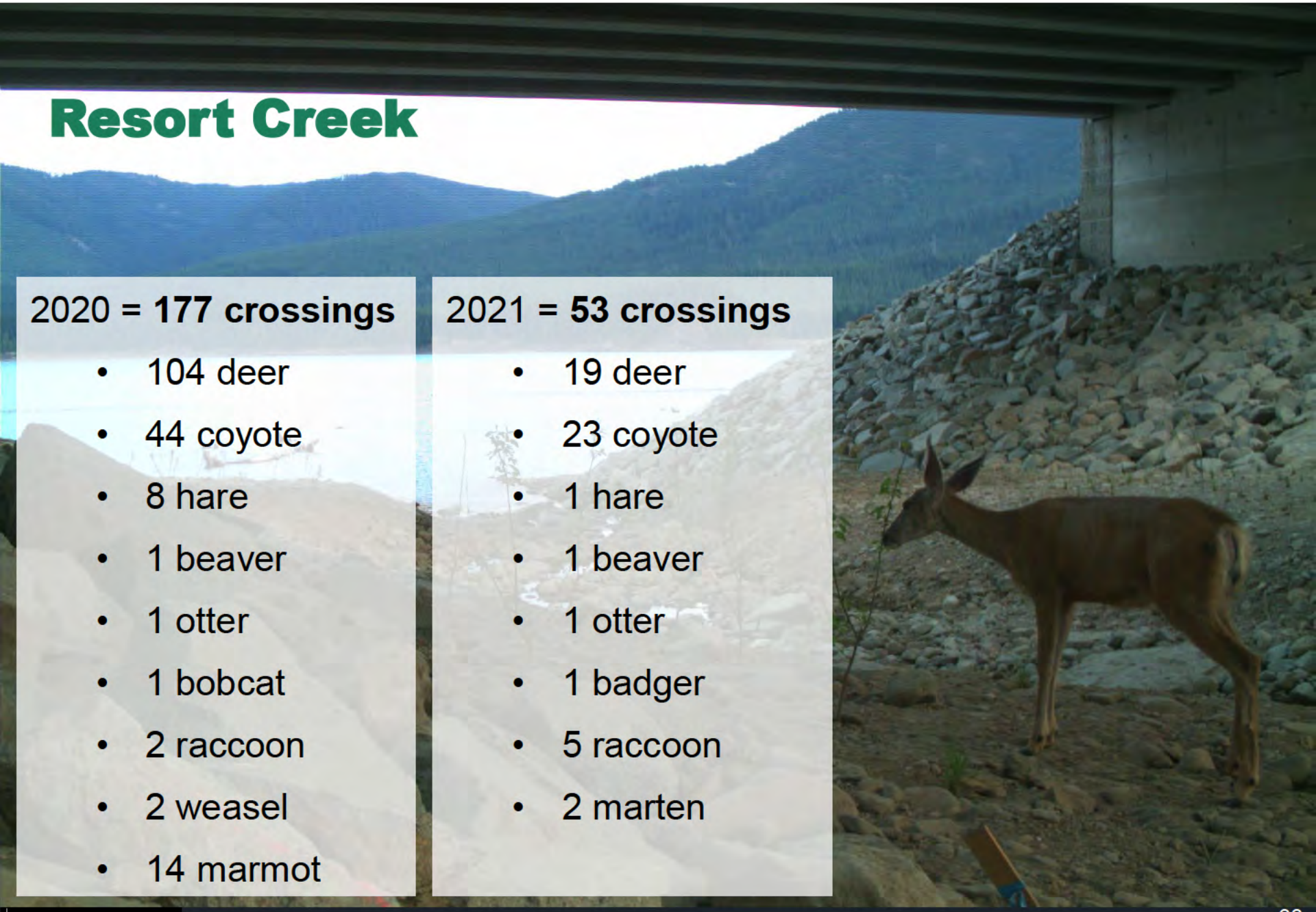
Openness ratio: 26.63

Constructed: 2015
Planted: 2017
Fenced: 2019

Resort Creek
Pre-Construction

Resort Creek
Post-Construction

Resort Creek



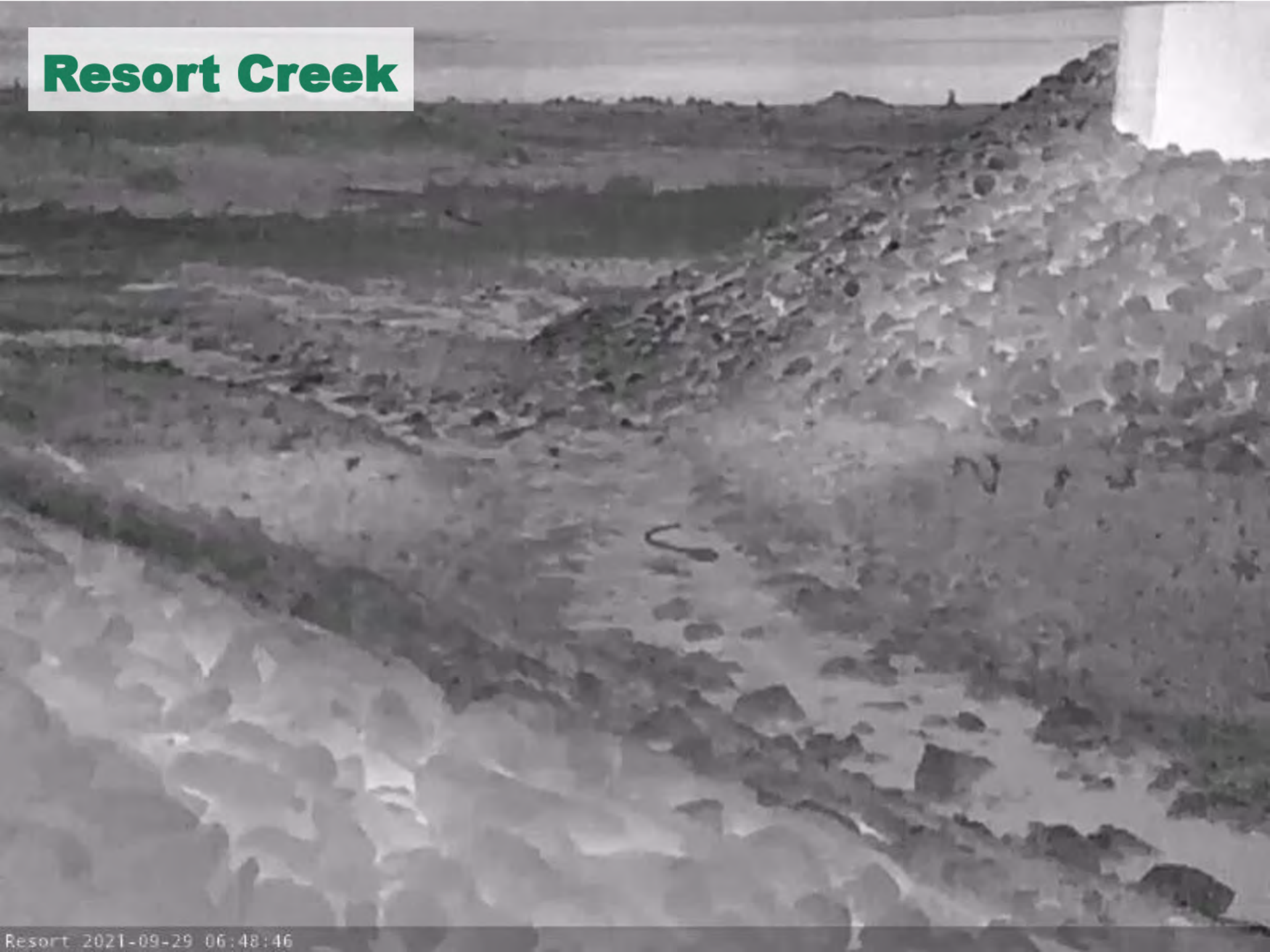
2020 = **177 crossings**

- 104 deer
- 44 coyote
- 8 hare
- 1 beaver
- 1 otter
- 1 bobcat
- 2 raccoon
- 2 weasel
- 14 marmot

2021 = **53 crossings**

- 19 deer
- 23 coyote
- 1 hare
- 1 beaver
- 1 otter
- 1 badger
- 5 raccoon
- 2 marten


Resort Creek
Resort 2020-07-06 09:26:49

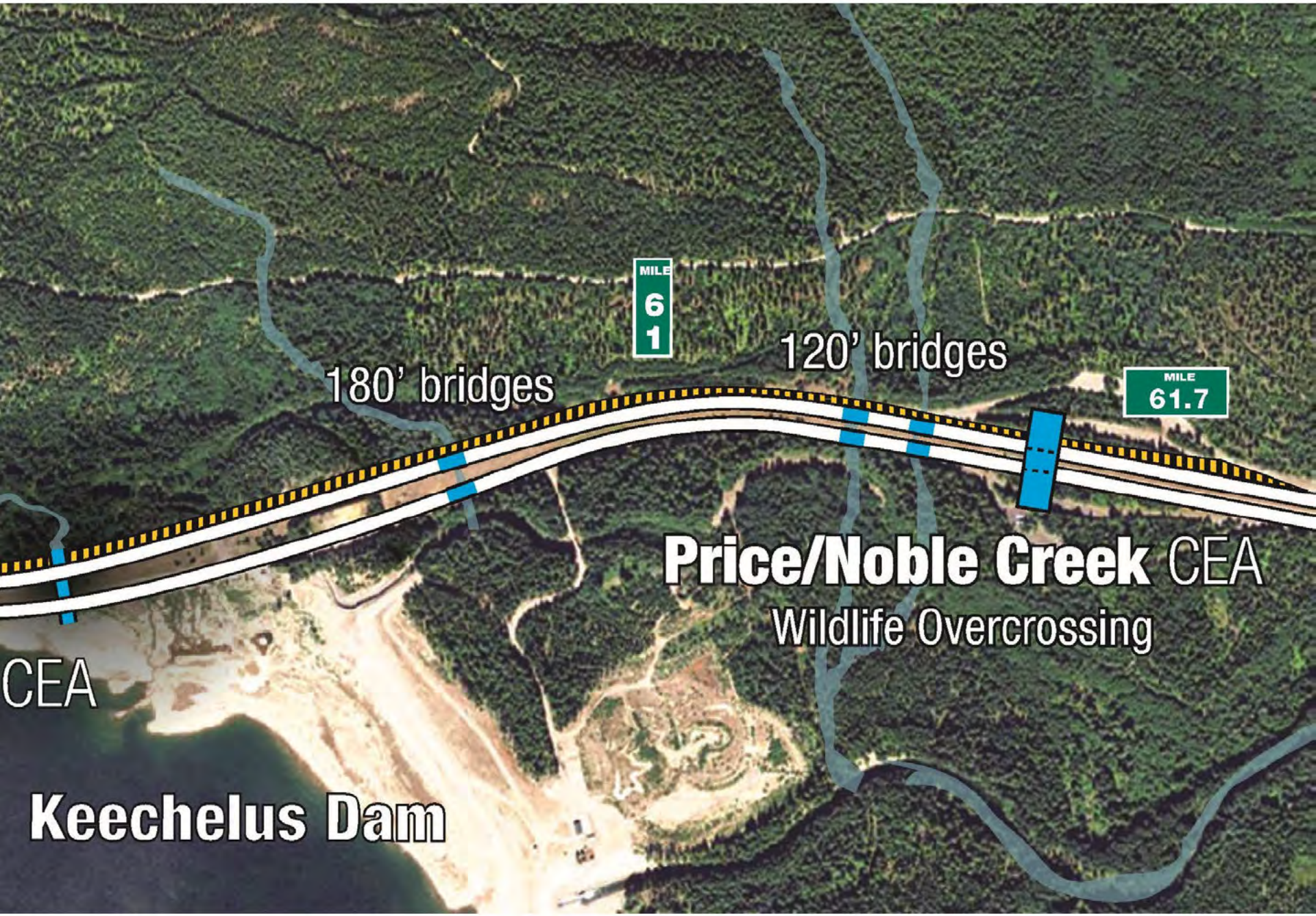

Resort Creek
Resort 2021-09-29 06:48:46

I-90 Snoqualmie Pass East
Hyak to Easton Project

Proposed **Phase 1A and B** (Completed) — Completed 2013

Proposed **Phase 1C** (Under Construction) — Scheduled Completion 2018

Proposed **Phase 2A** (Under Construction) — Scheduled Completion 2018


MILE
6
1
180’ bridges
120’ bridges
MILE
61.7
Price/Noble Creek CEA
Wildlife Overcrossing
CEA
Keechelus Dam


MP 60.9
Pre-Construction

MP 60.9 Undercrossing

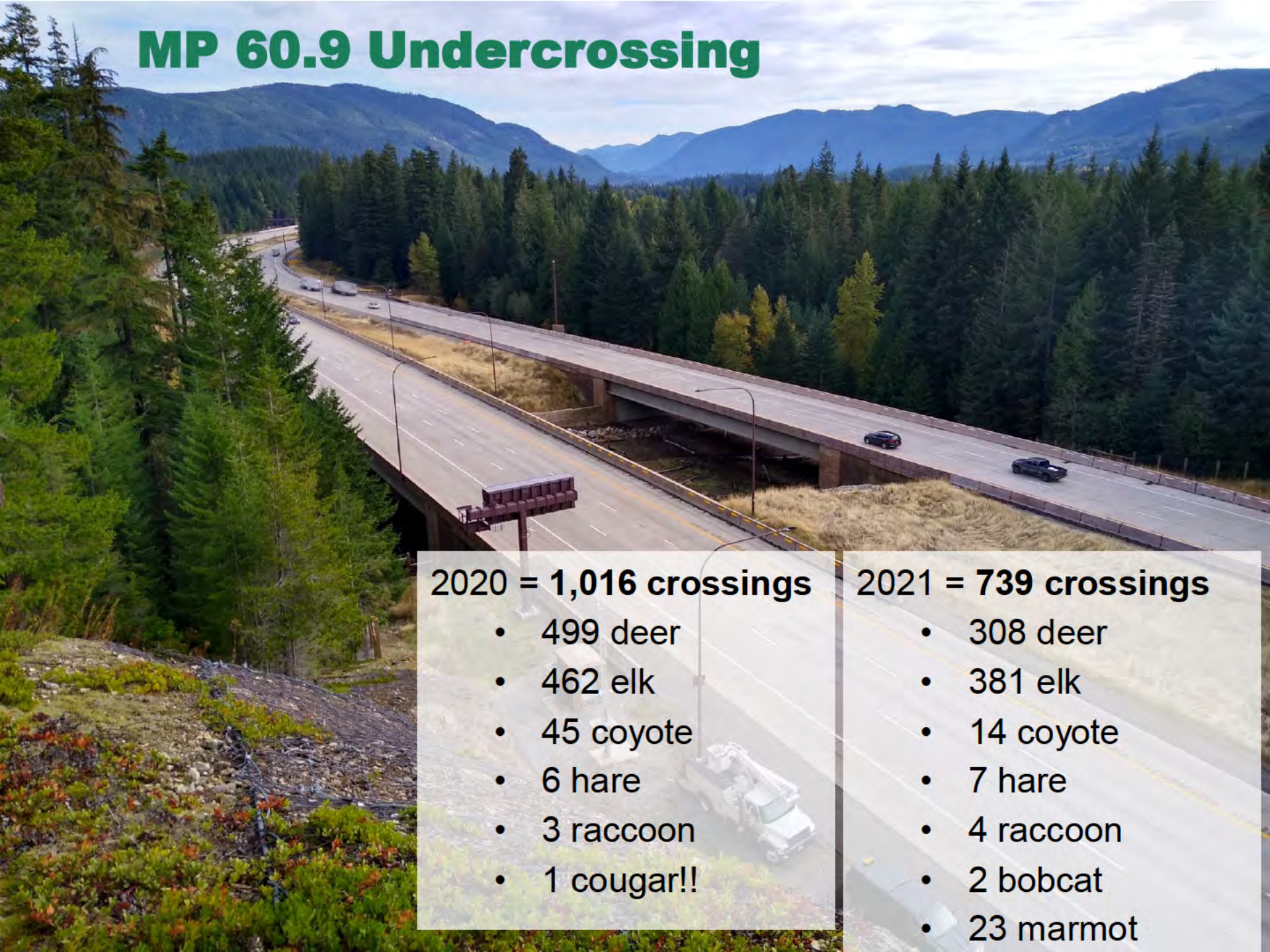
180’ wide x 24’ high x 220’ long

Openness ratio: 19.64

Constructed: 2018
Planted: 2021
Fenced: 2019

Post-Construction

MP 60.9 Undercrossing



2020 = **1,016 crossings**

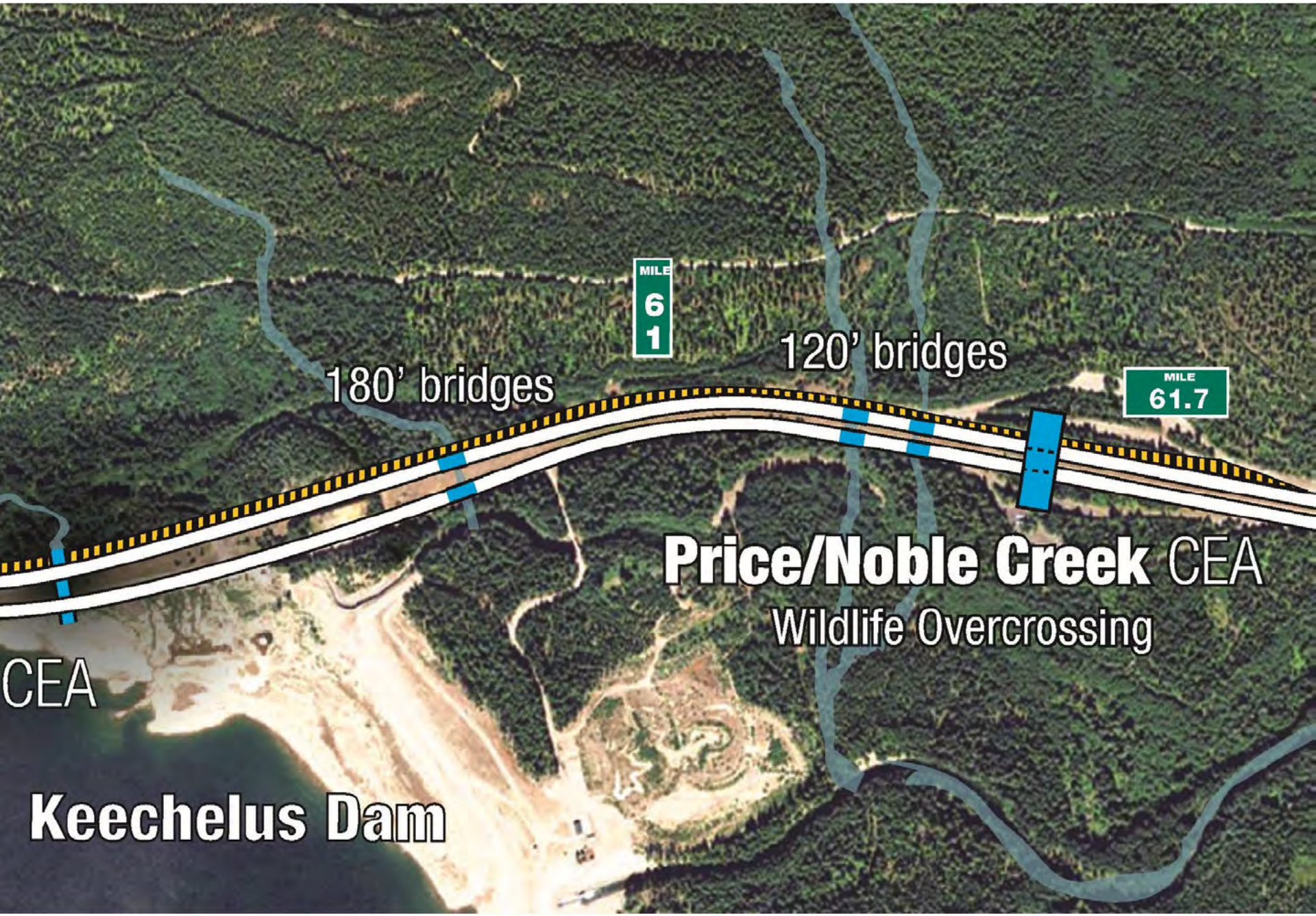
- 499 deer
- 462 elk
- 45 coyote
- 6 hare
- 3 raccoon
- 1 cougar!!

2021 = **739 crossings**

- 308 deer
- 381 elk
- 14 coyote
- 7 hare
- 4 raccoon
- 2 bobcat
- 23 marmot


MP 60.9 Undercrossing
60.9 N 2020-10-04 11:15:57


MP 60.9 Undercrossing
60.9_S 2019-09-17 21:51:22


MILE
61
180’ bridges
120’ bridges
MILE
61.7
Price/Noble Creek CEA
Wildlife Overcrossing
CEA
Keechelus Dam

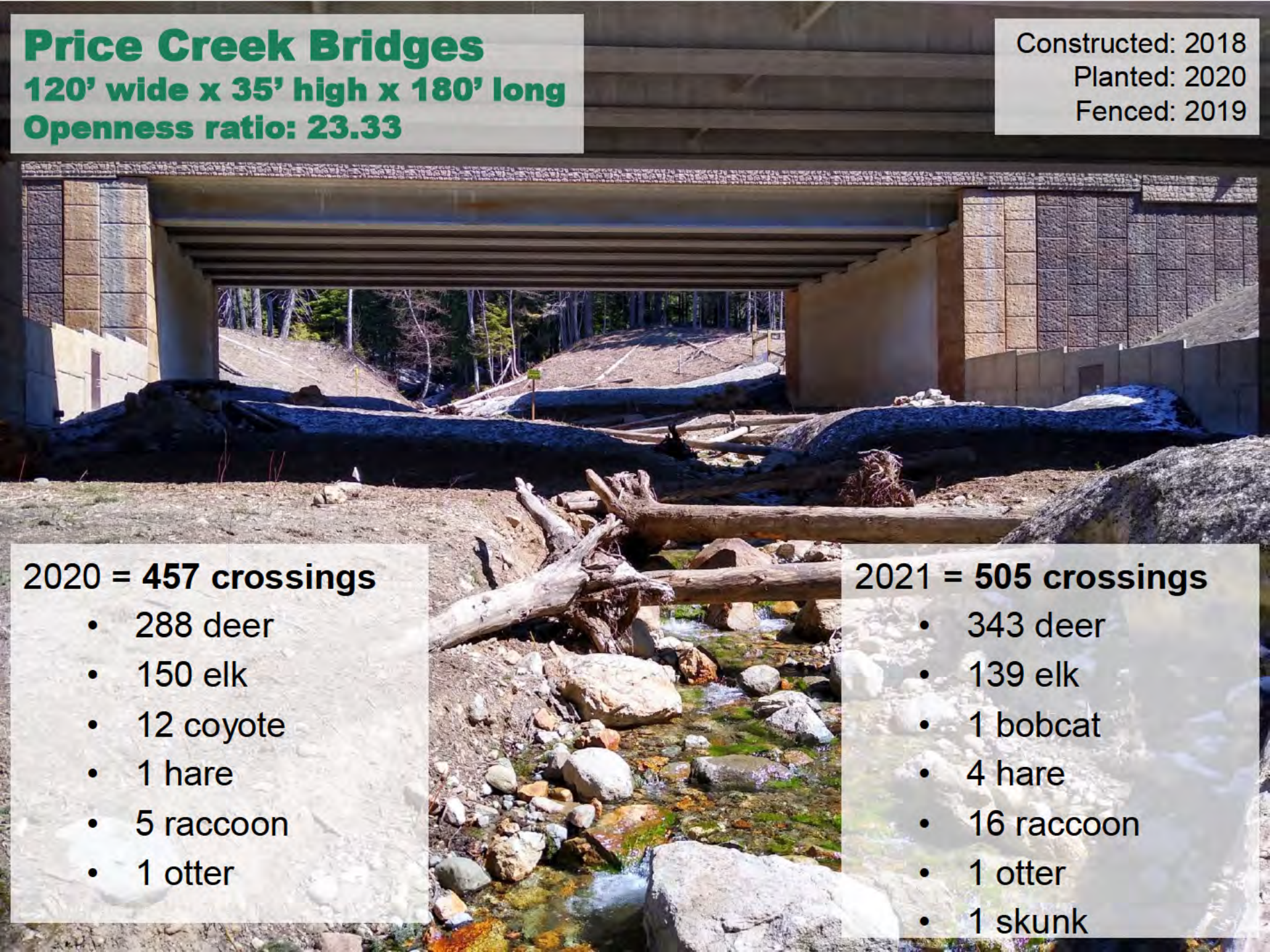

Price Creek
Post-Construction
Pre-Construction

Price Creek Bridges

120’ wide x 35’ high x 180’ long

Openness ratio: 23.33

Constructed: 2018
Planted: 2020
Fenced: 2019



2020 = **457 crossings**

- 288 deer
- 150 elk
- 12 coyote
- 1 hare
- 5 raccoon
- 1 otter

2021 = **505 crossings**

- 343 deer
- 139 elk
- 1 bobcat
- 4 hare
- 16 raccoon
- 1 otter
- 1 skunk

Price Creek Bridges

Price Creek Bridges


Noble Creek
Pre-Construction

Noble Creek Bridges

120’ wide x ~22’ high x 185’ long

Openness ratio: ~14.27

Constructed: 2018
Planted: 2020
Fenced: 2019

2020 = **463 crossings**

- 241 deer
- 215 elk
- 3 coyote
- 4 raccoon

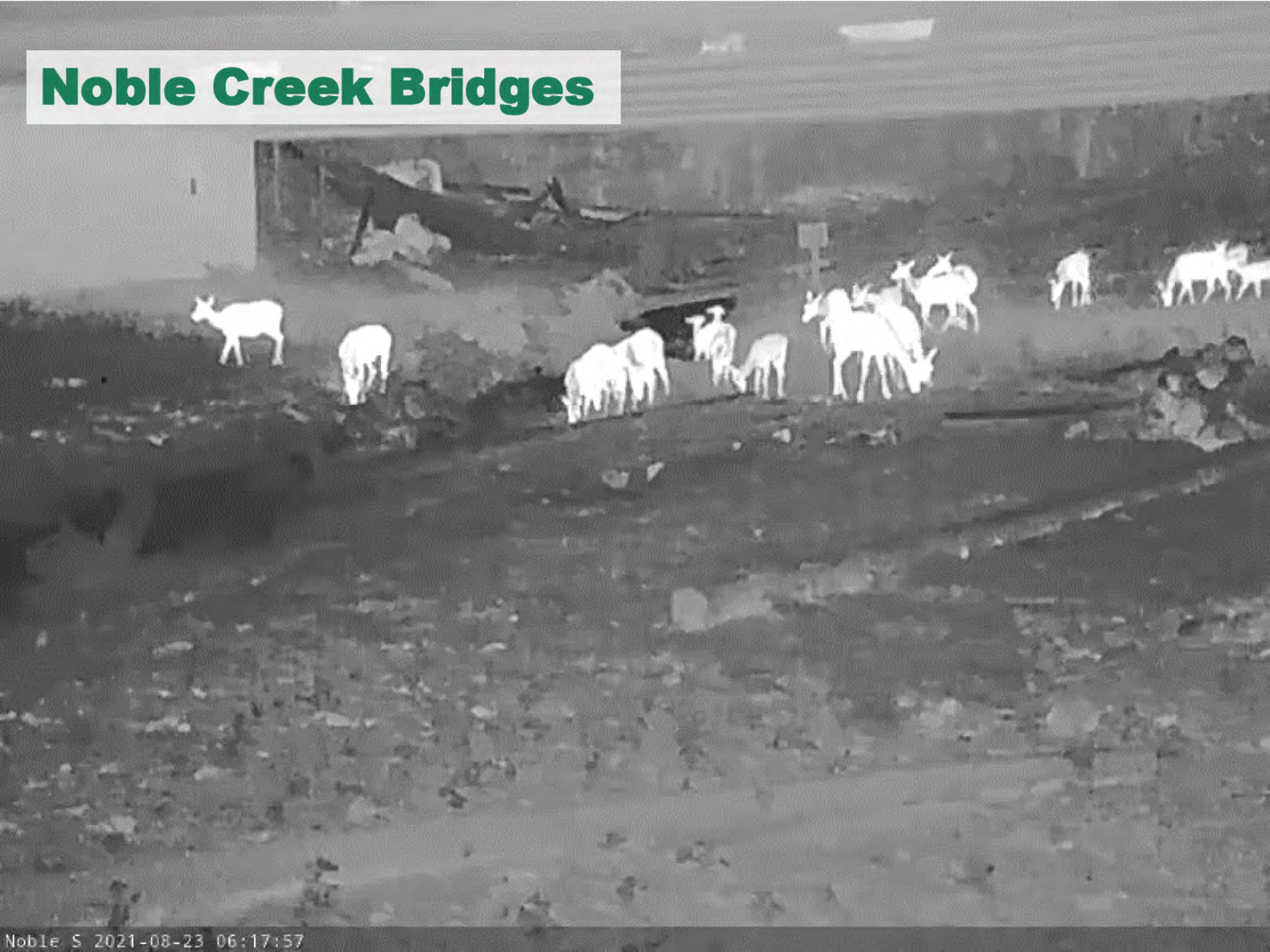
2021 = **491 crossings**

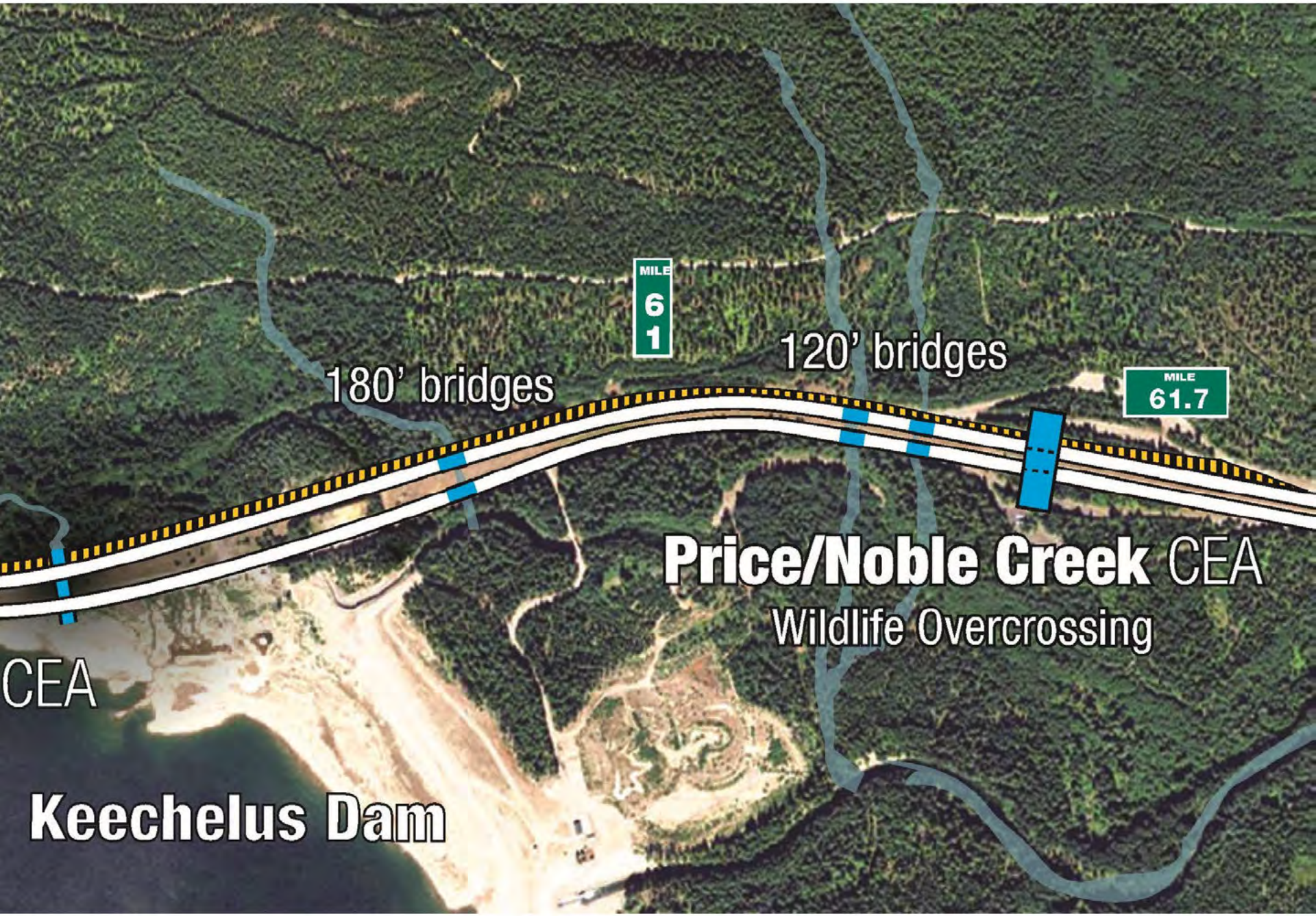
- 200 deer
- 276 elk
- 1 coyote
- 1 hare
- 10 raccoon
- 2 otter
- 1 weasel

Post-Construction


2021-08-23 06:18:40 M
53°F
Noble Creek Bridges
61.4
RECONYX

Noble Creek Bridges

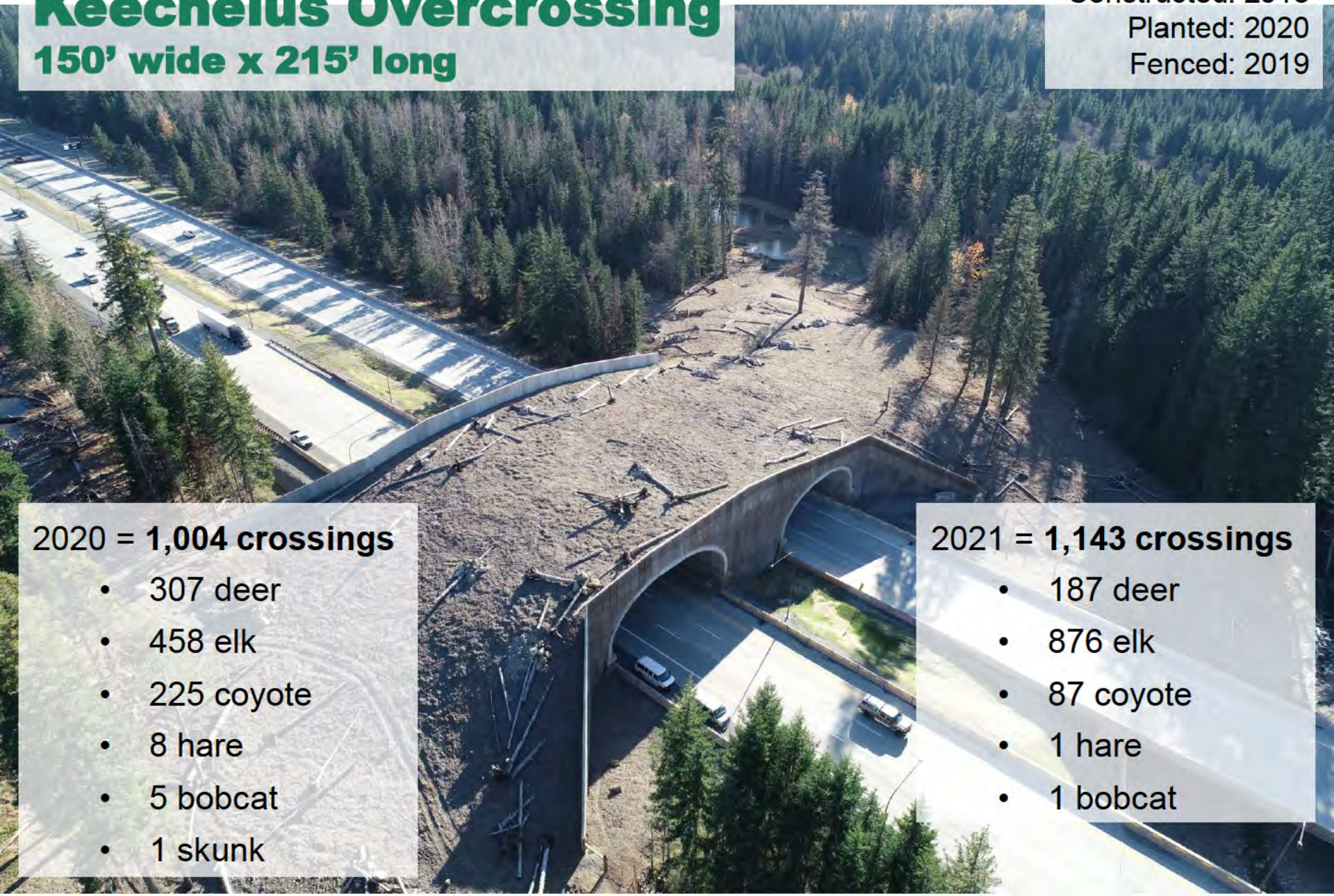



MILE
6
1
180’ bridges
120’ bridges
MILE
61.7
Price/Noble Creek CEA
Wildlife Overcrossing
CEA
Keechelus Dam

Keechelus Overcrossing

150’ wide x 215’ long

Constructed: 2018
Planted: 2020
Fenced: 2019



2020 = **1,004 crossings**

- 307 deer
- 458 elk
- 225 coyote
- 8 hare
- 5 bobcat
- 1 skunk

2021 = **1,143 crossings**

- 187 deer
- 876 elk
- 87 coyote
- 1 hare
- 1 bobcat

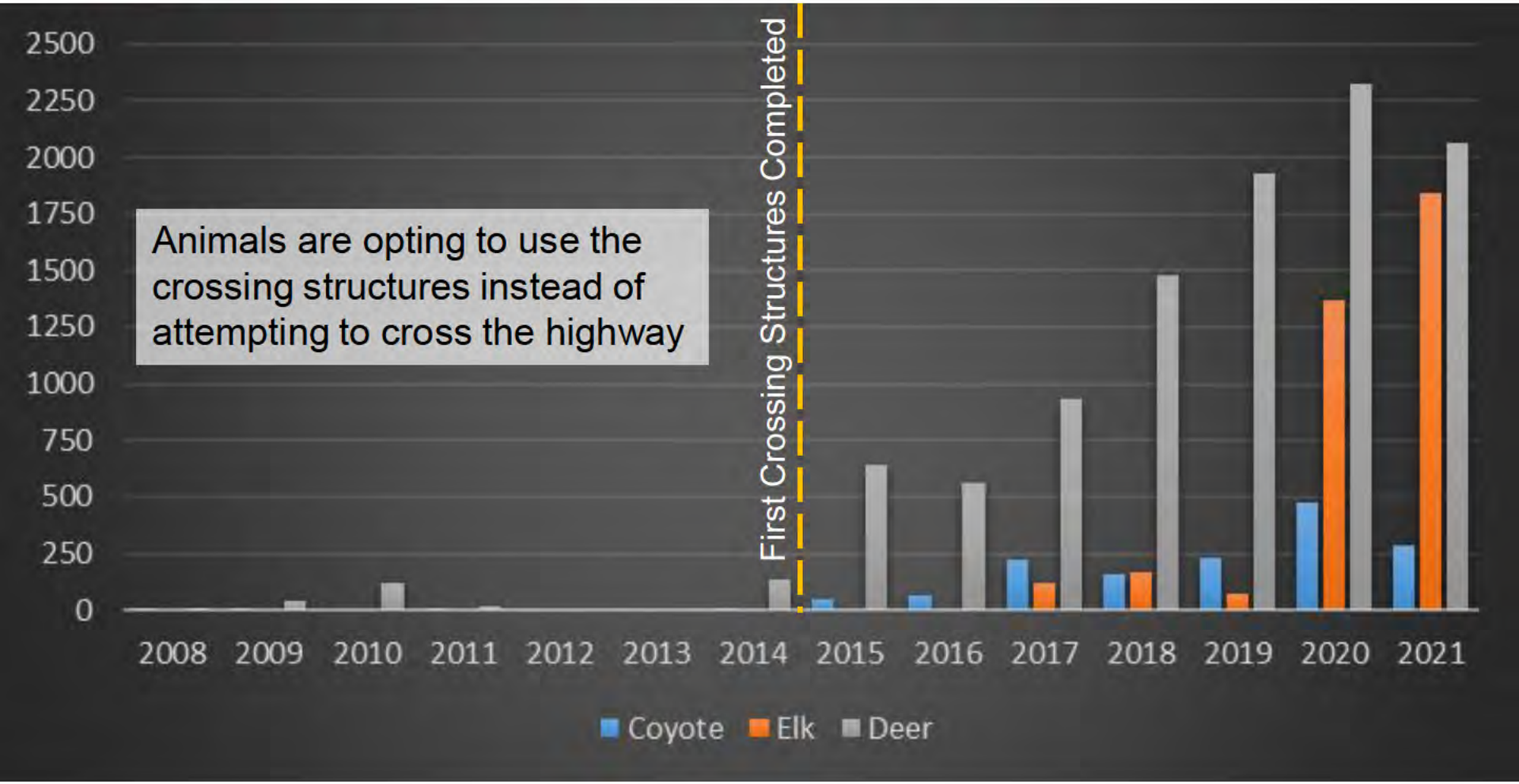
Keechelus Overcrossing

Keechelus Overcrossing

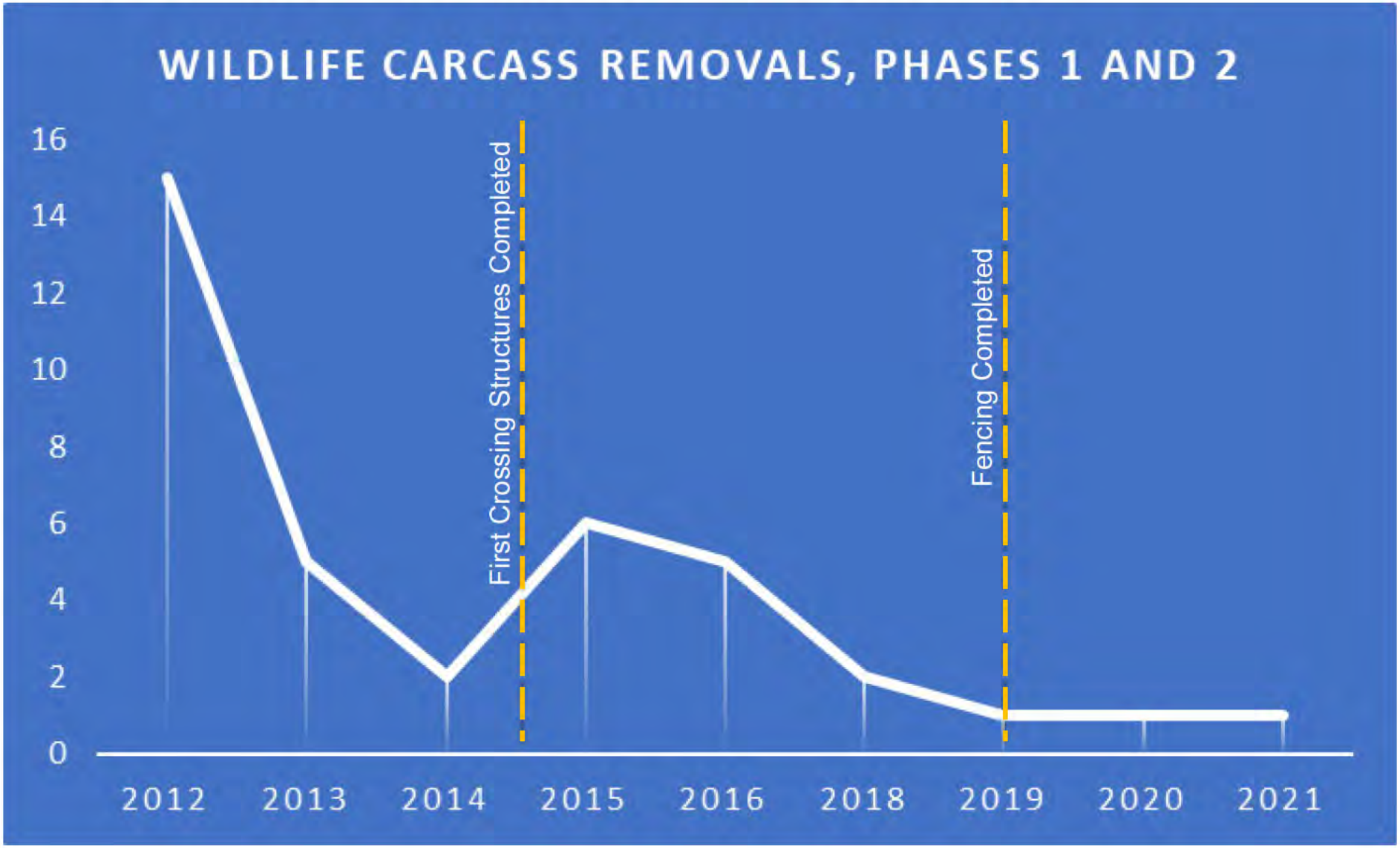
Keechelus Overcrossing

Keechelus Overcrossing

Wildlife Crossings 2008 - 2021



Wildlife-Vehicle Collisions



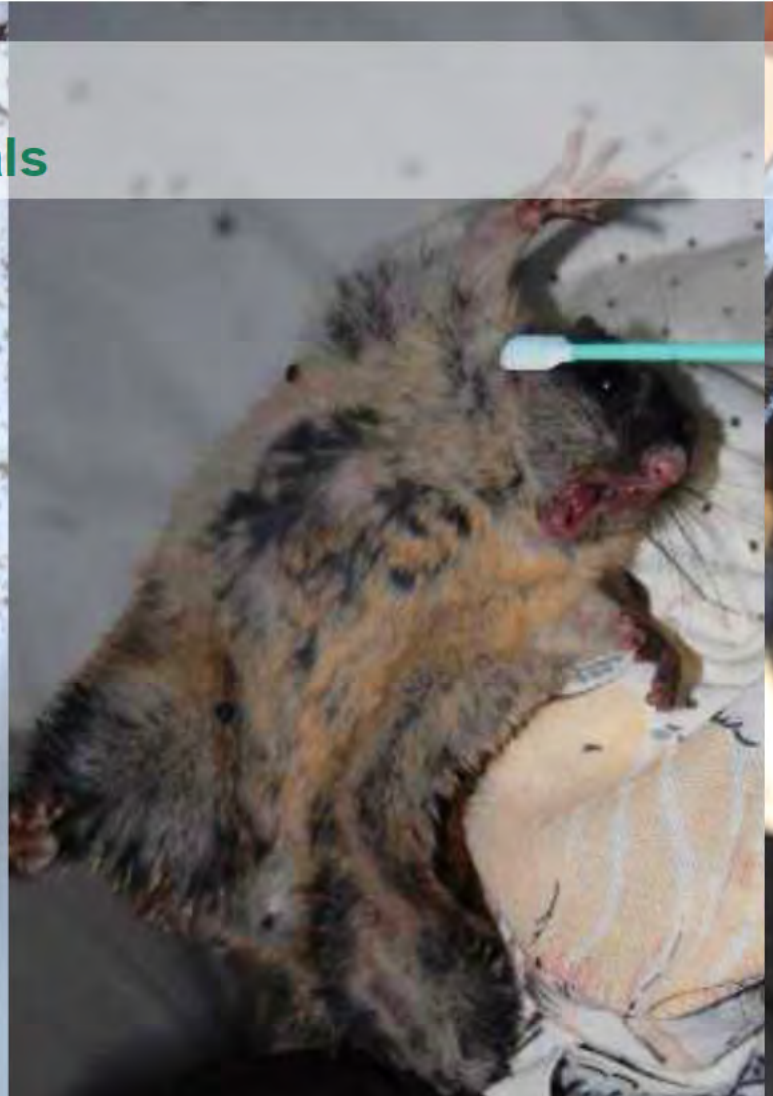
WSDOT/CWU I-90 Partnership

Central Washington University (CWU) has been monitoring small mammals, amphibians, reptiles, and fish on the I-90 Project under a research agreement with WSDOT since 2008. This partnership provides a cost-effective way to meet the project's wildlife monitoring commitments and aligns well with the goal areas of WSDOT's Strategic Plan.

CWU

Small mammals

Shrew



Flying squirrel

Chipmunk

CWU
Small mammals

- Pika are often observed living in the highway rock embankment.

CWU
Small mammals

CWU Amphibians

CWU Amphibians

- Western toad populations are declining throughout its range
- Toads were observed breeding at the Townsend Creek mitigation site and at the south end of the new overpass!

- Radio-tracked toads were observed crossing I-90 using new overpass!

CWU

Amphibians – Coastal Giant Salamander

- Coastal giant salamanders can grow to 13+ inches long!
- It is one of the most common amphibian species found in the project area.

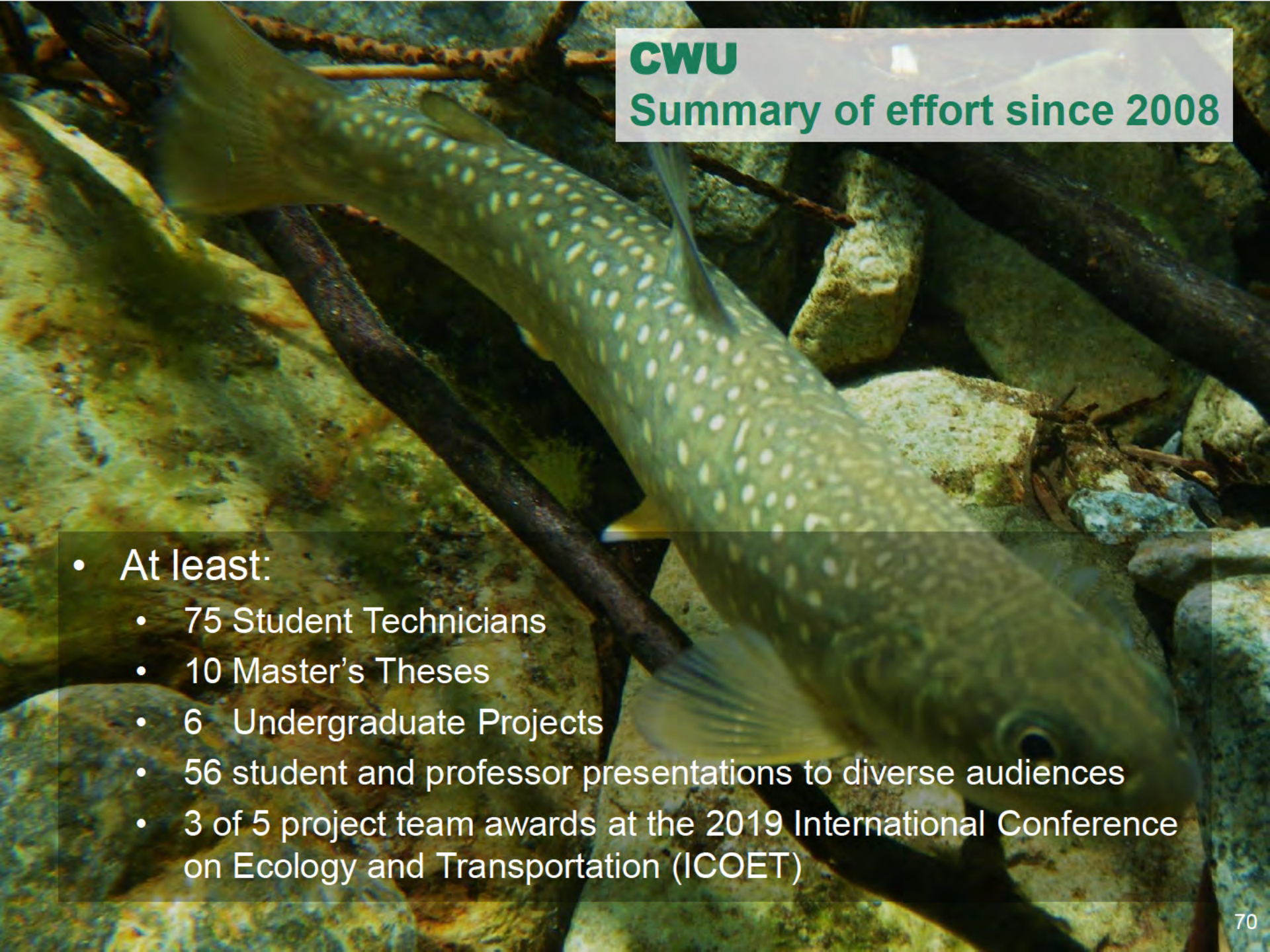
- Price Creek Underpass
  - 5 days after construction a salamander moved into stream bed
  - One adult documented crossing I-90 safely and relocating upstream of structure the next year
- Wolfe Creek Oversized Culvert
  - New artificial streambed inhabited by coastal giant salamanders


Extended chain-up
MILE 57
Rocky Run Creek CEA
120' bridge
140' bridge
Wolfe Creek CEA
Oversized culverts
UNSTABLE SLOPES
MILE 58

CWU
Fish

Professor Paul James and students regularly complete snorkel surveys to identify and observe fish species in the project area

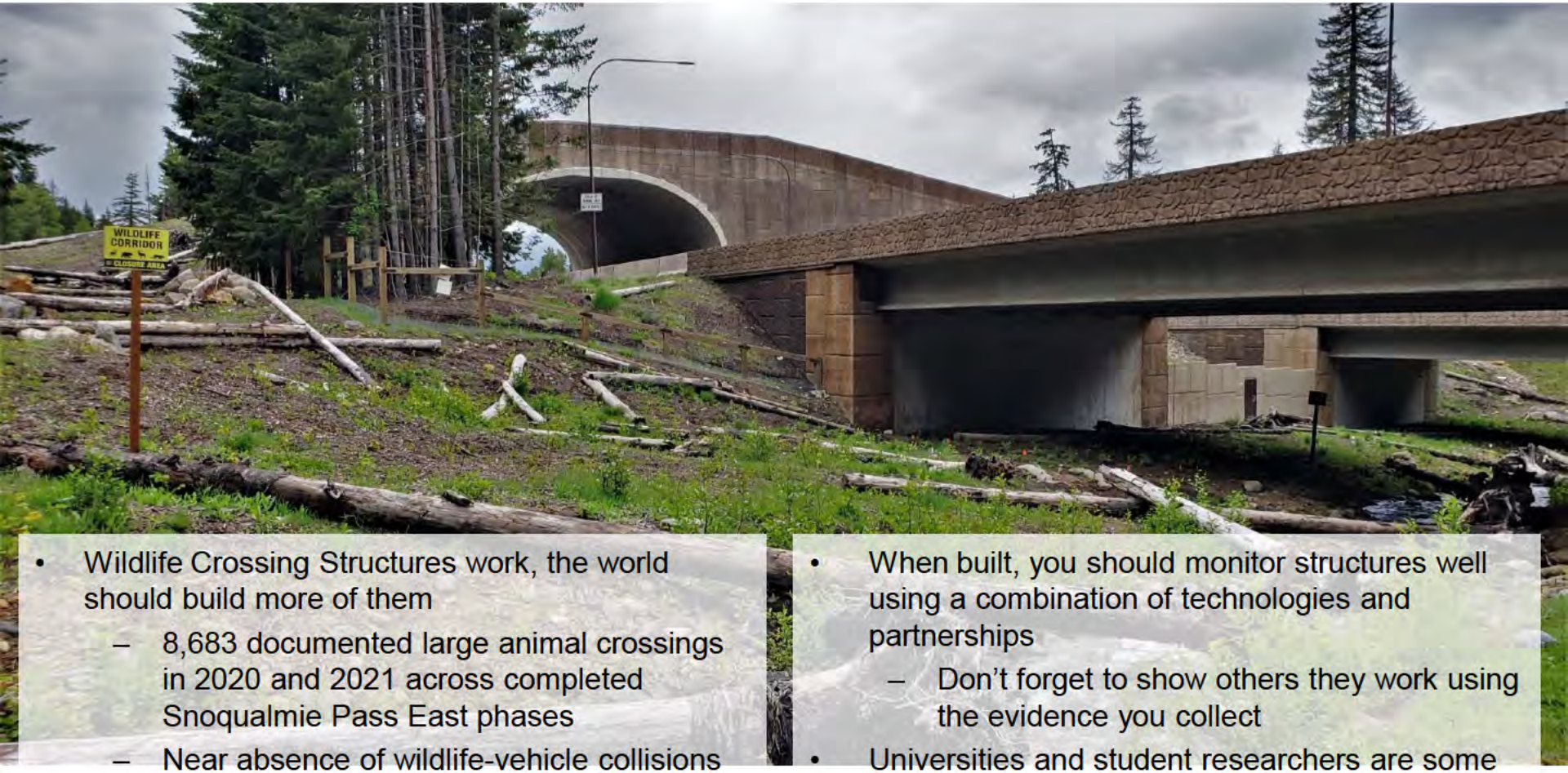
CWU
Fish



CWU
Summary of effort since 2008

- At least:
  - 75 Student Technicians
  - 10 Master's Theses
  - 6 Undergraduate Projects
  - 56 student and professor presentations to diverse audiences
  - 3 of 5 project team awards at the 2019 International Conference on Ecology and Transportation (ICOET)

In Summary…



- Wildlife Crossing Structures work, the world should build more of them
  - 8,683 documented large animal crossings in 2020 and 2021 across completed Snoqualmie Pass East phases
  - Near absence of wildlife-vehicle collisions in completed phases
- When built, you should monitor structures well using a combination of technologies and partnerships
  - Don't forget to show others they work using the evidence you collect
- Universities and student researchers are some of the best partners you can find
  - Anybody out there looking for new hires with road ecology knowledge, let us know

Questions?

Glen Kalisz – WSDOT Habitat Connectivity Biologist – glen.kalisz@wsdot.wa.gov

Frasier Shilling
fmshilling@ucdavis.edu
University of California, Davis

Andrew Runk
arunk@conteches.com
Contech Engineered Solutions

Glen Kalis
kalisgl@wsdot.wa.gov
Washington State Department of Transportation

Other Events for You:

- **May 21 – June 2, 2022**

  Conference on Sustainability and Emerging Transportation Technology

- **August 29-31, 2022**

  TRB's Tools of the Trade Conference

https://www.nationalacademies.org/trb/events

TRB Weekly

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Get Involved with TRB

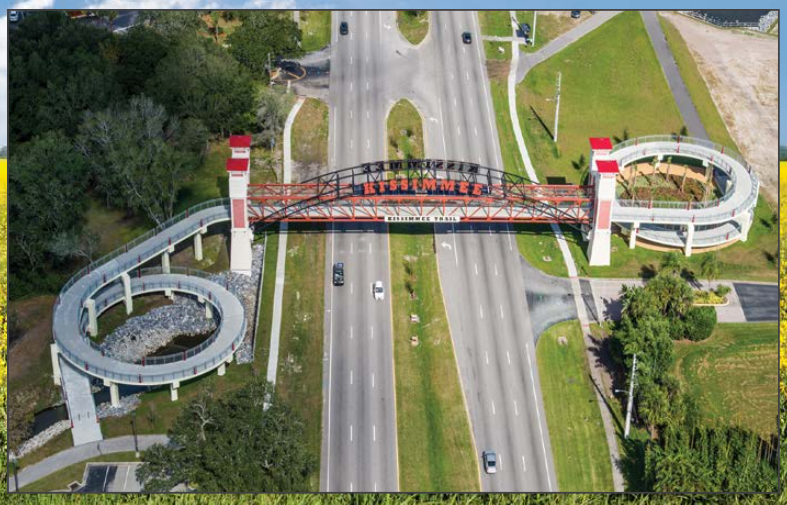
Getting involved is free!

Be a Friend of a Committee bit.ly/TRBcommittees
- Networking opportunities
- May provide a path to Standing Committee membership

Join a Standing Committee bit.ly/TRBstandingcommittee

Work with CRP https://bit.ly/TRB-crp

Update your information www.mytrb.org



STRUCTURES
REFERENCE
GUIDE

CONTECH®
ENGINEERED SOLUTIONS

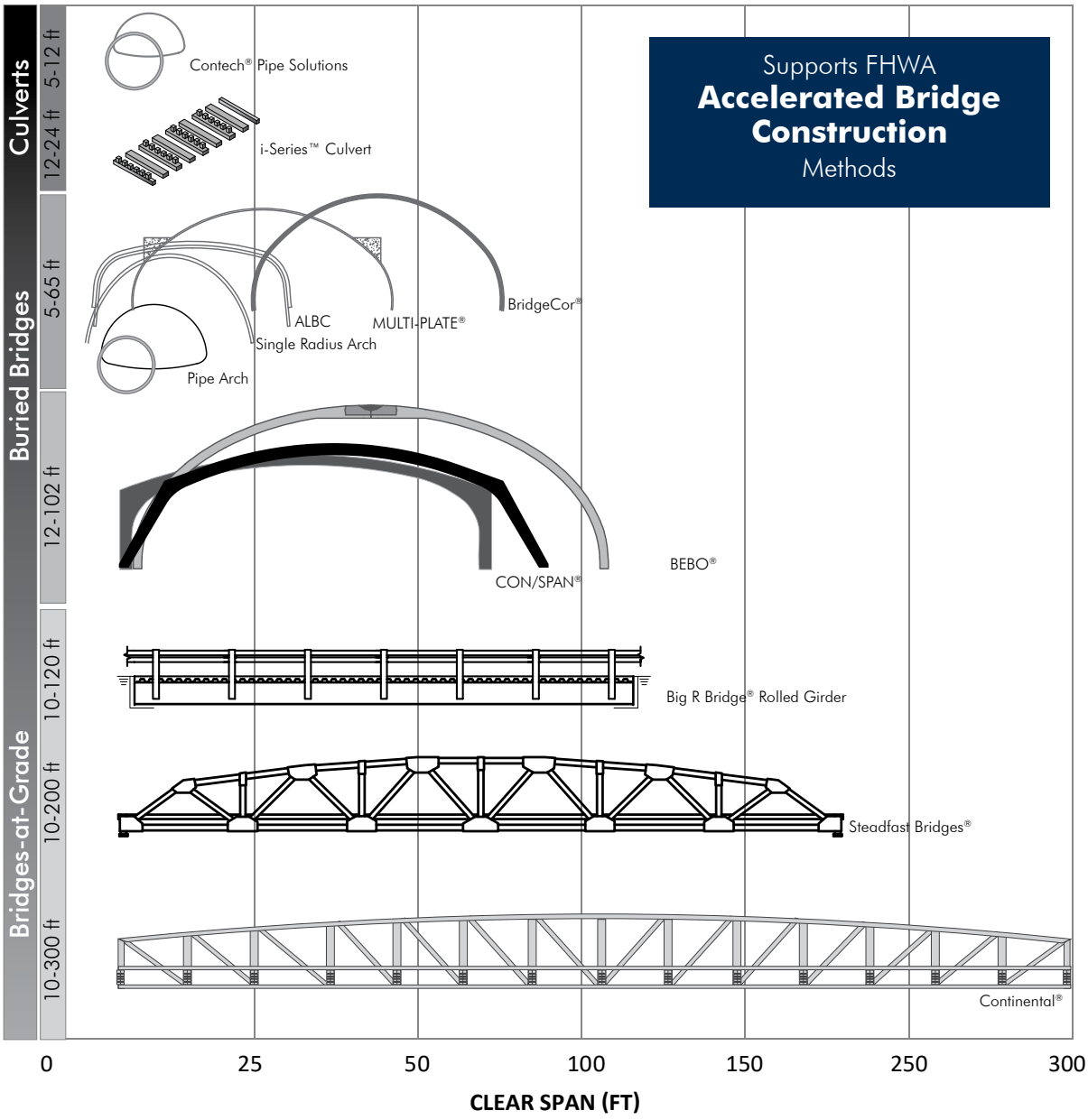
CROSSINGS. CULVERTS. BRIDGES. CONTECH.

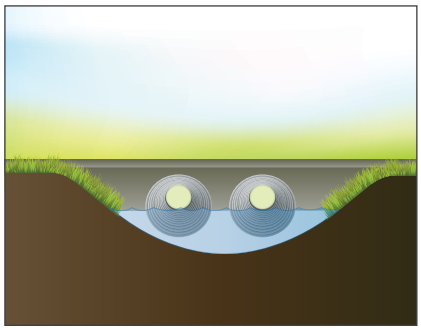
CROSSINGS. CULVERTS. BRIDGES. CONTECH.

Clear Span Bridges

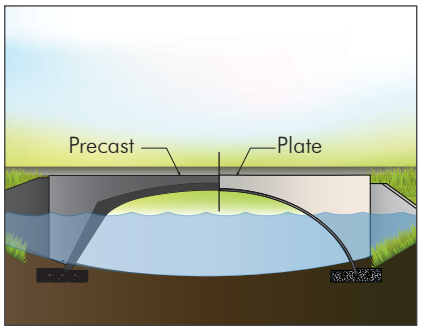
CULVERTS
PLATE
PRECAST
GIRDER
VEHICULAR
TRUSS
PEDESTRIAN

CONTECH PIPE SOLUTIONS
i-SERIES
CONTECH STRUCTURAL PLATE
BridgeCor
CON SPAN i-SERIES
CON SPAN BRIDGE SYSTEMS
BEBO Arch Systems
BIG R BRIDGE
STEADFAST BRIDGES
CONTINENTAL BRIDGE

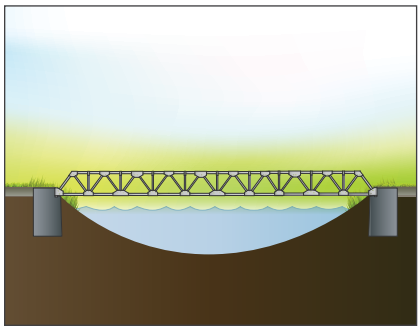




CULVERT



BURIED BRIDGE



BRIDGE AT-GRADE

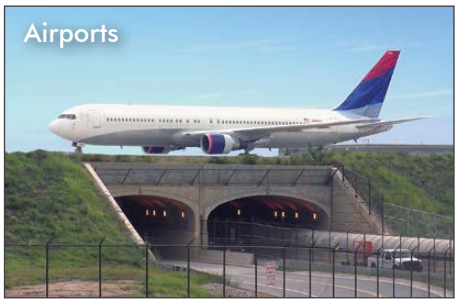
Spanning America since 1931

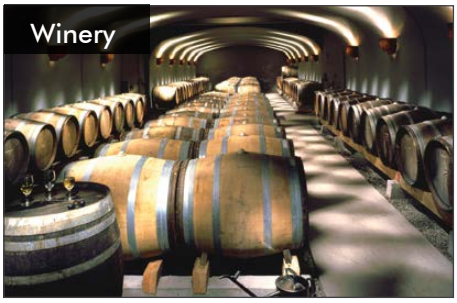
OVER 90,000 INSTALLATIONS WORLDWIDE!

Contech Engineered Solutions provides a comprehensive array of plate, precast, and truss structures, with the best-known brands available worldwide. Contech bridges - vehicular and pedestrian - fit a wide variety of applications, spanning distances from five to 300 feet and more. These bridge brands include Contech Structural Plate, CON/SPAN®, BEBO®, Continental®, Steadfast Bridges®, and Big R Bridge®.

Experience, innovative thinking and exceptional service have put more than 90,000 Contech bridge installations on the map worldwide.

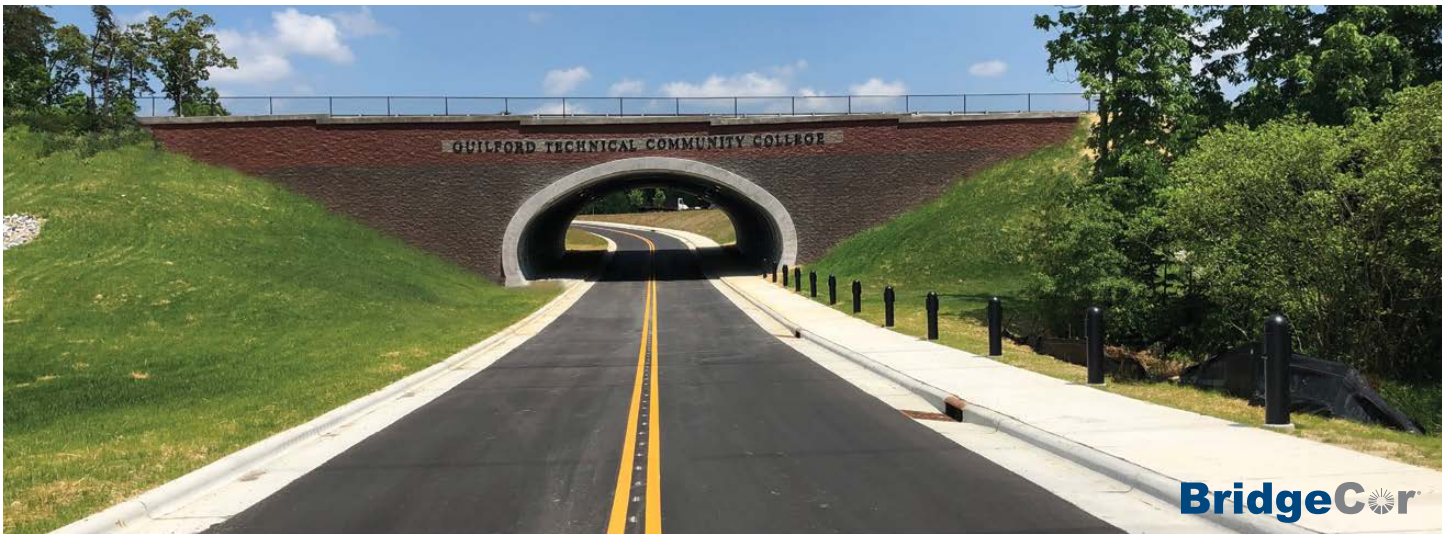
Markets





CONTECH® STRUCTURAL PLATE

Steel Structural Plate & Box Culvert



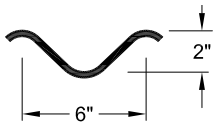
Aluminum Structural Plate & Box Culvert

STRENGTH. VERSATILITY. ECONOMY. PLATE.

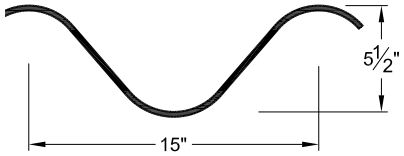
Strength

STEEL

6" X 2" CORRUGATION



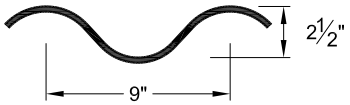
15" X 5 ½" CORRUGATION



Gage	12	10	8	7	5	3	1	5/16	3/8
Thickness	.111	.140	.170	.188	.218	.249	.280	.318	.380

ALUMINUM

9" X 2 ½" CORRUGATION



Thickness	.125	.150	.175	.200	.225	.250

Freight Economy

ONE BRIDGE = ONE TRUCK

Lightweight. Bolted Plate Construction Process.

PLATE ASSEMBLY

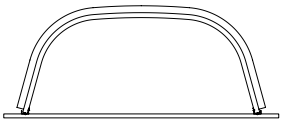
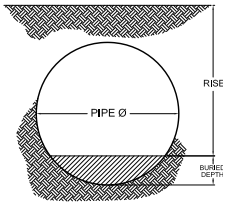
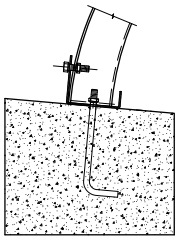
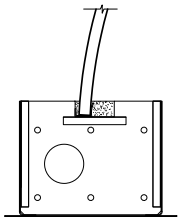
REINFORCING RIBS

LIFTING ASSEMBLED BOX

COMPLETE SYSTEM

STRENGTH. VERSATILITY. ECONOMY. PLATE.

Foundations

FOUNDATION OPTIONS			
Full Invert	Buried Invert	Strip Footing with Channel	EXPRESS® Foundations
			

End Treatments

KEYSTONE®

CONCRETE HEADWALL

ALUMINUM HEADWALL

BEVELED END

STEP-BEVELED END

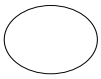
STEP-BEVEL W/ CONCRETE

WELDED WIRE WALL

METRIC SHEETING HEADWALL

MSE HEADWALL

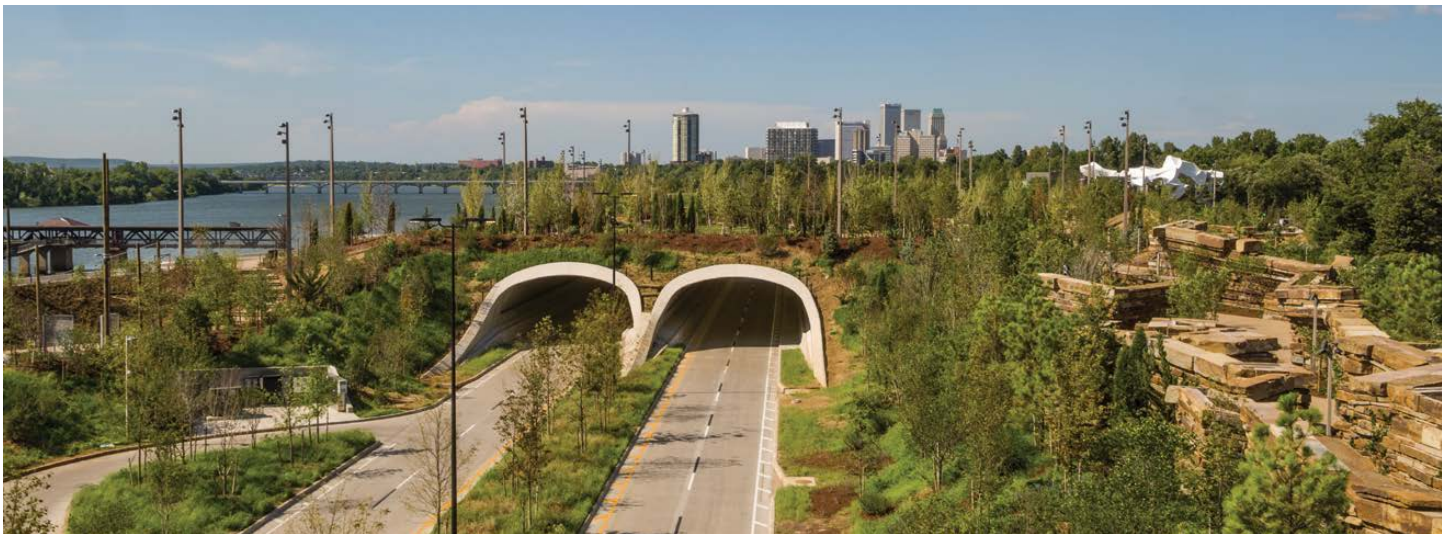
Shape Versatility

SHAPES			STRUCTURE SIZE RANGES - INSIDE SPAN X RISE MULTI-PLATE® *6" x 2" Steel*	BridgeCor® *15" x 5.5" Steel*	ALSP *9" x 2.5" Aluminum*
Round		min.	5'-0"	19'-11"	6'-0"
		max.	26'-0"	50'-6"	21'-0"
Vertical Ellipse		min.	4'-8" x 5'-2"		4'-8" x 5'-2"
		max.	25'-0" x 27'-8"		20'-1" x 22'-3"
Underpass		min.	12'-2" x 11'-0"		12'-1" x 11'-0"
		max.	20'-4" x 17'-9"		20'-5" x 17'-9"
Single Radius Arch		min.	6'-0" x 1'-10"	19'-7" x 9'-9"	5'-0" x 1'-9"
		max.	26'0" x 13'1"	54'-4" x 27'-2"	23'-0" x 11'-11"
Two Radius Arch		min.		18'-5" x 8'-4"	
		max.		50'-7" x 19'-11"	
Horizontal Ellipse		min.	7'-4" x 5'-6"		9'-2" x 6'-8"
		max.	14'-11" x 11'-2"		14'-11" x 11'-2"
Pipe Arch		min.	6'-1" x 4'-7"		6'-7" x 5'-8"
		max.	20'-7" x 13'-2"		21'-11" x 14'-11"
Low-Profile Arch SUPER-SPAN™ / SUPER-PLATE®		min.	19'-5" x 6'-9"		19'-5" x 6'-9"
		max.	45'-0" x 18'-8"		38'-8" x 15'-9"
High Profile Arch SUPER-SPAN™ / SUPER-PLATE®		min.	20'-1" x 9'-1"		20'-1" x 9'-1"
		max.	35'-4" x 20'-0"		35'-5" x 20'-0"
Horizontal Ellipse SUPER-SPAN™ / SUPER-PLATE®		min.	19'-4" x 12'-9"		19'-4" x 12'-9"
		max.	37'-2" x 22'-2"		37'-3" x 22'-2"
Pear-Arch SUPER-SPAN™		min.	23'-11" x 23'-4"		
		max.	30'4" x 25'10"		
Pear SUPER-SPAN™		min.	23'-8" x 25'-5"		
		max.	29'-11" x 31'-3"		
Box Culvert		min.		17'-6" x 6'-10"	8'-9" x 2'-6"
		max.		35'-4" x 13'-11"	35'-3" x 13'-7"

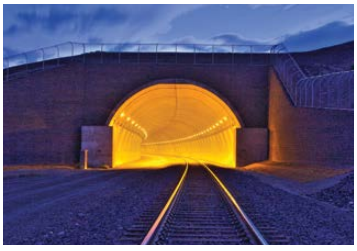
Custom sizes and shapes are available. Not available.

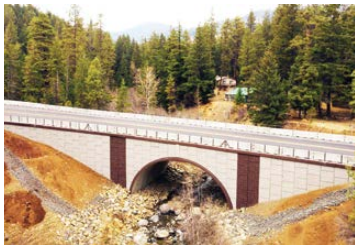
* For more details on Contech's complete structural plate offering, please consult the current edition of the Structural Plate Design Guide.

CON SPAN® -SERIES® Precast Arch Bridge System



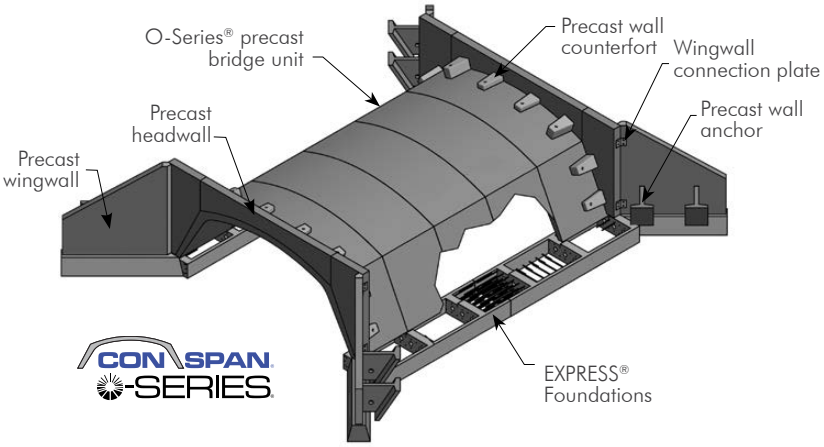
BEBO® Arch Systems Precast Arch Bridge System

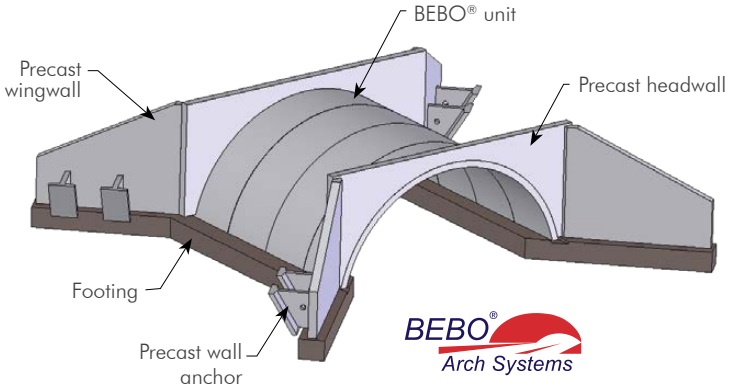




MODULAR. EFFICIENT. COMPLETE. PRECAST ARCH.

Modular Components



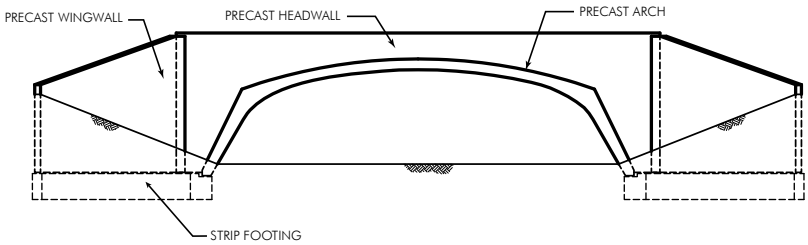


Installation

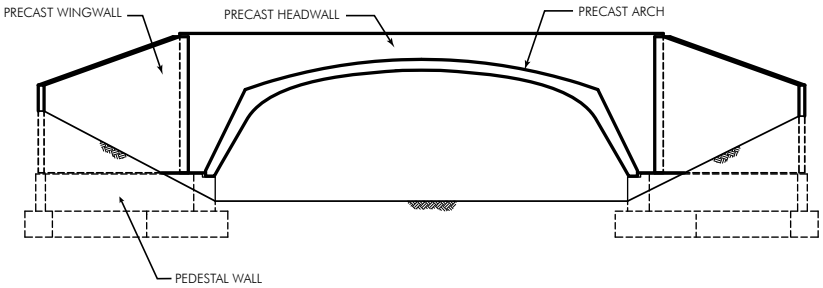
MODULAR. EFFICIENT. COMPLETE. PRECAST ARCH.

Foundations

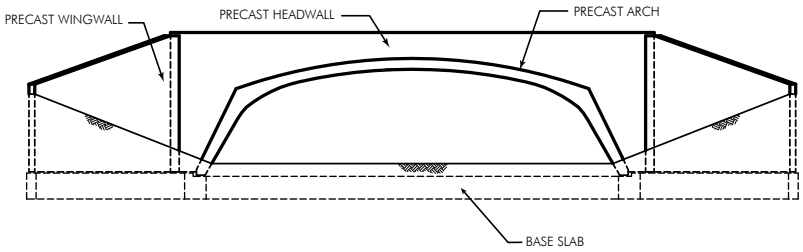
STRIP FOOTING



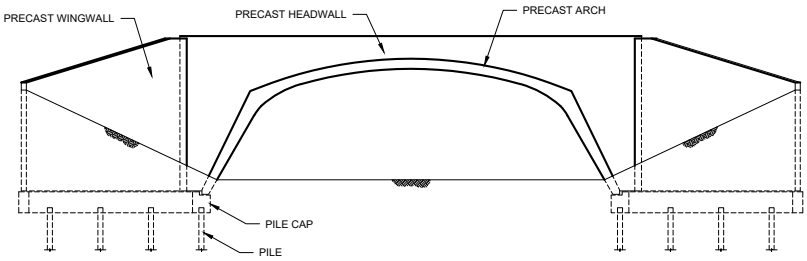
PEDESTAL WALL



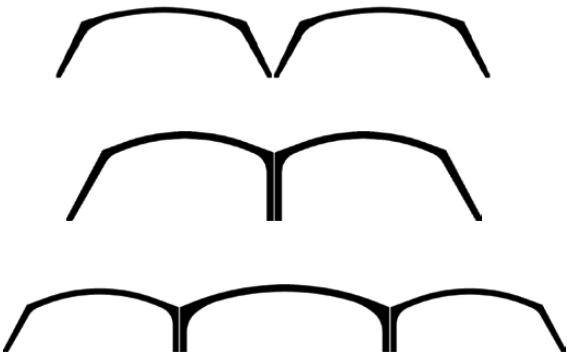
BASE SLAB



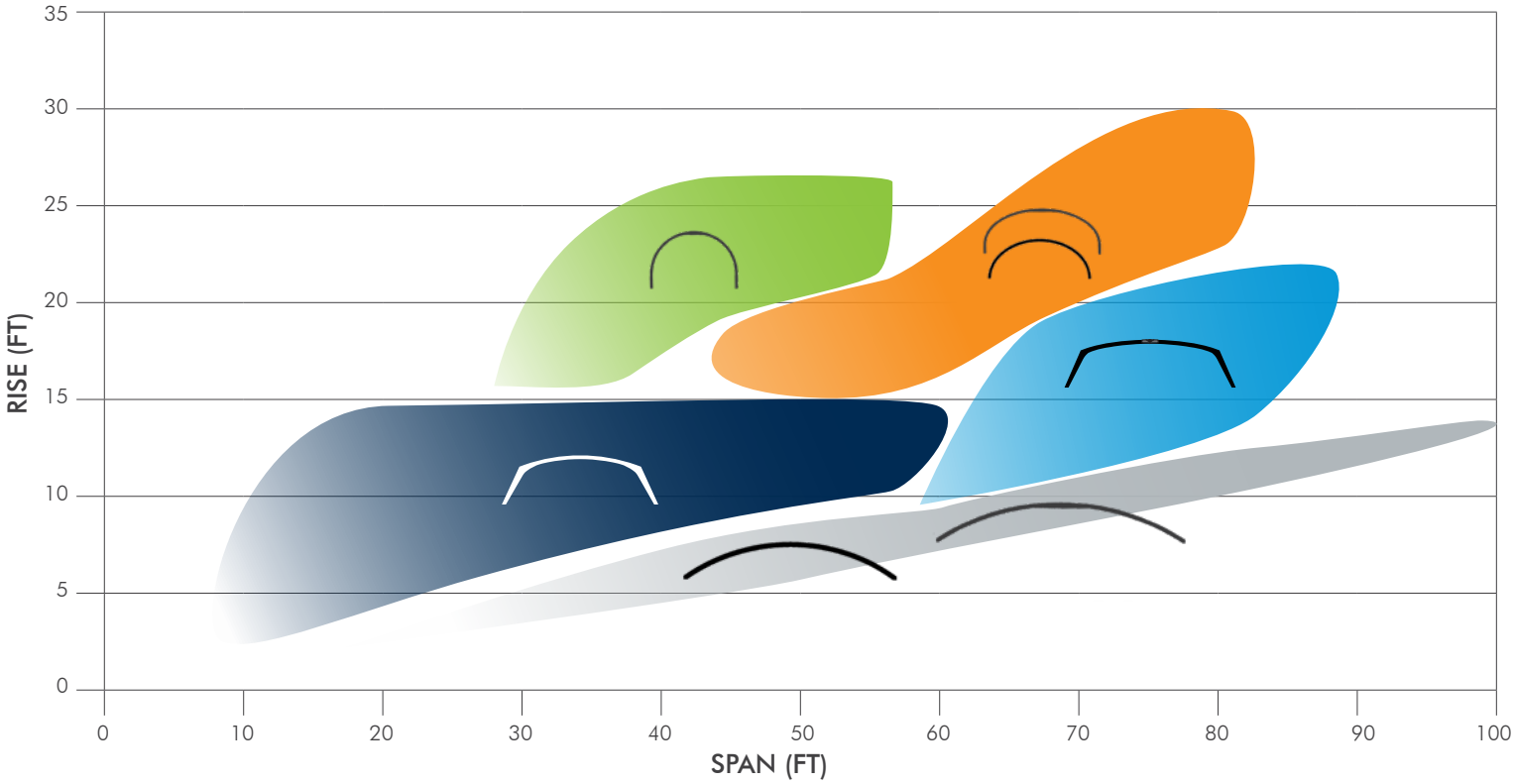
DEEP FOUNDATION



Multiple cell configurations



Shape Versatility



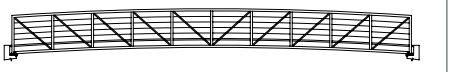
STRUCTURE				APPLICATIONS	SPAN RANGE (FT)	RISE RANGE (FT)	WATERWAY RANGE (SF)
CON/SPAN®*		O-Series®		Hydraulics, clear spans, grade separations	13 - 65	3.23 - 13.77	33 - 685
		O-Series® Twin Leaf		Longer span hydraulics, clear spans, grade separations	66 - 87	10.50 - 20.95	550 - 1442
BEBO®		C-Series Twin Leaf		Grade separation, high rise, high covers	29.33 - 54	11.33 - 26.33	260 - 1140
		E-Series		Arch shape, clearance box, aesthetics	11.17 - 47.75	3.5 - 13.5	28 - 479
		E-Series Twin Leaf		High rise, large span, grade separation	53.58 - 84	14 - 29.83	588 - 2076
		T-Series		Low clearance crossings	22 - 62	2.60 - 9	39 - 377
		T-Series Twin Leaf		Large spans with good soil conditions	64 - 102	7.42 - 13.67	340 - 982
Available for limited applications.							

* For additional shape information, please consult the Precast Waterway Charts Overview.

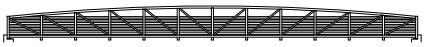
Pedestrian Truss Bridges

Continental® Pedestrian Truss Styles*

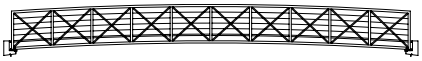
Connector®



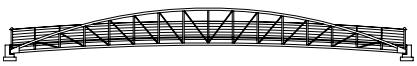
Capstone®



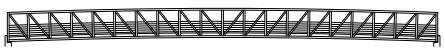
Link®



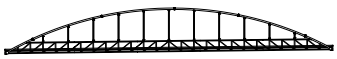
Keystone®



Gateway®



Tied Arch®



**Custom styling is available to make your project a reality (e.g. skywalks, cable-stayed bridges).*

Continental® Signature Designs

Rolled Girders

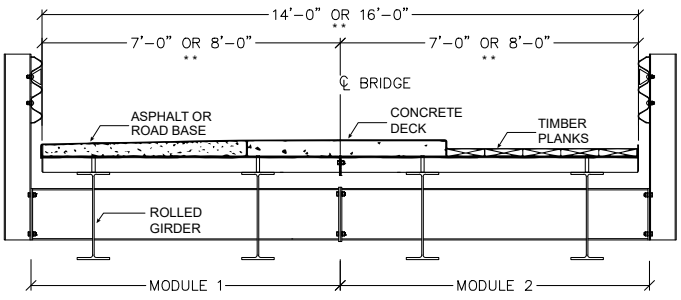
Big R EXPRESS® Modular Bridges

STANDARD FEATURES

- Single lane, modular bridge with a longitudinal splice
- Heavy duty loading (AASHTO HL-93 and U-80 off-highway trucks)
- Weathering steel structural members in stock
- 4.25" 9-gage galvanized Big R Bridge Deck
- Precast sills available
- Available in standard EXPRESS sizes
  - » Drawings typically available in one week
  - » Generally, ready to ship in one month

EXPRESS ATTRIBUTES	BRIDGE WIDTHS			
	12'	14'	*16'	18'
Standard Spans (5' Incr.)	30' - 60'	30' - 80'	30' - 80'	30' - 60'
Number of Rolled Girders	3	4	4	5
Number of Modules	1	2	2	2
Longitudinal Splice	No	Yes	Yes	Yes

*Seasonal stock typically available in 40', 50' and 60' spans.



* * 12' Bridges come in one - 3 girder module
18' Bridges come in one- 3 girder module & one - 2 girder module

Big R Site-Specific Modular Bridges

CUSTOMIZABLE TO MEET ANY SITE NEEDS

ANY SPAN & WIDTH

DESIGN ACCOMMODATES

- AASHTO LRFD
- HL-93 vehicular loading
- State DOT requirements
- Customer-specified vehicle loads
- Any rail or decking type
- Shipped in 2 or 3 beam modules

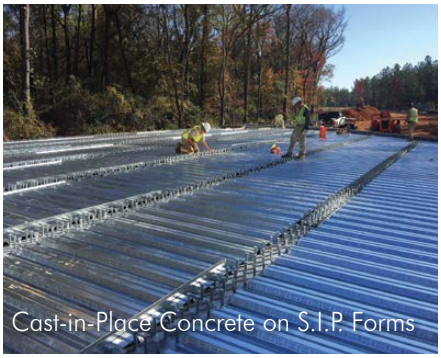
GUARDRAIL OPTIONS


W-Beam


Thrie-Beam


Custom Rail

DECK TYPES


Cast-in-Place Concrete on S.I.P. Forms


Concrete/Asphalt on Bridge Plank


Gravel on Bridge Plank

INSTALLATION AND ASSEMBLY OPTIONS

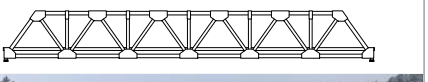

Component

COMPONENT/KIT ASSEMBLY ALSO AVAILABLE AS A CONSTRUCTION OPTION

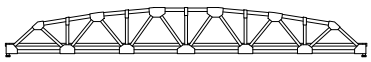
Vehicular Truss Bridges

Steadfast Bridges® Vehicular Truss Styles

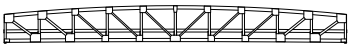
Colonial® Flat



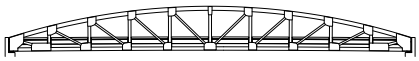
Colonial®



Capstone®



Keystone®



Archway®

Efficient. Economical. Timeless Designs.

Deck, Finish & Rail Options

DECK


Wood


Cast-in-Place


Asphalt


Steel Grate or FRP

FINISH


Weathering Steel


Painted Steel

Galvanized Steel*


TrussCoat® Duplex Coating

RAIL


Mesh Panels/Wood Rub Rail


Vertical Picket/Pipe Handrail


Thrie-Beam**


W-Beam**

*Exclusive 35-year galvanized rust free warranty for vehicular truss. **Available for vehicular truss options only.

EXPRESS® Foundations Speed of precast. Economy of cast-in-place.


Strip Footing


Pile Cap


Pedestal Wall

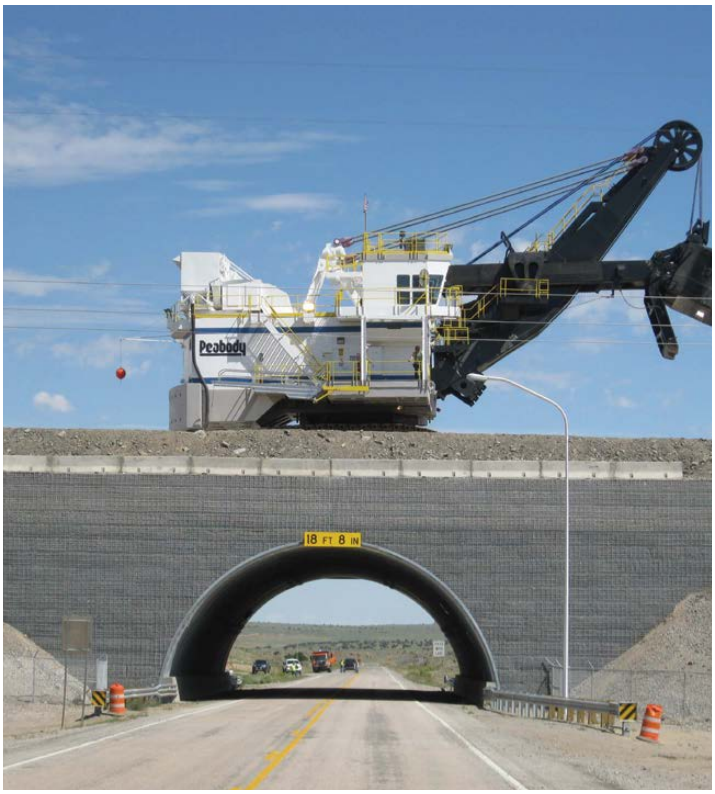

Base Slab

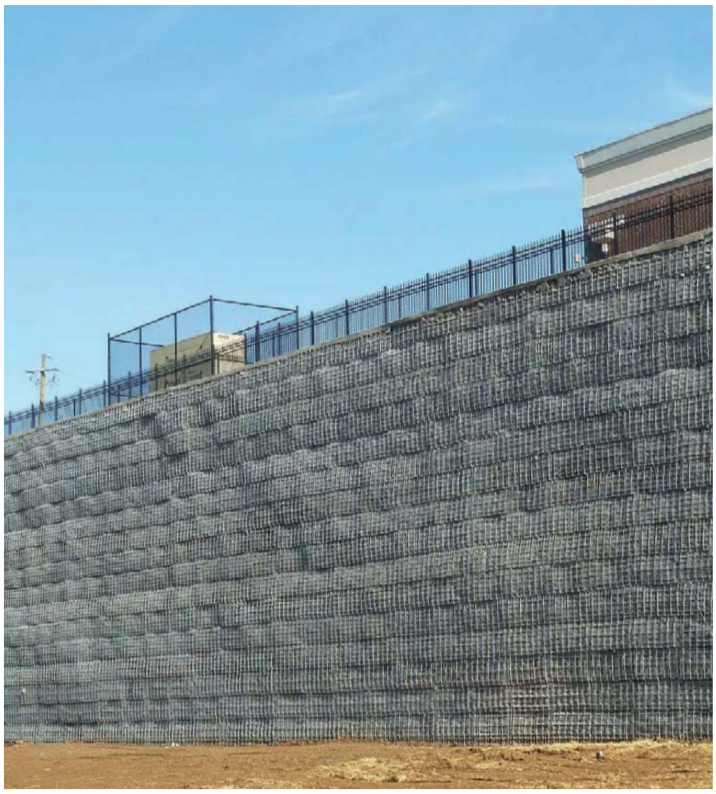
STEEL EXPRESS® Foundations Efficiencies of steel. Economy of cast-in-place.

All precast EXPRESS Foundations are applicable to plate, precast, truss, and girder bridge solutions.
Steel EXPRESS Foundations are available for strip footing foundations for truss, girder and plate structures.

WALL SYSTEMS.

Vist-A-Wall® Wire Walls.





Vist-A-Wall Wire Walls are available as temporary or permanent solutions.

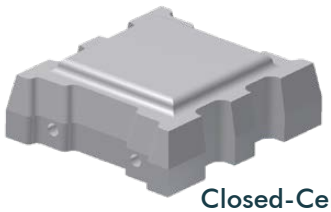
Vist-A-Wall® Precast Panel MSE Wall System

Featuring the Grid-Strip™ Soil Reinforcement System.

HARD ARMOR. ARMORTEC.

ArmorFlex®

ARTICULATING CONCRETE BLOCKS



Closed-Cell Block

Open-Cell Block

SPEED OF INSTALLATION

A-Jacks®

CONCRETE ARMOR UNITS

A-Jacks Unit

HARD ARMOR - SOFT AESTHETICS

INVERT PROTECTION

CHANNEL LINING

DAM OVERTOPPING

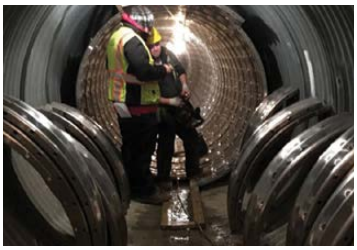
FOOTING PROTECTION

PIER PROTECTION

OUTLET PROTECTION

SPECIALTY PRODUCTS.

Contech Tunnel Liner Plate



Bin-Wall

Marine Bin-Wall

Bin-Wall/Blast Wall

Bridge Plank

Metric Sheeting

Cattle Guards

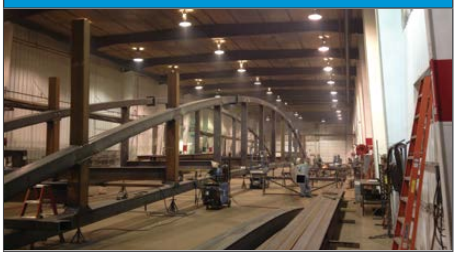
PROCESS – DESIGN SUPPORT. PREFABRICATION. INSTALL.

FABRICATION

PLATE

PRECAST

TRUSS & GIRDERS



FOUNDATIONS

EXPRESS® Foundations

- Strip footings
- Pedestal walls
- Deep foundations
- Base slab

TRANSPORTATION

ERECTION/ ASSEMBLY

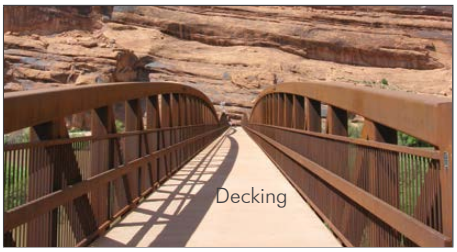
SYSTEM ELEMENTS

Scour Protection

END TREATMENTS

- CON/SPAN® Anchorwall
- Aluminum Headwall
- Welded Wire Wall

BACKFILLING



COMPLETION

Options & Support Specific to Your Project Needs

CONSIDERATIONS FOR ENGINEER OF RECORD
Site Design
Soil Borings
Soil Bearing Recommendations
Hydraulic Analysis
Scour Analysis
Scour Countermeasures
Permitting
Inspections

INSTALLATION SUPPORT	
Preconstruction Meeting	✳
Logistics Coordination	✳
Structure Onsite Installation Assistance	✳

✳	Contech Support Available
☑	Engineer of Record May Provide

SOLUTION DEVELOPMENT & DESIGN SUPPORT		
Structure Selection	✳	☑
Structure Siting and Layout	✳	☑
Engineer's Estimate	✳	
Photo Simulation	✳	☑
DYOB Concept	✳	☑
Proposal Drawings	✳	☑
Contract Drawings	✳	☑
Specifications	✳	☑
Foundation Reactions	✳	
Foundation Design	✳	☑
Hydraulic Coordinates	✳	
Scour References	✳	☑
Approval Assistance	✳	☑
Fabrication Drawings	✳	

DYOB® (DESIGN YOUR OWN BRIDGE)

www.ContechES.com/dyob

DRAWINGS & TECHNICAL SUPPORT

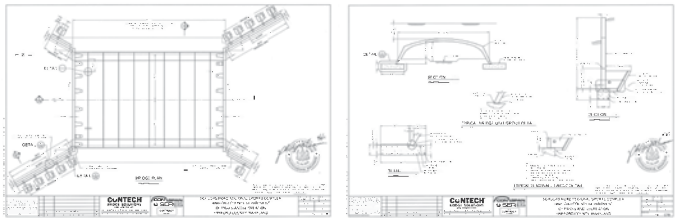


PHOTO SIMULATION

CONTECH®
ENGINEERED SOLUTIONS

Contech® Engineered Solutions provides innovative, cost-effective site solutions to engineers, contractors and developers on projects across North America. Our portfolio includes bridges, drainage, erosion control, retaining wall, sanitary sewer and stormwater management products.

STORMWATER SOLUTIONS

PIPE SOLUTIONS

STRUCTURE SOLUTIONS

BridgeCor
CONTECH® STRUCTURAL PLATE
CON/SPAN® -SERIES
BEBO® Arch Systems
EXPRESS® Foundations
CONTINENTAL® BRIDGE
STEADFAST BRIDGES®
BIG R BRIDGE
VISTAWALL®
ARMORTEC® Erosion Control Solutions

For more information, call one of Contech's Regional Offices located in the following cities:

Corporate Office - Ohio (Cincinnati)	**513-645-7000**
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Florida (Orlando)	321-348-3520
Maine (Scarborough)	207-885-9830
Maryland (Baltimore)	410-740-8490
Oregon (Portland)	503-258-3180
Texas (Dallas)	972-590-2000

www.ContechES.com
800-338-1122

steel

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