Eco-Logical and Wildlife Crossings: Concepts in Innovative Planning

Tuesday, May 24, 2011
1:00 – 2:30 PM Eastern

Presenters

- Mary Gray, FHWA Office of Project Development and Environmental Review
- Peter Kozinski, Colorado Department of Transportation
- Sarah Barnum, Normandeau Asssociates, Inc.
- Angela Kociolek, Western Transportation Institute

Moderated by Haley Peckett, Volpe National Transportation Systems Center/USDOT

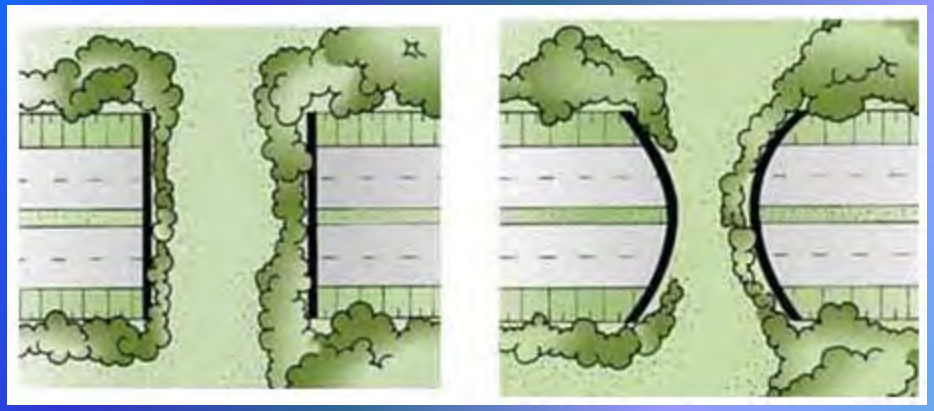
U.S. Department Of Transportation
Federal Highway Administration

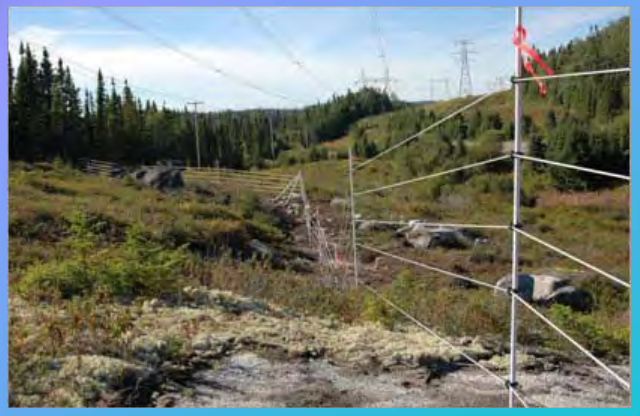
U.S. Department of Transportation
Research and Innovative Technology Administration

Ways in which FHWA is Protecting and Enhance Wildlife Habitat

Mary Gray

FHWA Office of Project Development and Environmental Review





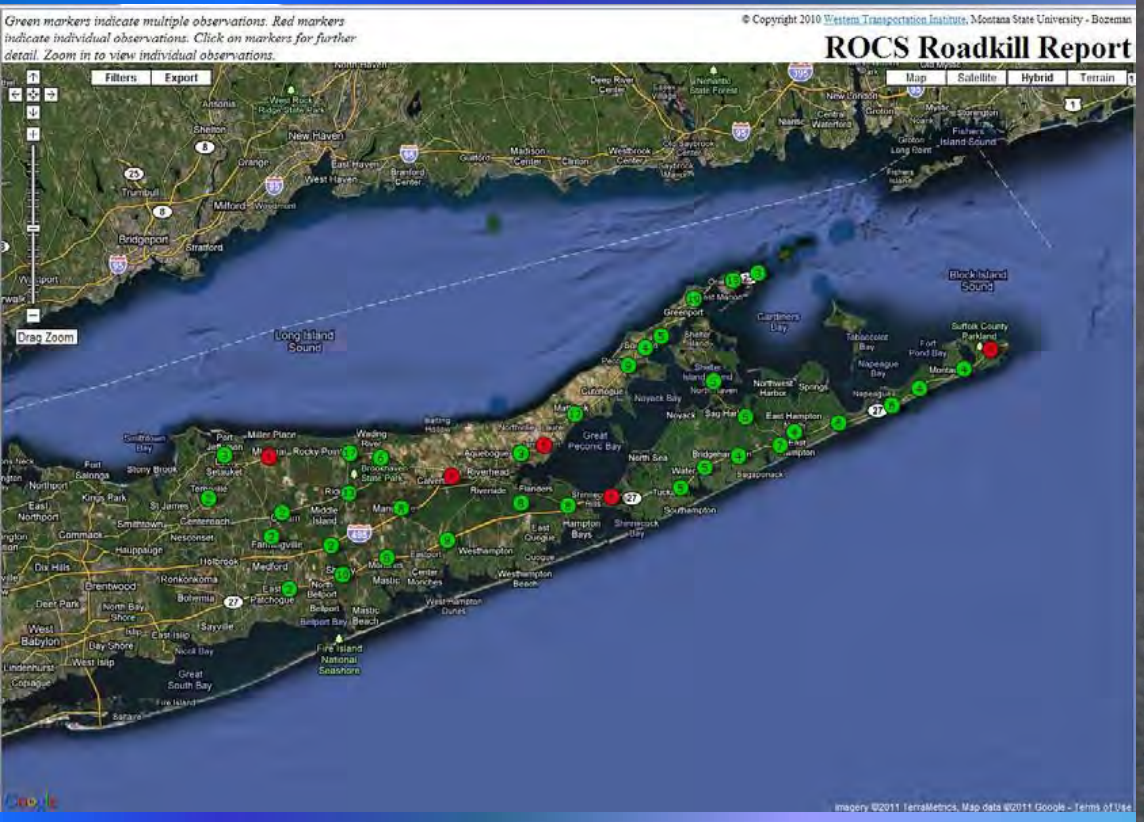
What We Do

Studies and Research
Webinars and Trainings
Guidance, Conferences

Research and Studies

- STEP Research Program
  - ROCS
  - Deer Crash.com
  - Wildlife Crossing Structure handbook
- ARC Competition
- Wildlife Congressional Study
  - Best Practices Manual
  - On-line Training Course
- Eco-Logical

The Roadkill Observation Collection System (ROCS)



Deer-Vehicle Crash Information Clearinghouse (DVCIC)

Data
Research
Information
exchange

c

Wildlife Crossing Structure Handbook

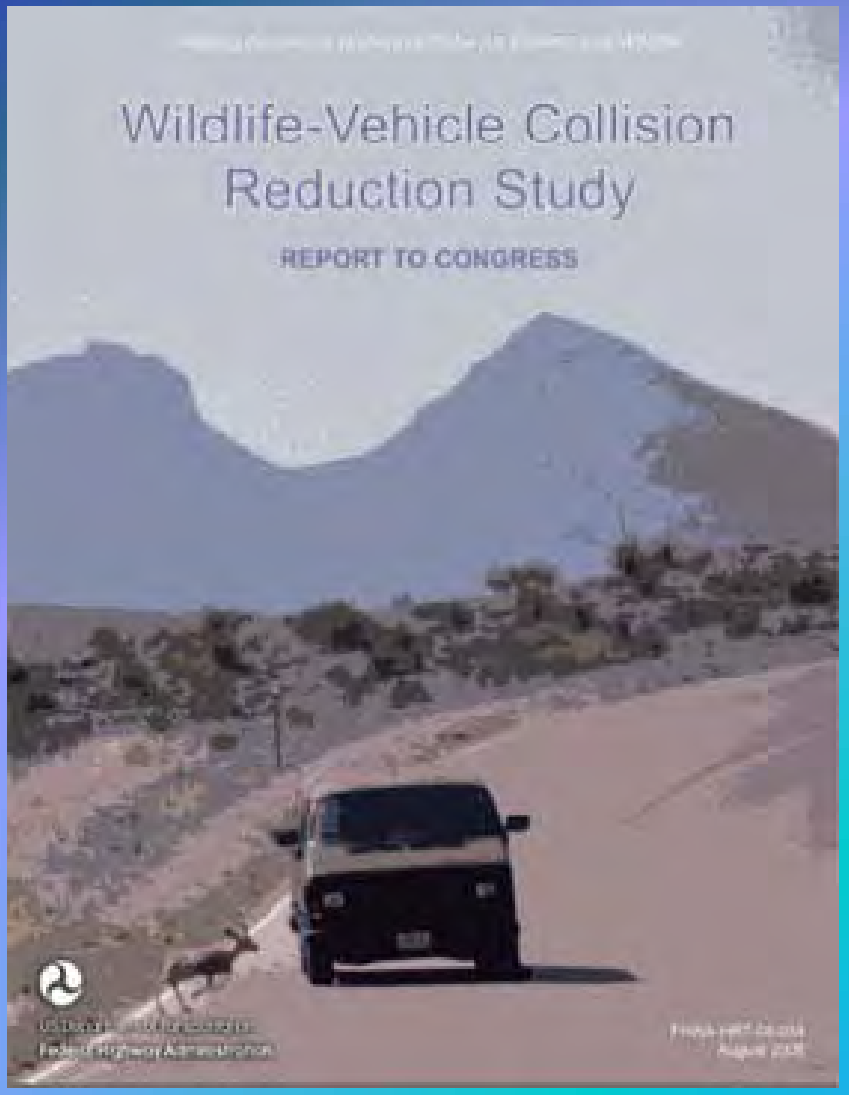
Planning
Placement
Design
Guidelines

ARC International Wildlife Crossing Infrastructure Design Competition

Wildlife Vehicle Reduction Study

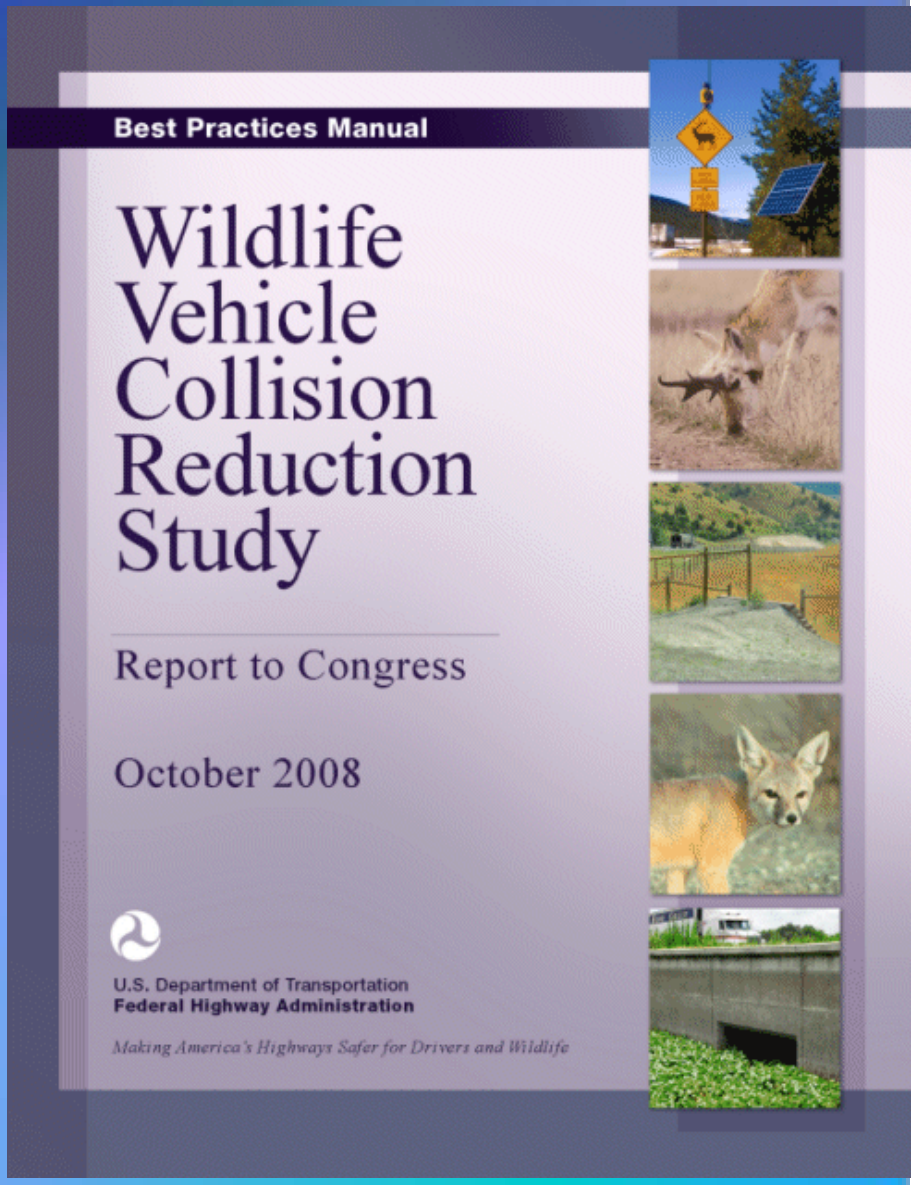
WVC Impacts
- Focused on large animals
- Trends
- Locations and costs

WVC Mitigations
- No single solution
- Design guidelines



Best Practices Manual

- Regional and statewide tools
- Guidance on incorporating into roadway design
- Best management practices for reducing WVCs w/ large animals.
- Best management practices for reducing WVCs w/T&E species.
- Monitoring and evaluating

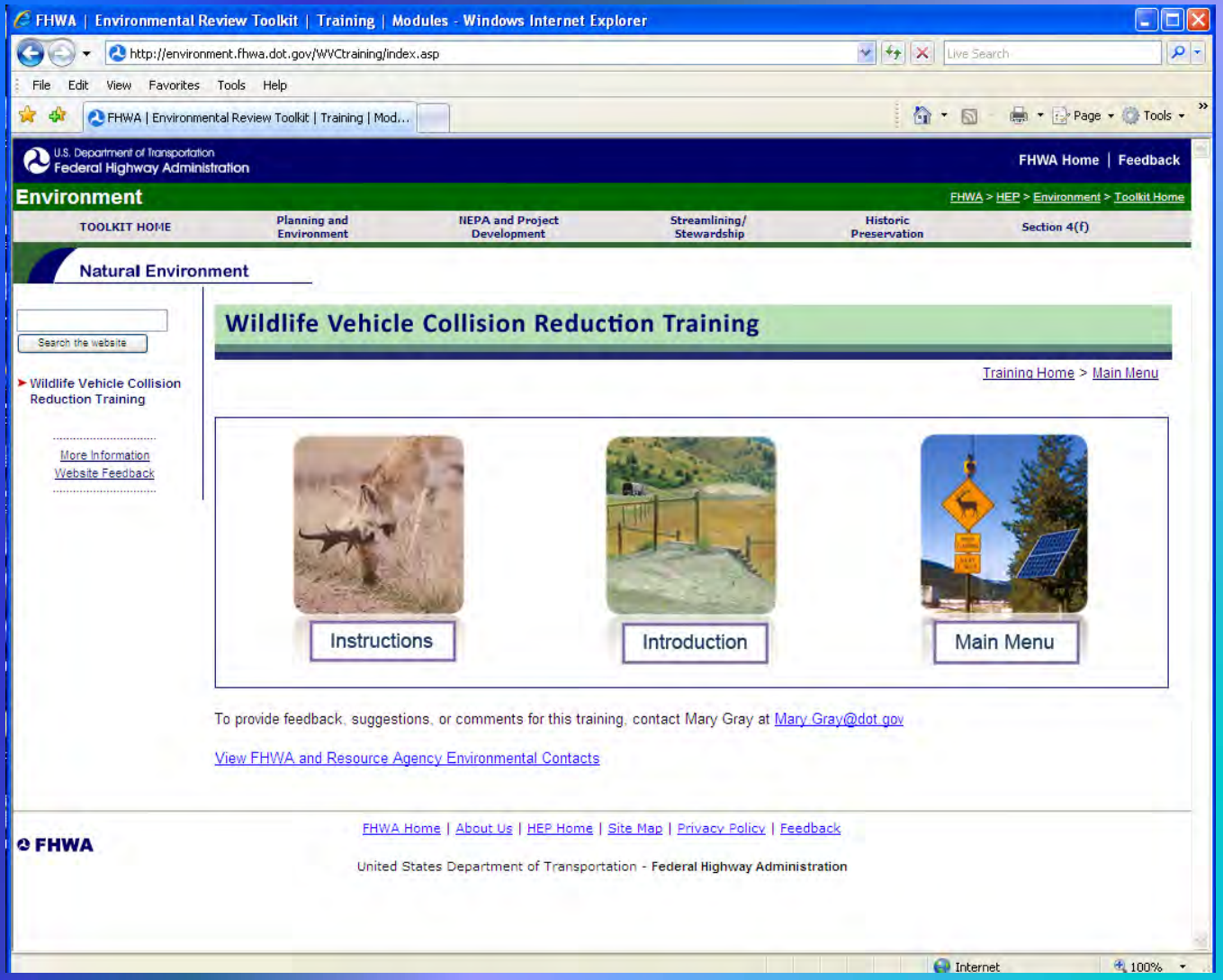


Trainings, Webinars and Guidance

On-Line Training Webinars ICOET

Keeping It Simple: Easy Ways to Help Wildlife Along Roads

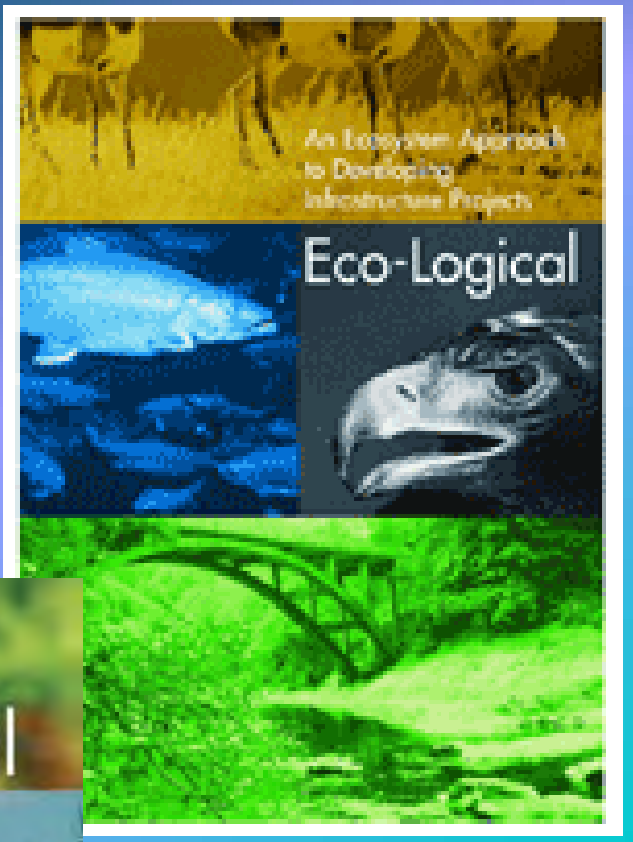
FHWA Wildlife Vehicle Collision Reduction Online Training



The 2011 International Conference on Ecology & Transportation

Eco-Logical

Pilots
Research
Interagency Exchange



More Information

Wildlife Vehicle Collision Reduction Training
http://www.environment.fhwa.dot.gov/wvctraining/index.asp

Congressional Report: Wildlife Vehicle Collision Reduction Study
http://www.tfhrc.gov/safety/pubs/08034/index.htm

Best Practices Manual: Wildlife Vehicle Collision Reduction Study
http://www.fhwa.dot.gov/environment/hconnect/wvc/index.htm

Website: Deer Vehicle Crash Information Clearinghouse:
http://www.deercrash.com.

Website: Keeping It Simple Toolkit
http://www.fhwa.dot.gov/environment/wildlifeprotection/index.cfm.

Critter Crossings:
http://www.fhwa.dot.gov/environment/wildlifecrossings/index.htm.

Eco-Logical
http://environment.fhwa.dot.gov/ecological/eco_entry.asp

Report: Guidelines for Designing and Evaluating North American Wildlife Crossing Systems

I-70 Mountain Corridor & FHWA Eco-Logical Grant

Presented By

Peter Kozinski
Colorado Department of Transportation

I-70 Mountain Corridor CSS
Partnerships Powered by Context

I-70 Mountain Corridor CSS

Partnerships Powered by Context

I-70 Mountain Corridor Context Statement

The I-70 Mountain Corridor is a magnificent scenic place. Human elements are woven through breathtaking natural features. The integration of these diverse elements has occurred over the course of time. This corridor is a recreational destination for the world, a route for interstate and local commerce and a unique place to live.

It is our commitment to seek balance and provide for 21st century uses.

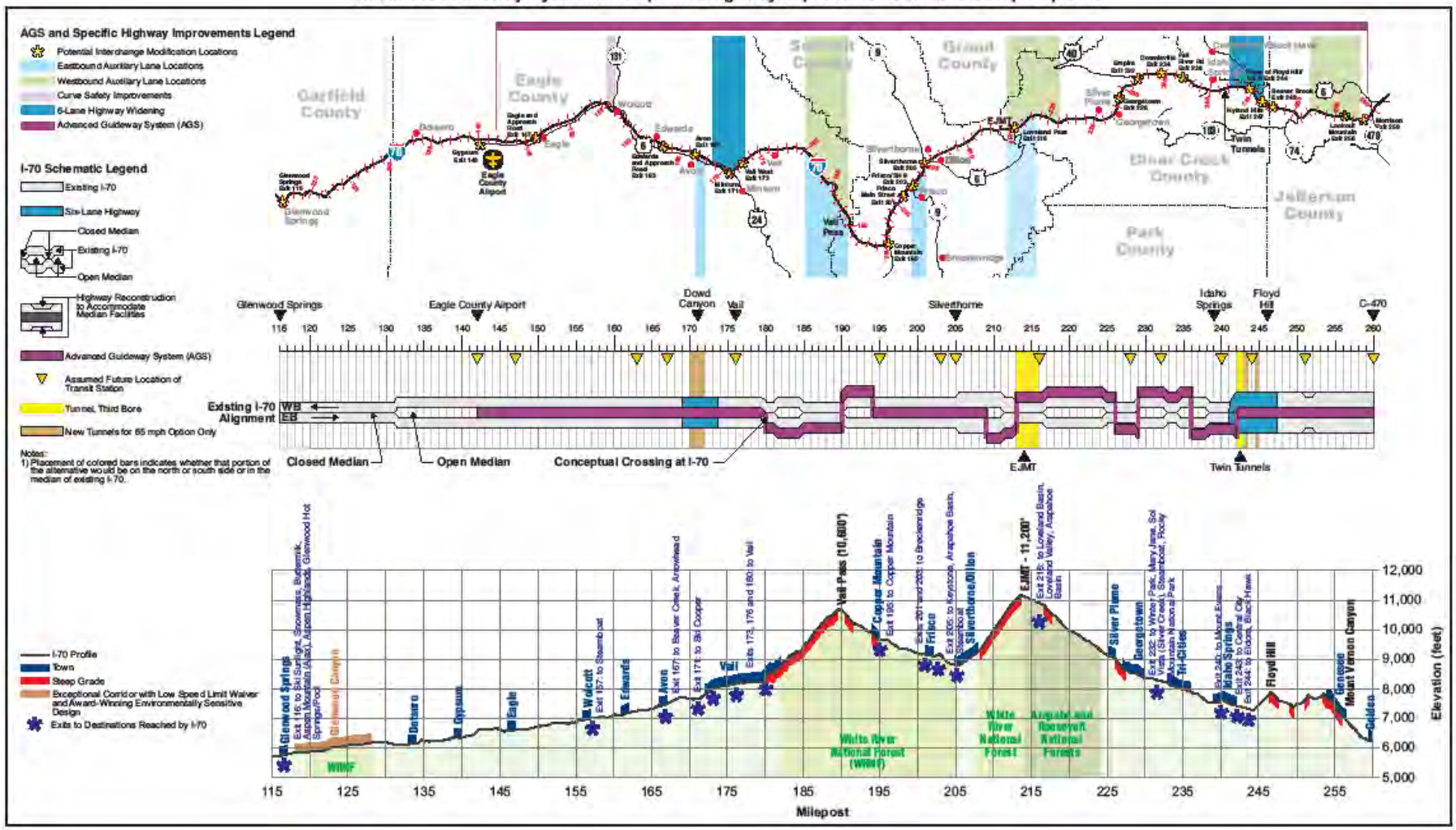
We will continue to foster and nurture new ideas to address the challenges we face.

We respect the importance of individual communities, the natural environment, and the need for safe and efficient travel.

Well thought-out choices create a sustainable legacy.

I-70 Mountain Corridor CSS
Partnerships Powered by Context

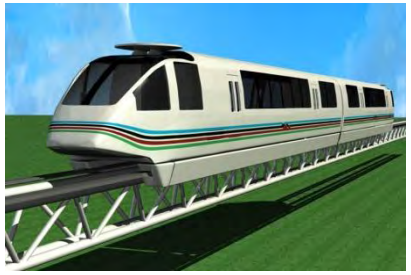
Figure 1. Consensus Recommendation - Preferred Alternative: Minimum Program of Improvements
Advanced Guideway System with Specific Highway Improvements- 55 and 65 mph Options

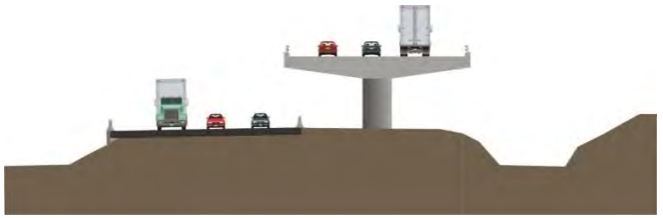


I-70 Mountain Corridor CSS
Partnerships Powered by Context

How does the Eco-Logical Grant Integrate into the I-70 Mtn. Corridor?

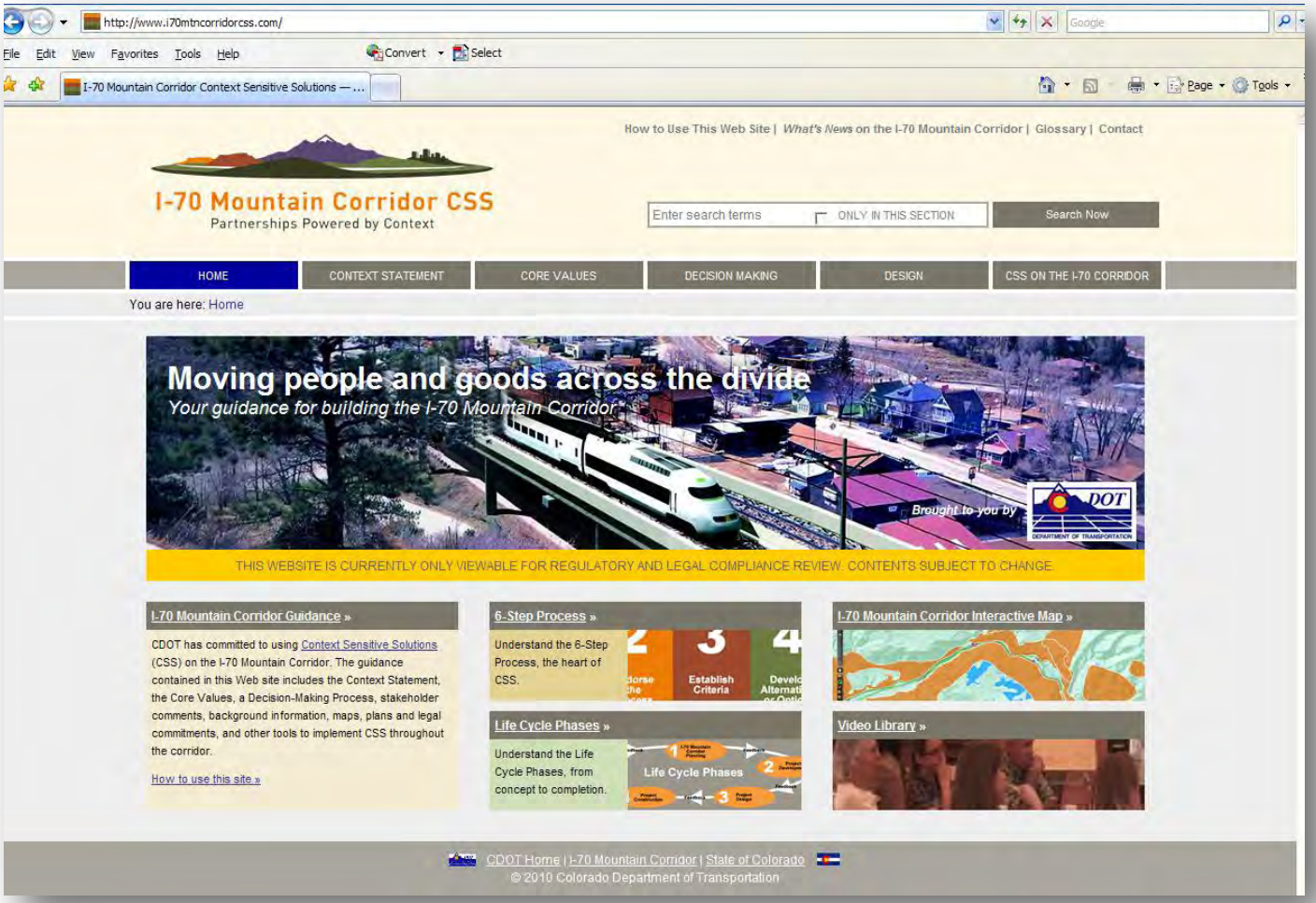
- Alternatives to minimize footprint impacts in Tier 2 processes
- Four agreements/commitments
  - Context Sensitive Solutions process
  - Section 106 Programmatic Agreement
  - SWEEP and ALIVE Memoranda of Agreement
- Other mitigation strategies presented in Chapter 3 of the PEIS





I-70 Mountain Corridor CSS
Partnerships Powered by Context

The CSS Website

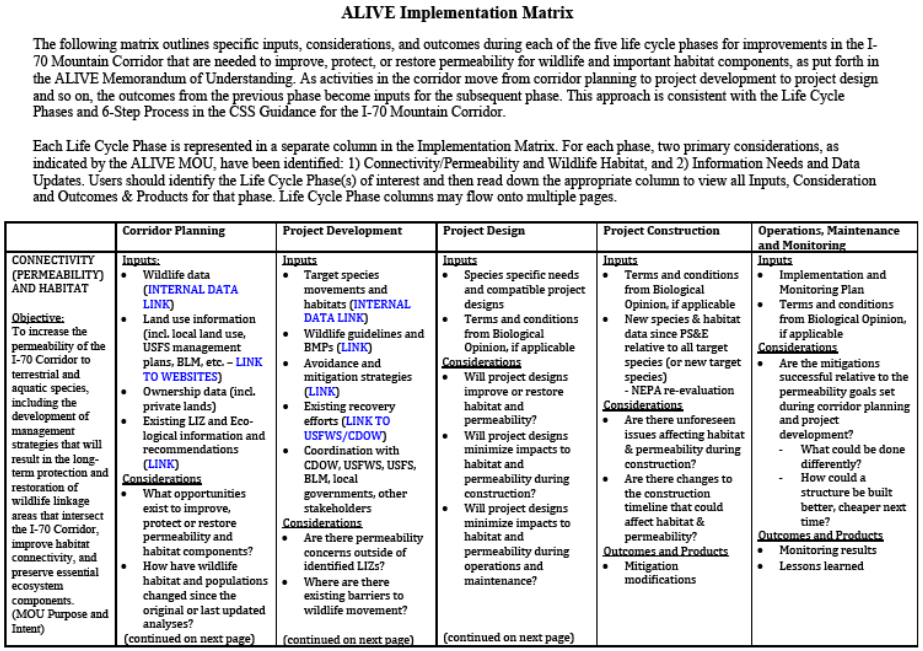


www.i70mtncorridorcss.com

I-70 Mountain Corridor CSS
Partnerships Powered by Context

ALIVE Implementation Matrix

- Inputs, considerations, and outcomes for five life cycle phases of corridor improvements
- Five life cycle phases:
  1. Corridor Planning
  2. Project Development
  3. Project Design
  4. Project Construction
  5. Operations, Maintenance, and Monitoring
- Two primary considerations for each phase:
  1. Connectivity/Permeability and Wildlife Habitat
  2. Information Needs and Data Updates



ALIVE Implementation Matrix

The following matrix outlines specific inputs, considerations, and outcomes during each of the five life cycle phases for improvements in the I-70 Mountain Corridor that are needed to improve, protect, or restore permeability for wildlife and important habitat components, as put forth in the ALIVE Memorandum of Understanding. As activities in the corridor move from corridor planning to project development to project design and so on, the outcomes from the previous phase become inputs for the subsequent phase. This approach is consistent with the Life Cycle Phases and 6-Step Process in the CSS Guidance for the I-70 Mountain Corridor.

Each Life Cycle Phase is represented in a separate column in the Implementation Matrix. For each phase, two primary considerations, as indicated by the ALIVE MOU, have been identified: 1) Connectivity/Permeability and Wildlife Habitat, and 2) Information Needs and Data Updates. Users should identify the Life Cycle Phase(s) of interest and then read down the appropriate column to view all Inputs, Consideration and Outcomes & Products for that phase. Life Cycle Phase columns may flow onto multiple pages.

	Corridor Planning	Project Development	Project Design	Project Construction	Operations, Maintenance and Monitoring
CONNECTIVITY (PERMEABILITY) AND HABITAT Objective: To increase the permeability of the I-70 Corridor to terrestrial and aquatic species, including the development of management strategies that will result in the long-term protection and restoration of wildlife linkage areas that intersect the I-70 Corridor, improve habitat connectivity, and preserve essential ecosystem components. (MOU Purpose and Intent)	Inputs: • Wildlife data (INTERNAL DATA LINK) • Land use information (incl. local land use, USFS management plans, BLM, etc. – LINK TO WEBSITES) • Ownership data (incl. private lands) • Existing LIZ and Eco-logical information and recommendations (LINK) Considerations • What opportunities exist to improve, protect or restore permeability and habitat components? • How have wildlife habitat and populations changed since the original or last updated analyses? (continued on next page)	Inputs • Target species movements and habitats (INTERNAL DATA LINK) • Wildlife guidelines and BMPs (LINK) • Avoidance and mitigation strategies (LINK) • Existing recovery efforts (LINK TO USFWS/CDOW) • Coordination with CDOW, USFWS, USFS, BLM, local governments, other stakeholders Considerations • Are there permeability concerns outside of identified LIZs? • Where are there existing barriers to wildlife movement? (continued on next page)	Inputs • Species specific needs and compatible project designs • Terms and conditions from Biological Opinion, if applicable Considerations • Will project designs improve or restore habitat and permeability? • Will project designs minimize impacts to habitat and permeability during construction? • Will project designs minimize impacts to habitat and permeability during operations and maintenance? (continued on next page)	Inputs • Terms and conditions from Biological Opinion, if applicable • New species & habitat data since PS&E relative to all target species (or new target species) - NEPA re-evaluation Considerations • Are there unforeseen issues affecting habitat & permeability during construction? • Are there changes to the construction timeline that could affect habitat & permeability? Outcomes and Products • Mitigation modifications	Inputs • Implementation and Monitoring Plan • Terms and conditions from Biological Opinion, if applicable Considerations • Are the mitigations successful relative to the permeability goals set during corridor planning and project development? - What could be done differently? - How could a structure be built better, cheaper next time? Outcomes and Products • Monitoring results • Lessons learned

I-70 Mountain Corridor CSS
Partnerships Powered by Context

I-70 Eco-Logical Project

Goals:

1. Compile baseline information on the presence of and use of existing crossing structures by wildlife along I-70;
2. Develop recommendations for mitigating the impacts of roads and traffic on wildlife;
3. Facilitate environmental review processes and stakeholder engagement in terrestrial and aquatic connectivity along the corridor.

I-70 Mountain Corridor CSS
Partnerships Powered by Context

I-70 Eco-Logical Project

Methods:

1. Roadway Inventory
2. Camera Monitoring
3. Incorporation of connectivity concerns in stakeholder processes & CDOT planning
4. Identification of connectivity zones and recommendations development

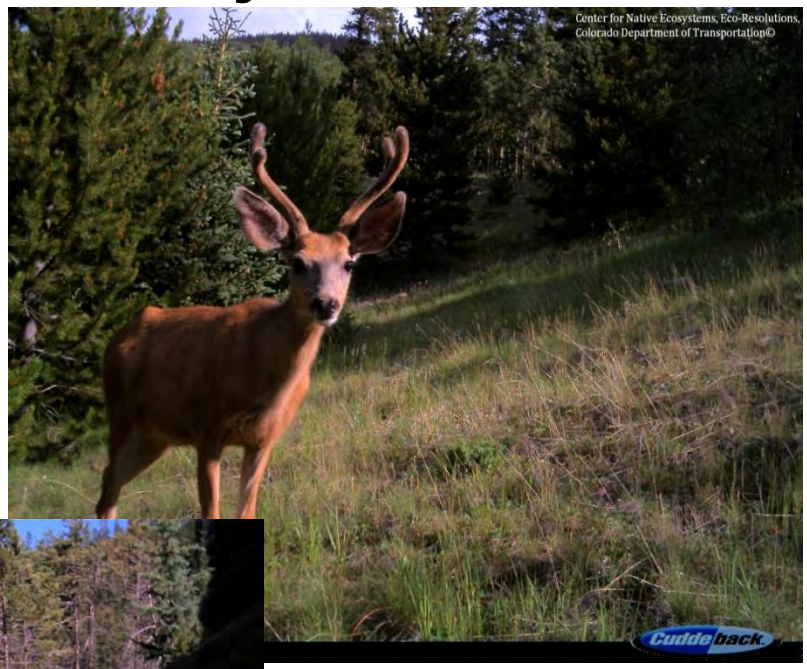
I-70 Mountain Corridor CSS
Partnerships Powered by Context

I-70 Eco-Logical Project

Results:

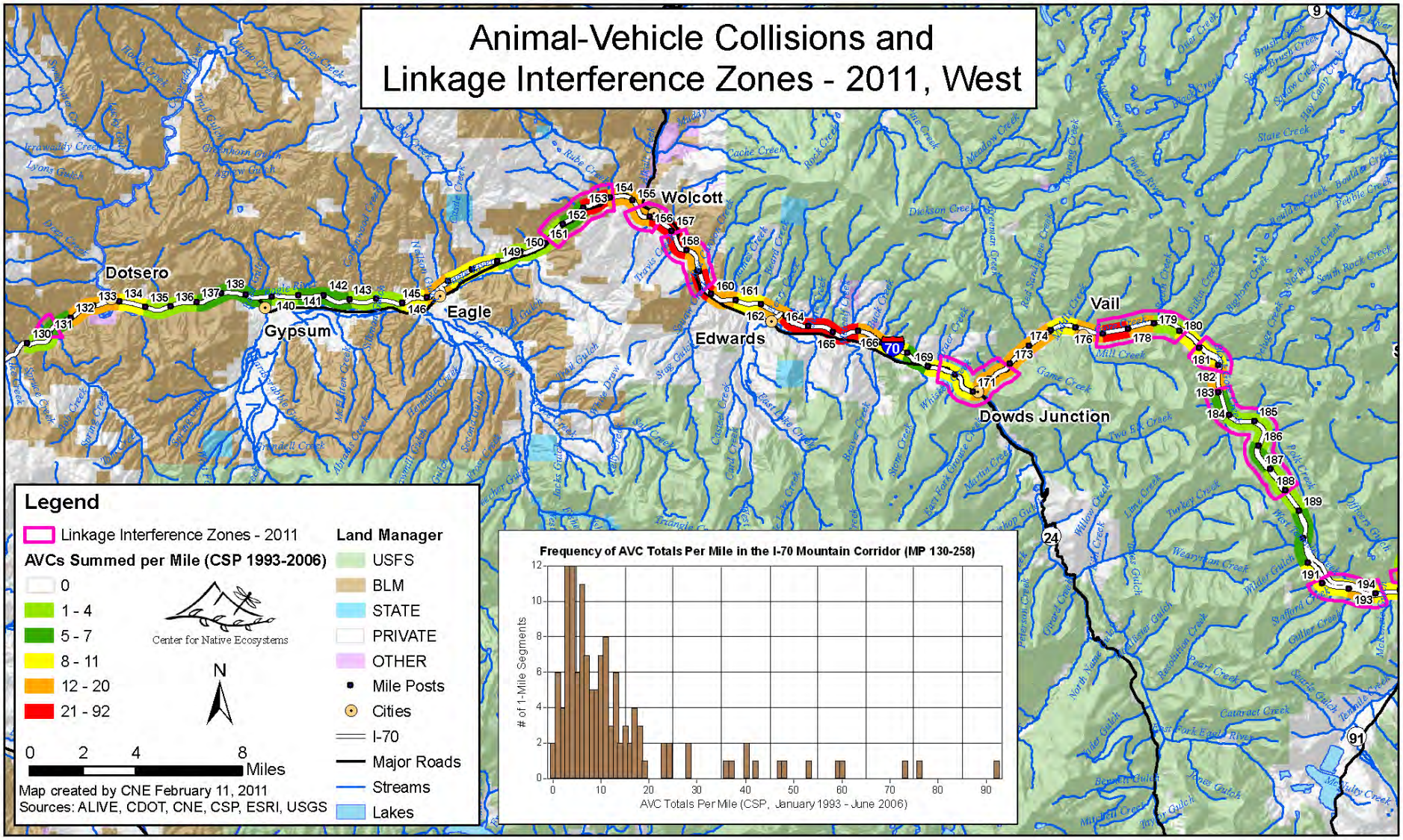
- LIZs-2011
- Aquatic connectivity locations

www.I-70WildlifeWatch.org



I-70 Mountain Corridor CSS
Partnerships Powered by Context

Animal-Vehicle Collisions and Linkage Interference Zones - 2011, West



I-70 Mountain Corridor CSS

Partnerships Powered by Context

I-70 Eco-Logical Project

Project Outcomes and Implementation

- Recommendations and BMPs for improving terrestrial and aquatic connectivity
- All data layers, databases and recommendations available for project planning via CSS website
- Framework for ongoing stakeholder engagement
- Project completion: Sept. 2011

I-70 Mountain Corridor CSS
Partnerships Powered by Context

Using Hotspot Analysis to Plan Wildlife Crossing Opportunities

Sarah A. Barnum, Ph.D.
Senior Wildlife Ecologist

NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

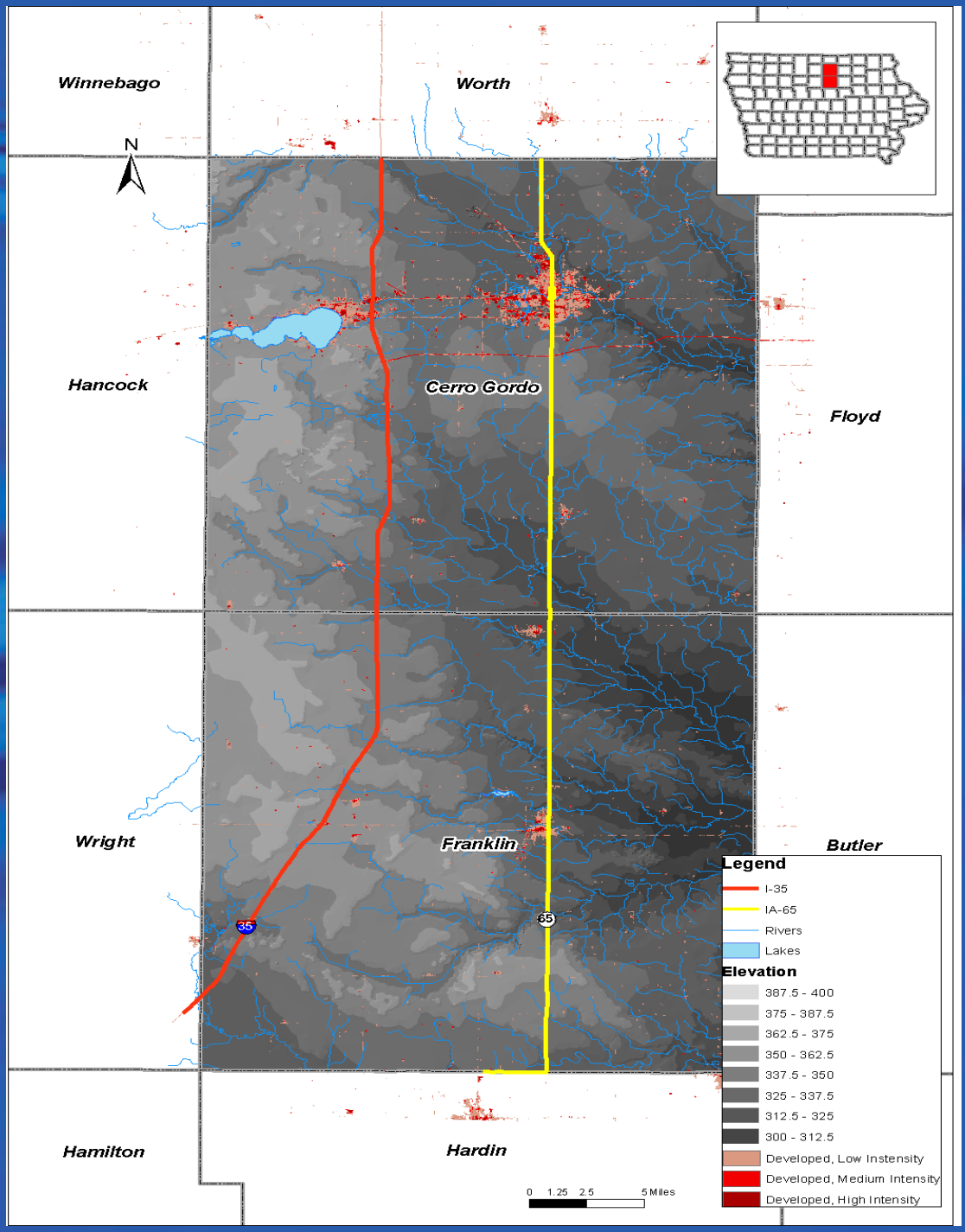
This Project is Funded by

- The Deer Vehicle Crash Information and Research Center (DVCIR) Pooled Fund
  - Contributors are: Connecticut, Iowa, Maryland, Minnesota, New Hampshire, New York, Ohio, Texas, Wisconsin, and the FHWA.
- The FHWA is the manager of the study.

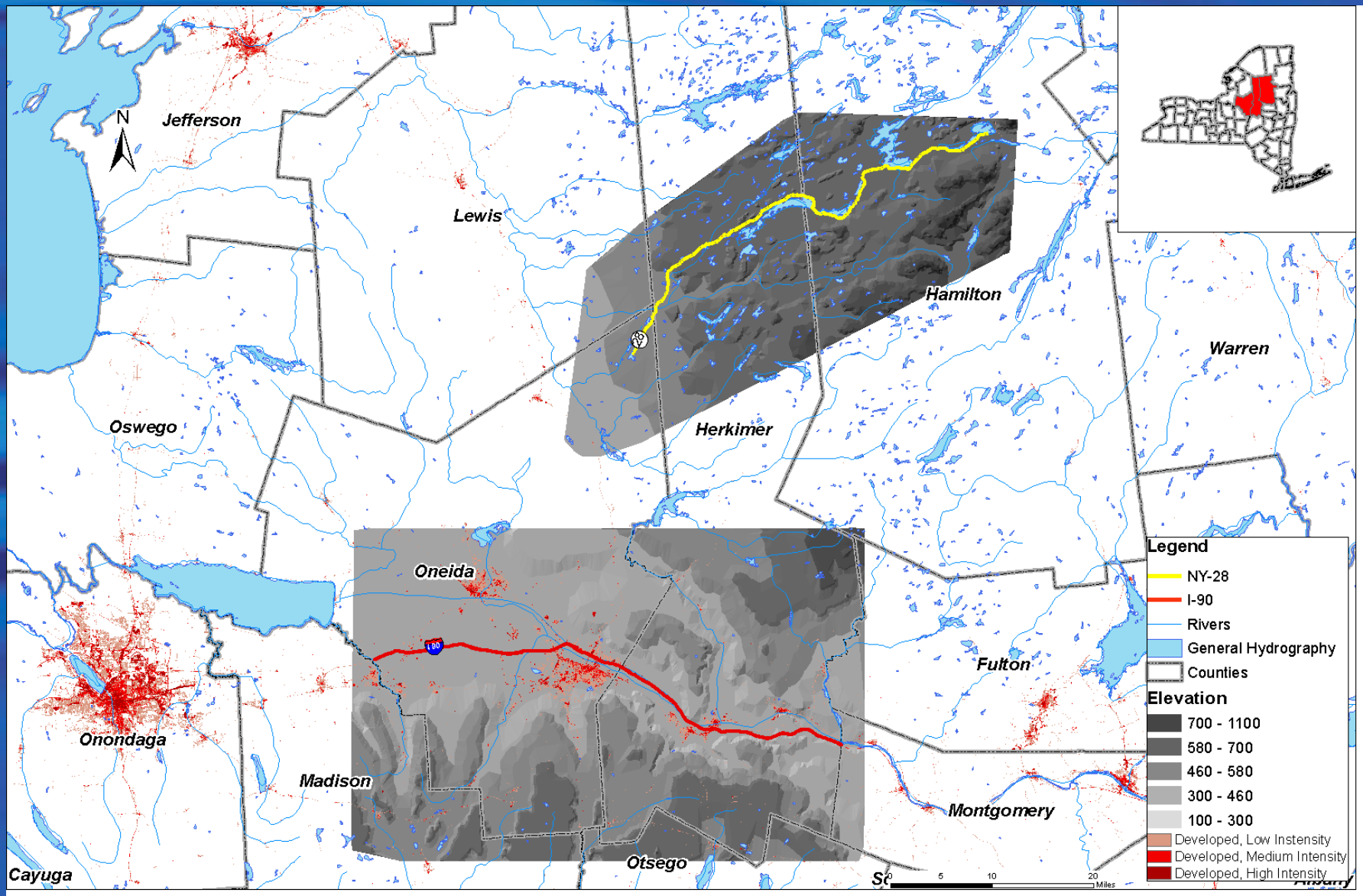
Overview

- This project looked at methods to identify AVC hotspots
- The findings are applicable to all types of point data – AVC, carcasses, tracks, radio collar locations, live animal sighting
- This was a desktop study
- AVC data was acquired from the Iowa DOT and the New York State DOT

Iowa Study Areas



New York Study Areas



The Basic Questions…

- What is a Hotspot?
  - A location where crossing/AVC are significantly clustered **OR**
  - A location where more crossings/AVC occur than expected by chance
- How do you know if a cluster is significant?
- How do you know how many AVC to expect at a given location?

Methods to Identify Hotspots

- Methods to Identify Significant Clusters
  - Visual Analysis
  - Spatial Statistics
    - Getis-Ord Gi*
    - Hierarchical Nearest Neighbor Analysis (HNN)
- Methods to Identify More AVC then Expected by Chance
  - Density-based Measures
  - Models

Identifying Significant Clusters

First, determine if your data is clustered!

- Average Nearest Neighbor
  - "Regular" average nearest neighbor doesn't work
  - Linear nearest neighbor routines can be created
- Moran's I
  - Moran's I is a spatial statistic, other spatial approaches are also available

Visual Analysis

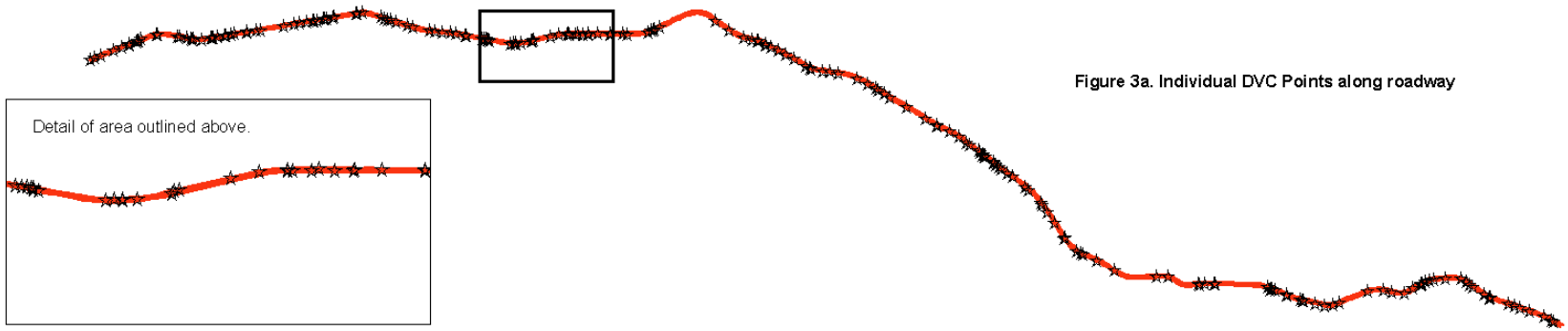


Figure 3a. Individual DVC Points along roadway

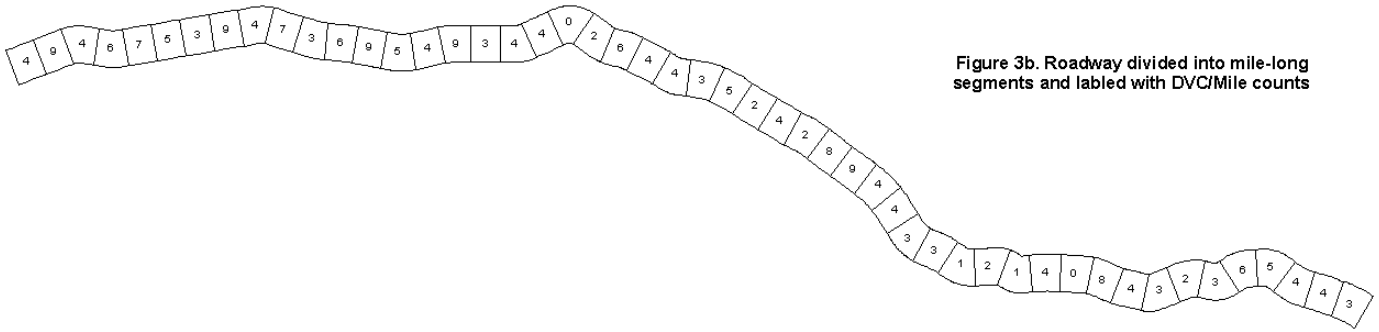


Figure 3b. Roadway divided into mile-long segments and labled with DVC/Mile counts

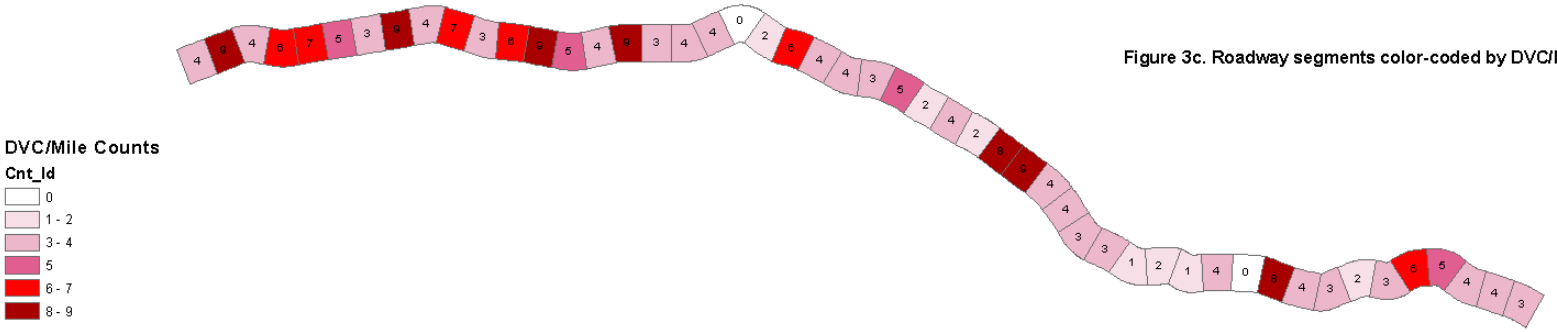
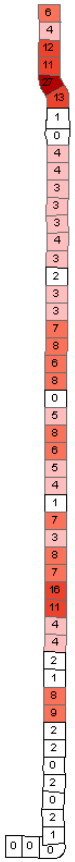


Figure 3c. Roadway segments color-coded by DVC/Mile counts

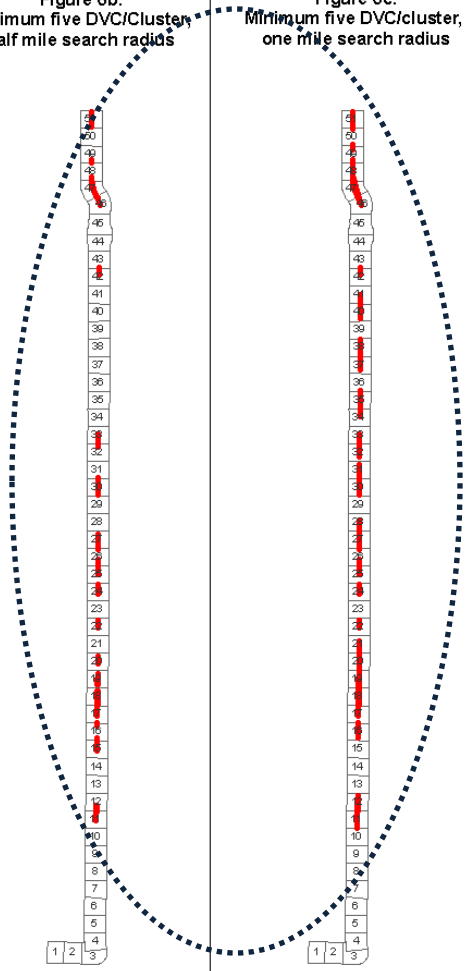
Spatial Statistics - HNN

Figure 6a.
Visual Analysis



DVC/Mile Counts
- 0 - 2
- 3 - 5
- 6 - 9
- 10 - 16
- 17 - 27

Figure 6b.
Minimum five DVC/Cluster,
half mile search radius



HNN Hotspot

Figure 6c.
Minimum five DVC/cluster,
one mile search radius

Figure 6d.
Minimum 10 DVC/cluster,
half-mile search radius

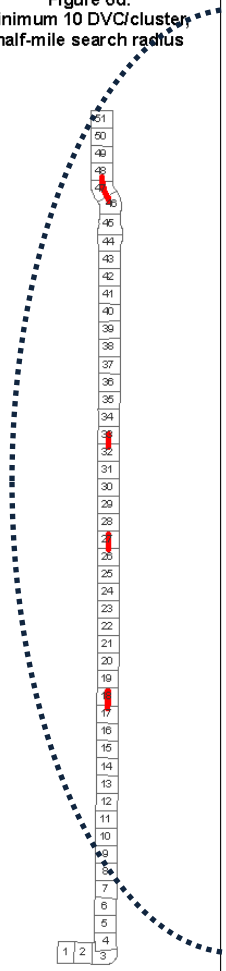


Figure 6 e.
Minimum 10 DVC/cluster,
one-mile search radius

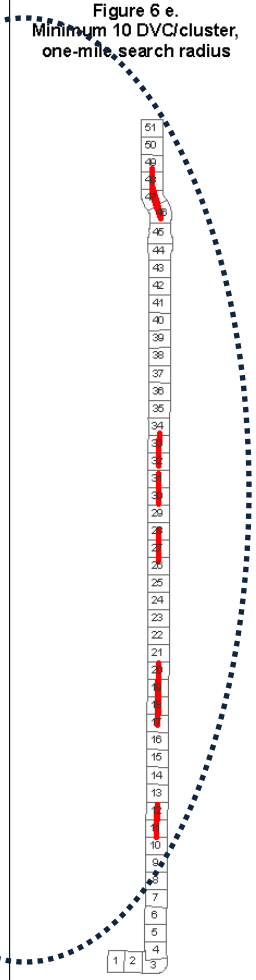


Figure 6f.
Minimum 11 DVC/cluster,
half-mile search radius

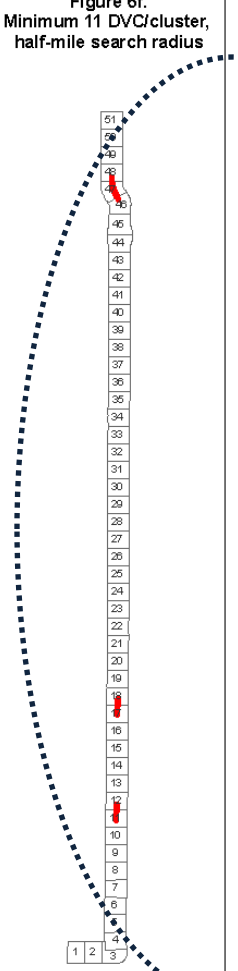
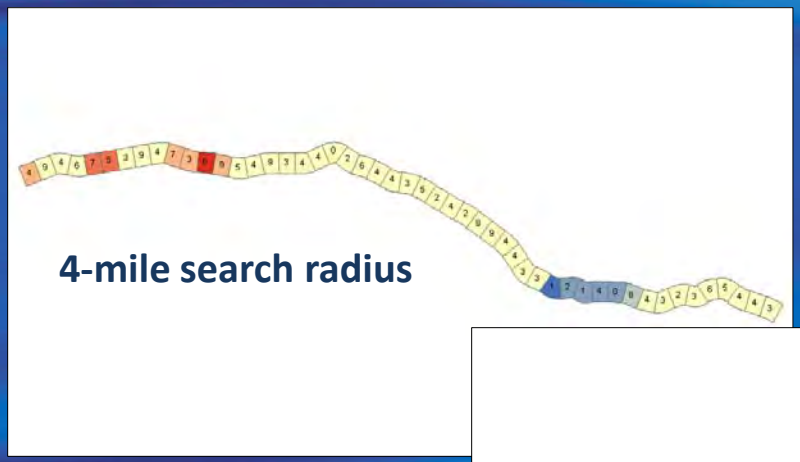
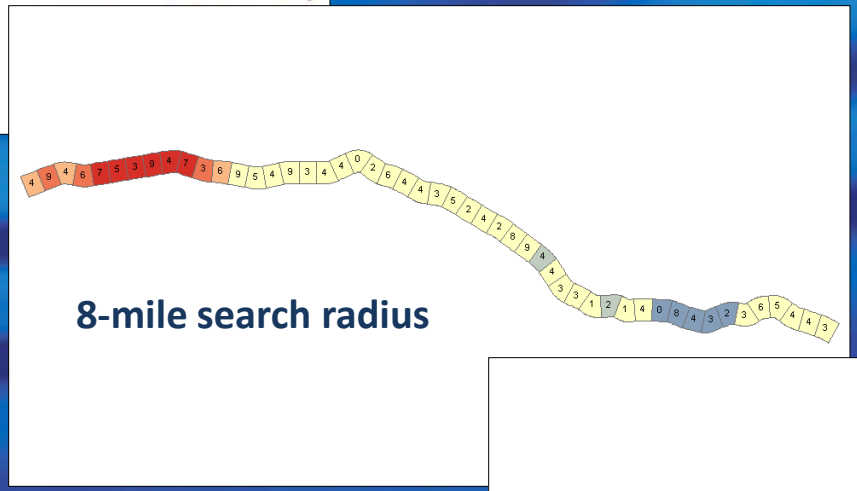
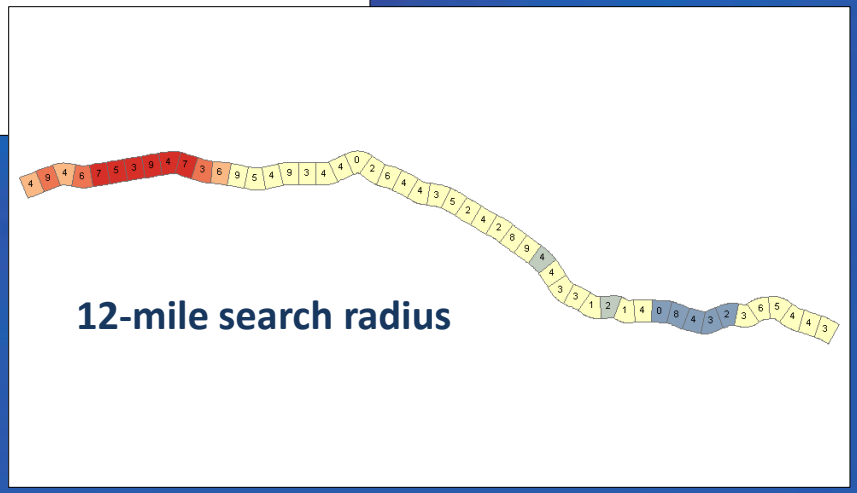


Figure 6g.
Minimum 11 DVC/cluster,
one-mile search radius

Spatial Statistics – Getis-Ord Gi*



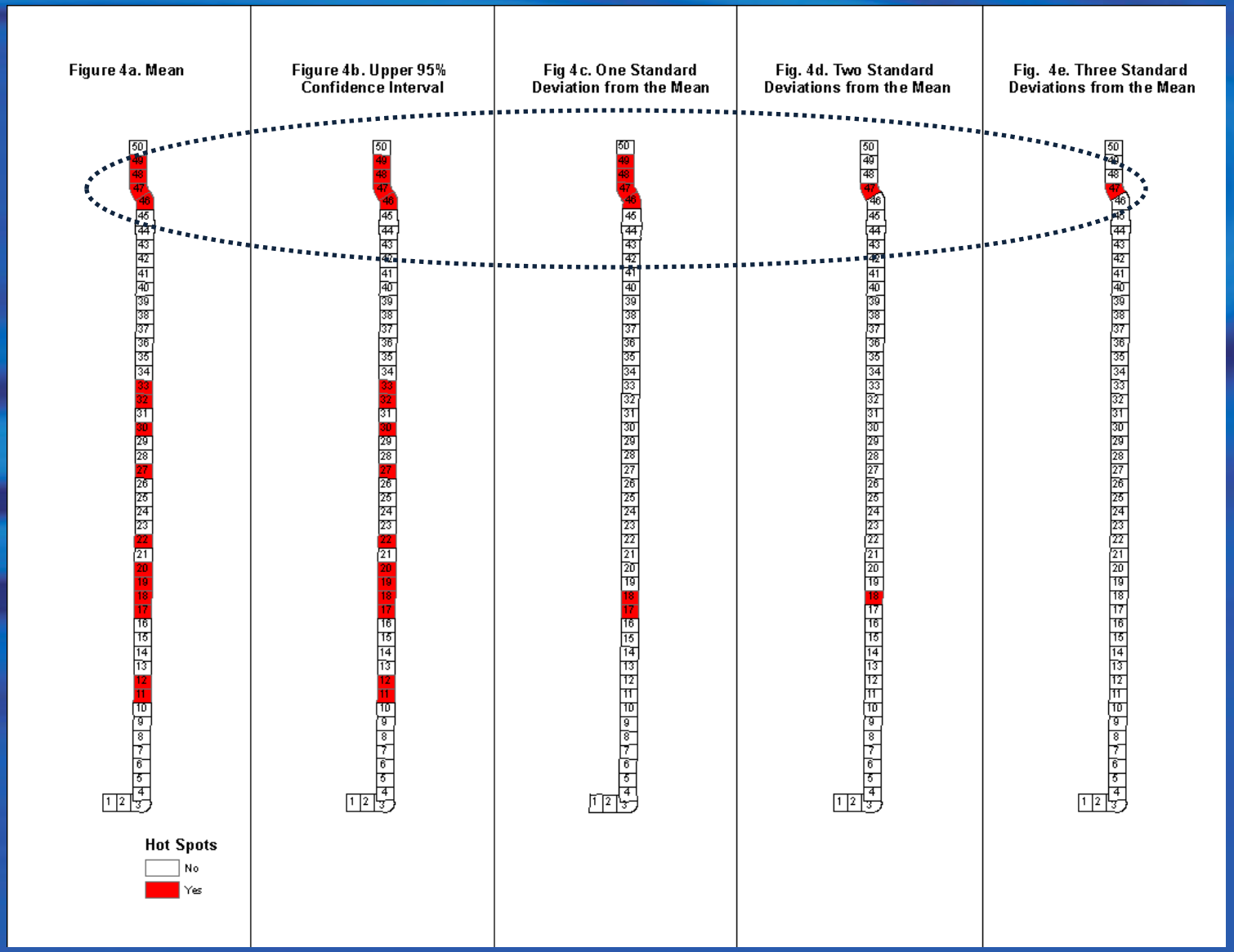




Identifying Locations with more AVC than Expected by Chance

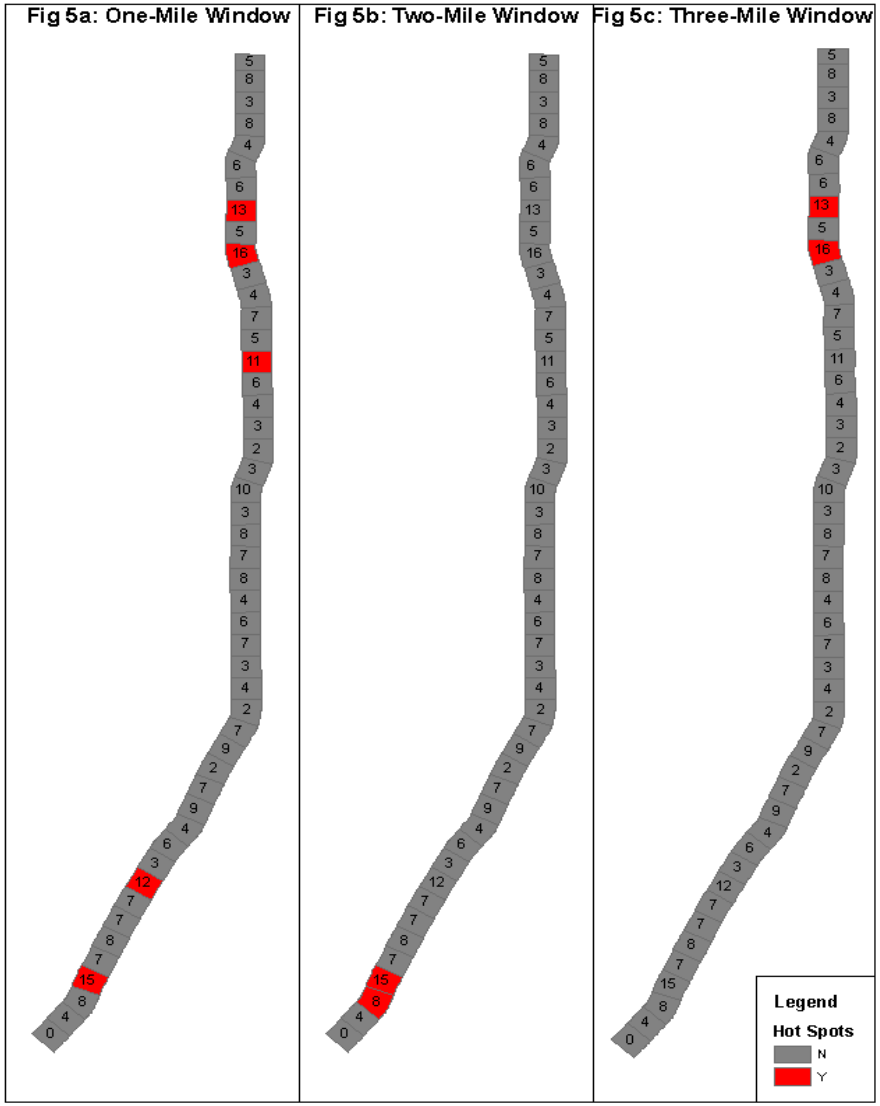
NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Density-based Measures



Models

Variation in the location of hotspots identified using a 95% CI, based on the binomial distribution, and a moving windows analysis with different sized windows.



NORMANDEAU ASSOCIATES
ENVIRONMENTAL CONSULTANTS

Best Method?

- All approached have strengths and weaknesses
  - Density-based measures may be weakest - require normally distributed data (rare).
  - Spatial statistics may be strongest - provide objective significance values (but results are heavily dependent on user inputs and assumptions).
- There is no single “best” method, instead look for hotspots repeatedly identified by multiple methods

Examples

Iowa Route 65

Figure 9a.
Visual Analysis

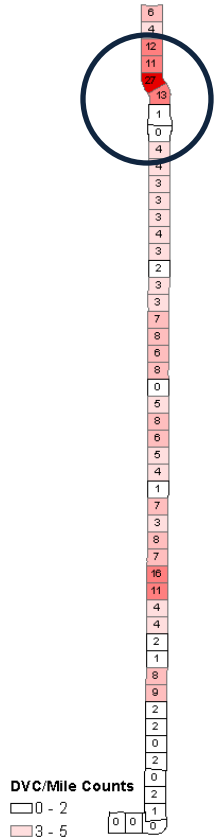


Figure 9b.
Density-based - 95% CI

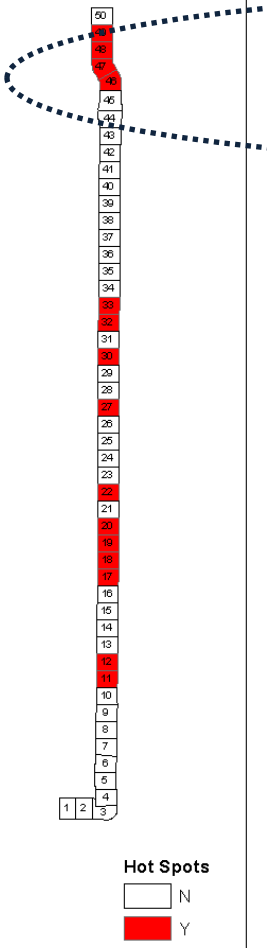


Figure 9c.
Binomial Model - 95% CI

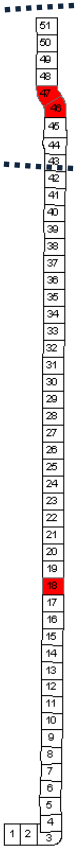


Figure 9d. Binomial
Model - Three-mile
Window

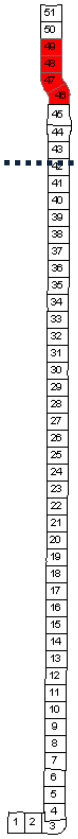


Figure 9e. Getis-Ord

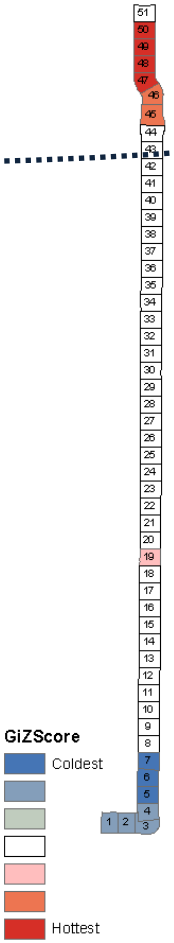
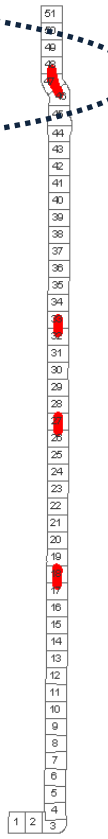


Figure 9f. HNN Analysis



New York I-90

Figure 10 a. Visual Analysis

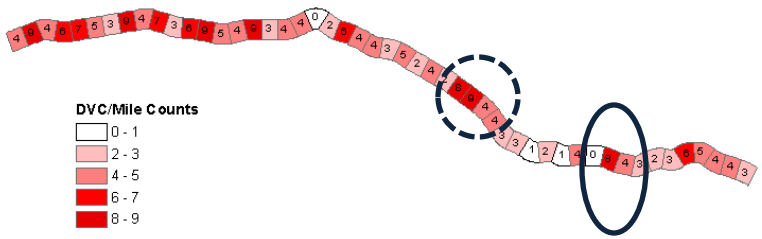


Figure 10d. Binomial Model - 3 Mile Window

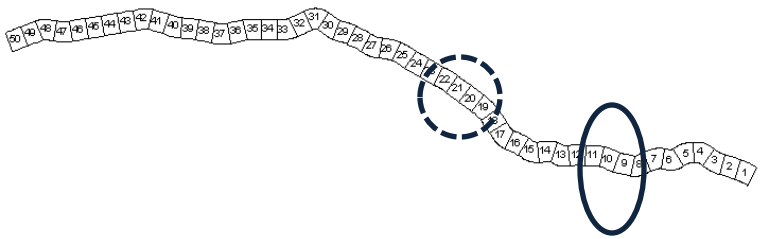


Figure 10b. Density-based - 95% CI

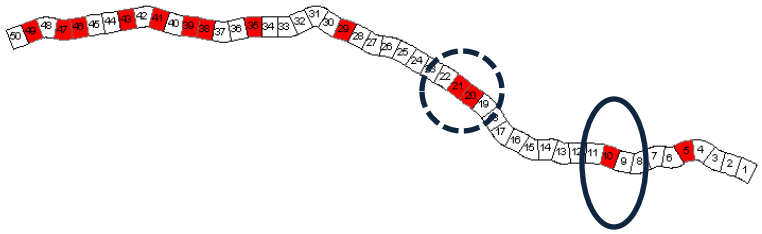


Figure 10e. Getis-Ord

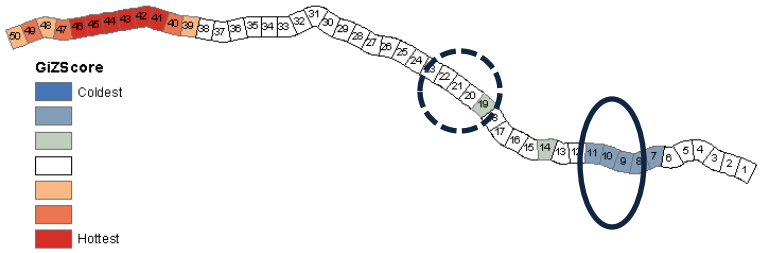


Figure 10c. Binomial Model - 95% CI

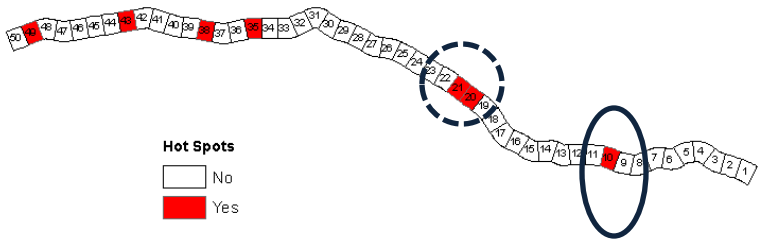
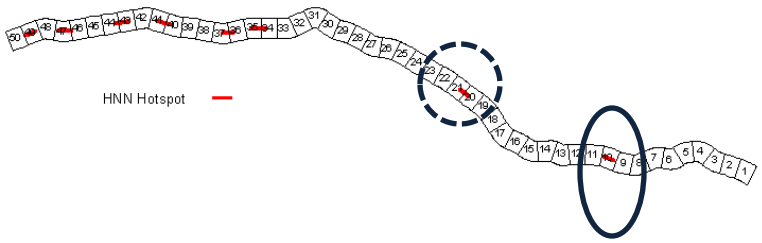


Figure 10f. HNN Analysis



Iowa I-35

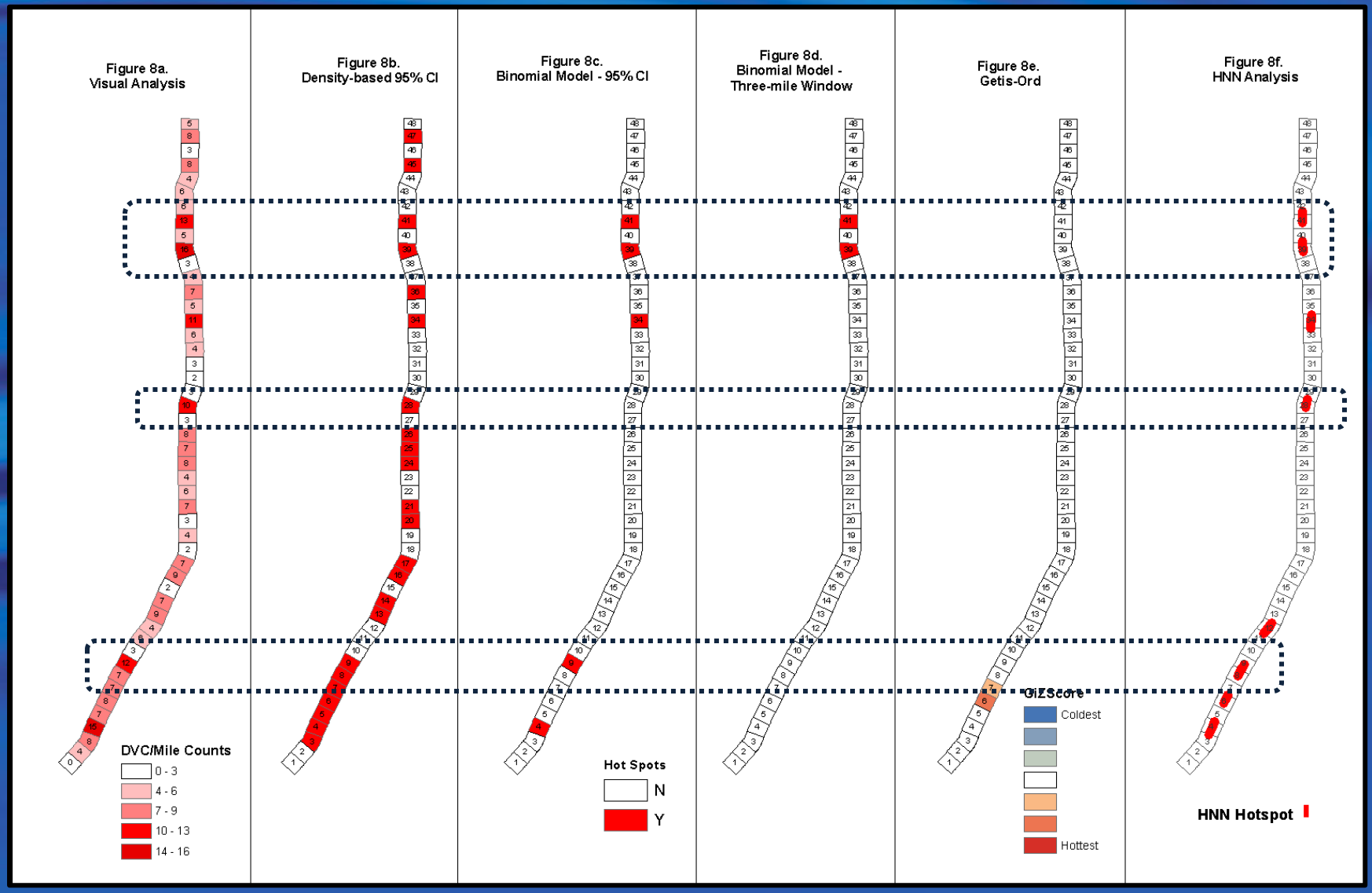


Figure 8a.
Visual Analysis
Figure 8b.
Density-based 95% CI
Figure 8c.
Binomial Model - 95% CI
Figure 8d.
Binomial Model -
Three-mile Window
Figure 8e.
Getis-Ord
Figure 8f.
HNN Analysis
DVC/Mile Counts
0 - 3
4 - 6
7 - 9
10 - 13
14 - 16
Hot Spots
N
Y
GiZScore
Coldest
Hottest
HNN Hotspot

Final Thoughts

- Use multiple methods
- Vary parameters within methods
- Create visual maps of the results to aid in interpretation
- Combine results with landscape variables to identify best crossing locations

Announcing the winners of the **ARC International Wildlife Crossing Infrastructure Design Competition**

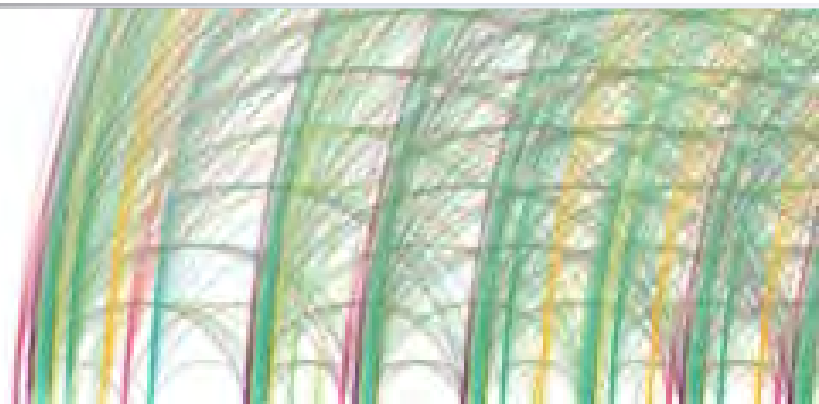
Angela Kociolek

ARC Technology Transfer Initiative Leader

Western Transportation Institute-MSU

ARC

NEW METHODS • NEW MATERIALS • NEW THINKING

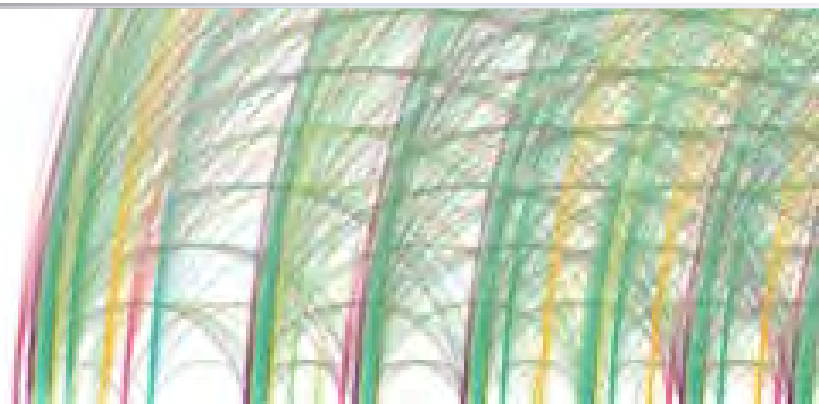


Outline

1. Origins and inspirations
2. Partnerships
3. Finalists, designs & jury
4. Continuing mission of ARC Partnership

ARC

NEW METHODS • NEW MATERIALS • NEW THINKING



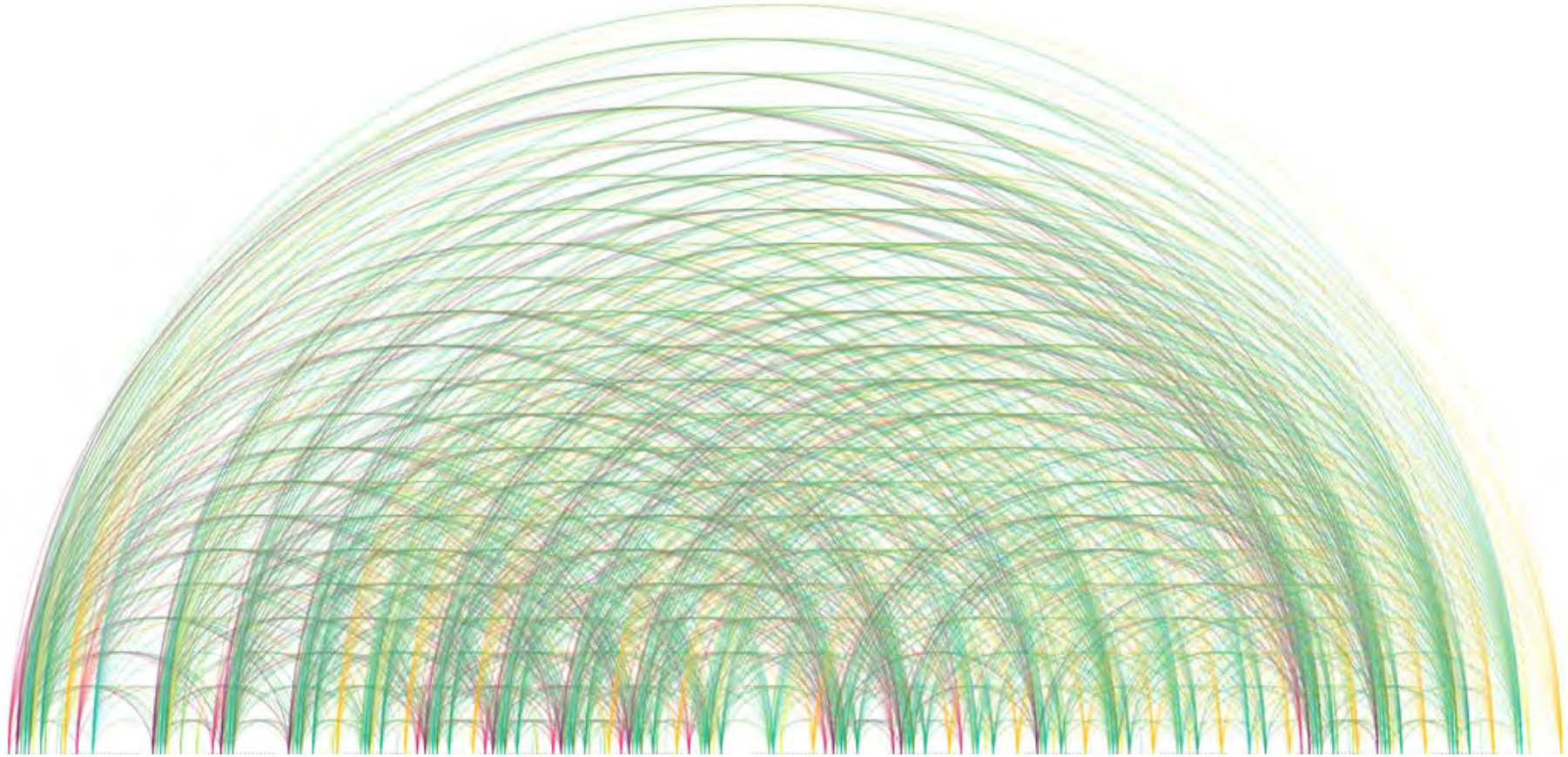
ARC name & visual identity

developed by

Studio: Blackwell;

Chris Harrison, Carnegie Mellon University; &

Dr. Tony Clevenger, WTI-MSU



Origins & inspirations

Photos courtesy A.P. Clevenger

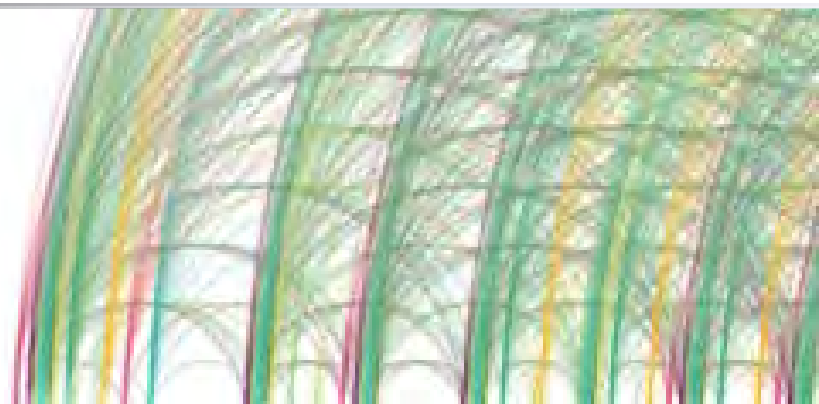
Dr. Tony Clevenger, initiator of ARC, at work in Banff, Canada.

The ARC challenge

1. Lower cost
2. Reduce ecological footprint
3. Adapt to changing climate

ARC

NEW METHODS • NEW MATERIALS • NEW THINKING



ARC Competition Partnership

Founding Sponsors

Organizations that developed, sustain or serve on the competition's Steering Committee

Woodcock Foundation

Montana State University – Western Transportation Institute

Education Community Foundation

U.S. Department of Transportation – Federal Highway Administration

Forest Service – U.S. Department of Agriculture

Federal Lands Highway – Connecting to Excellence

Organizing Sponsors

Organizations providing the site, information or major funding

DOT – Department of Transportation

CTIP

National Park Service

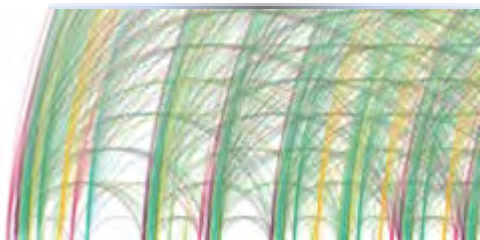
U.S. Fish & Wildlife Service – Department of the Interior

U.S. Department of the Interior – Bureau of Indian Affairs – 1824

Research and Innovative Technology Administration

Western Environmental Law Center

Continued…



ARC Competition Partnership

Supporting Sponsors

Organizations providing additional funds or in-kind support

Habitat and Highways Campaign

Yellowstone to Yukon

I-70 Coalition
selling the pace for the future

University of Toronto John H. Daniels Faculty of Architecture, Landscape, and Design

ZAS Architecture Interiors Transportation Planning

American Association of State Highway and Transportation Officials AASHTO

Animal Assistance Foundation

Canadian Pacific
Driving the Digital Railway

American Society of Landscape Architects

Ryerson University

Canada Denver Consulate General

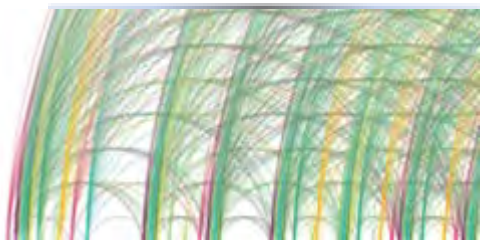
Endorsing Sponsors

Organizations providing a public endorsement of the competition's goals

Parks Canada

Parcs Canada

Center for Large Landscape Conservation



Partnership among disciplines

Engineering

Ecology

Architecture

Landscape Architecture

Wildlife Biology

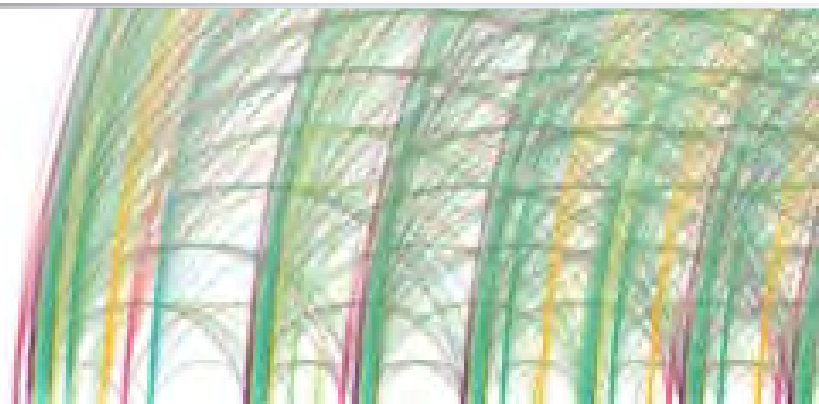
Transportation

Landscape Design

Graphic Design

ARC

NEW METHODS • NEW MATERIALS • NEW THINKING



Phases & stats

Phase 1 - Call for Expressions of Interest

- 100 firms
- 9 countries
- 36 teams

qualifications and design approaches

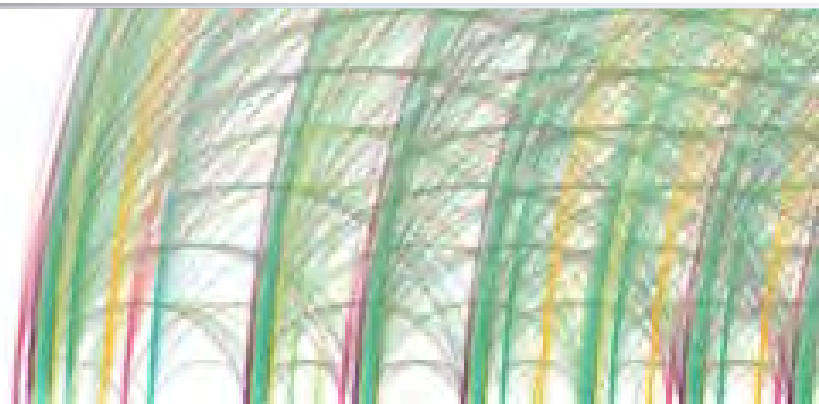
Phase 2 – Invited

- 5 finalist teams

model, panels & booklet

ARC

NEW METHODS • NEW MATERIALS • NEW THINKING



Finalist teams

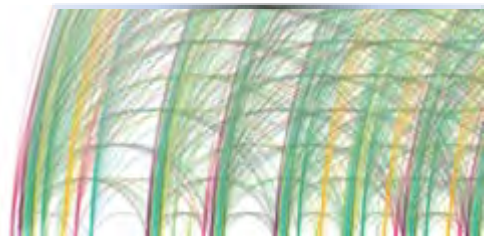
Balmori Associates (New York)
with StudioMDA, Knippers Helbig Inc., David Skelly, CITA, Bluegreen, John A. Martin & Associates, & David Langdon

HNTB with Michael Van Valkenburgh & Assoc. (New York) *with Applied Ecological Services, Inc.*

Janet Rosenberg & Associates (Toronto)
with Blackwell Bowick Partnership, Dougan & Associates, & Ecokare International

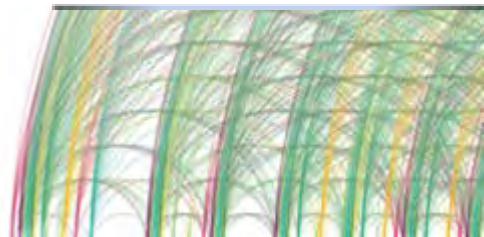
The Olin Studio (Philadelphia)
with Explorations Architecture, Buro Happold, & Applied Ecological Services

Zwarts & Jansma Architects (Amsterdam)
with OKRA Landscape Architects, IV-infra, & Planecologie



Vision for the competition

Specifically, ARC seeks innovation in **feasible**, **buildable**, **context-sensitive** and **compelling** design solutions for **safe**, **efficient**, **cost-effective**, and **ecologically responsive** highway crossings for wildlife. In the broadest context, ARC will challenge competitors to **reweave landscapes for wildlife** using **new methods, new materials, and new thinking**. In doing so, the ARC competition aims to raise international awareness of a need to better reconcile **human and wildlife mobility** through a more **creative, flexible** and **innovative** system of road and habitat networks in our landscapes.



Jury

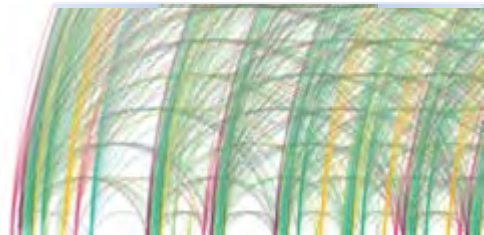
Prof. Charles Waldheim (Jury Chair), John E. Irving Professor and Chair of Landscape Architecture, Harvard University, Graduate School of Design

Jane Wernick, Structural Engineer and Director of Jane Wernick Associates, London.

William L. Withuhn, Curator Emeritus, History of Technology and Transportation, Smithsonian Institution

Prof. Jane Wolff, Associate Professor and Chair of Landscape Architecture, John H. Daniels Faculty of Landscape, Architecture and Design, University of Toronto

Dr. Anthony Clevenger, Senior Research Scientist (Road Ecology), Western Transportation Institute, Montana State University

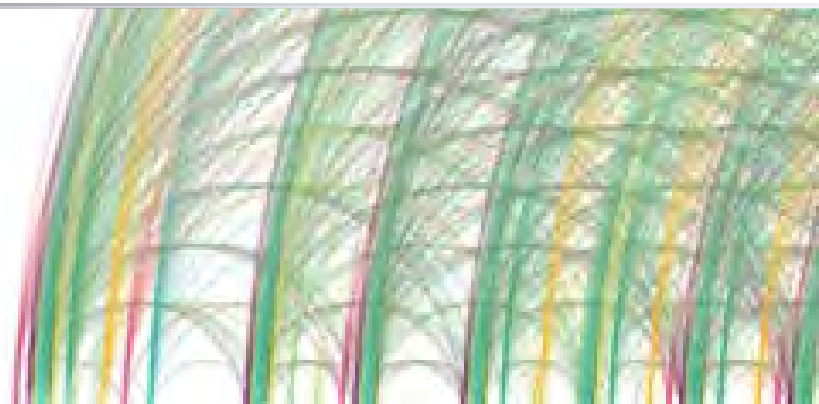


Jury assessment:

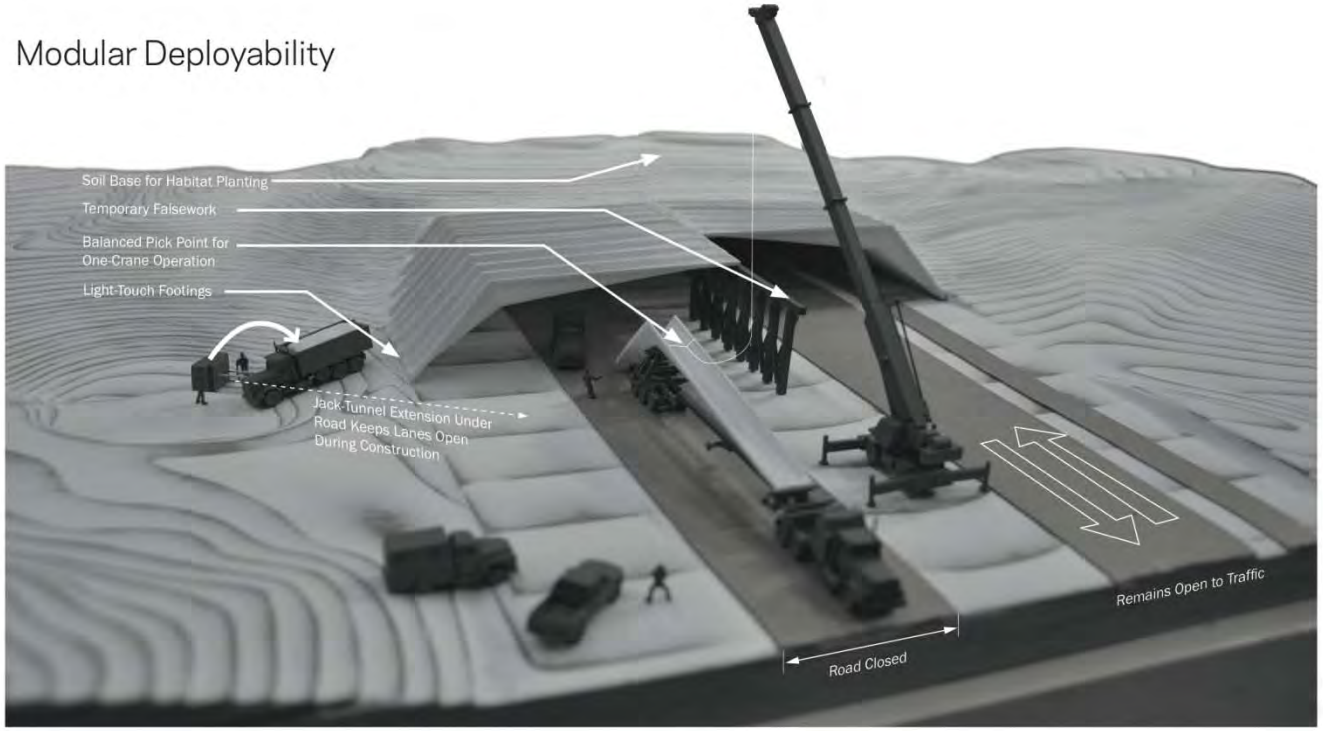
"the winning proposal
by HNTB Engineering
with Michael Van Valkenburgh & Associates
was not only eminently possible;
it has the capacity to transform
what we think of as possible."

ARC

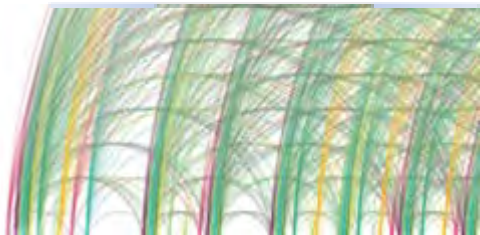
NEW METHODS • NEW MATERIALS • NEW THINKING



Crux of the HNTB + MVVA design

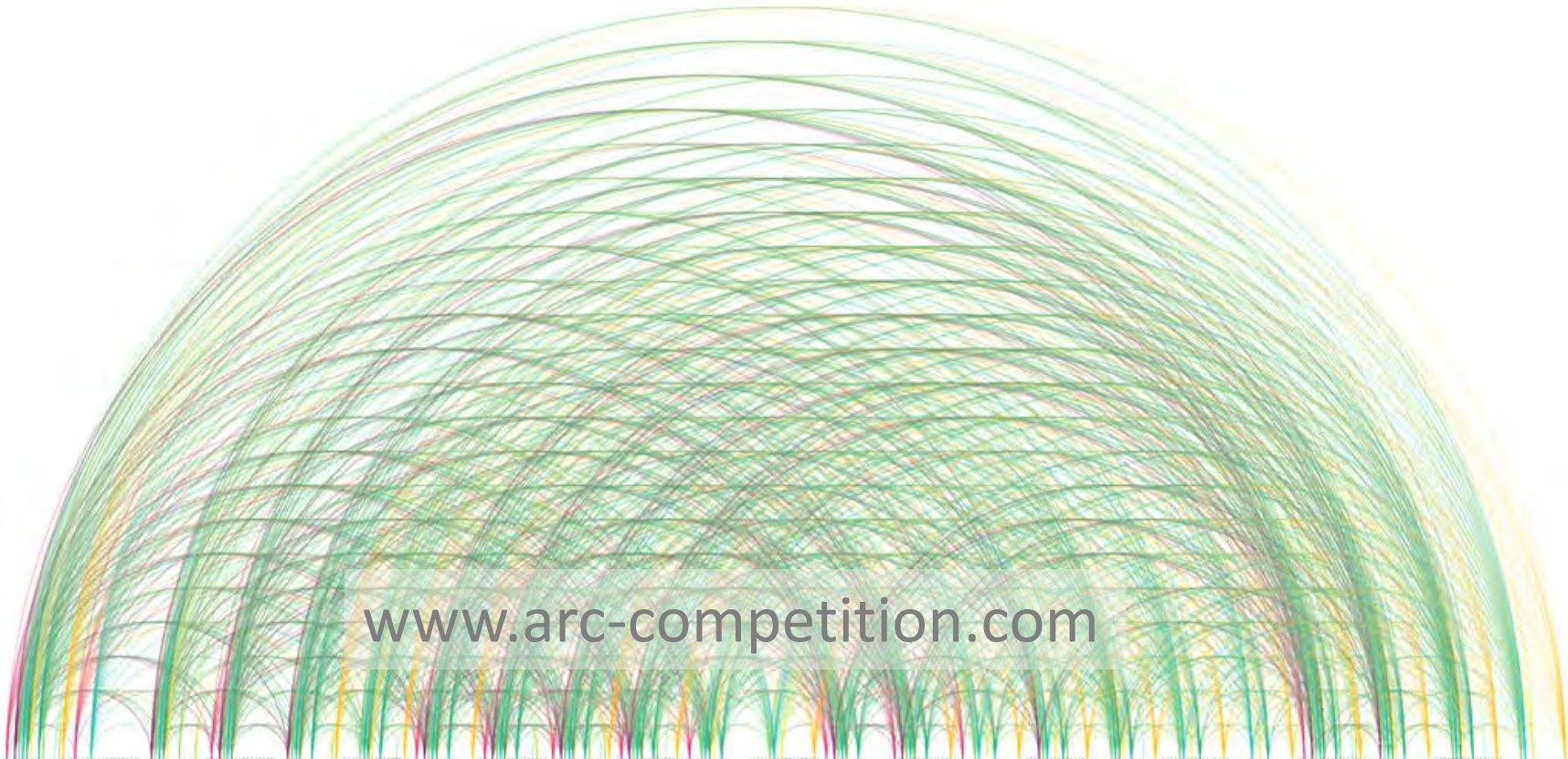


Model showing the construction phase of the hypar vault bridging structure, for maximum visibility of the modular construction system. The hypar modules are optimized for being efficient to transport, erect, combine, and recombine. No on-site concrete work is required, and bridges can be added to or removed as animal migration pressures shift over time.



Winning ARC entry by
HNTB + MVVA

To join the ARC Partnership,
contact
angela.kociolek@coe.montana.edu.



Eco-Logical and Wildlife Crossings: Concepts in Innovative Planning

Contacts:

Mary Gray
FHWA Office of Project Development and Environmental Review
Mary.Gray@dot.gov
(360) 753-9487

Peter Kozinski
Colorado Department of Transportation
Peter.Kozinski@dot.state.co.us
(970) 328-6385

Sarah Barnum
Normandeau Associates, Inc.
sbarnum@normandeau.com
(603) 637-1157

Angela Kociolek
Western Transportation Institute
angela.kociolek@coe.montana.edu
(406) 994-6308

Eco-Logical Website:
http://www.environment.fhwa.dot.gov/ecological/eco_entry.asp

Upcoming Webinars

1. June Eco-Logical Webinar
Date: Tuesday, June 21, 2011
Time: 2:00 – 3:30 PM Eastern

Topic: Best practices in advance mitigation and conservation banking

Watch your email for web conference link and call-in line or email haley.peckett@dot.gov to be added to the Eco-Logical Webinar Email List

2. June *NHI Innovations* Web Conference

Transportation Innovations: Linking Transportation and Natural Resource Planning through Environmental GIS Tools
June 16 from 2:30-4 PM Eastern

Visit the NHI Web Conference Calendar to register:
http://www.nhi.fhwa.dot.gov/resources/webconference/eventcalendar.aspx