

Changing Climate, the Pressure to Move, & the Challenges and Opportunities of Transportation Infrastructure.

Northeastern
Transportation and
Wildlife
Conference

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September 23, 2014

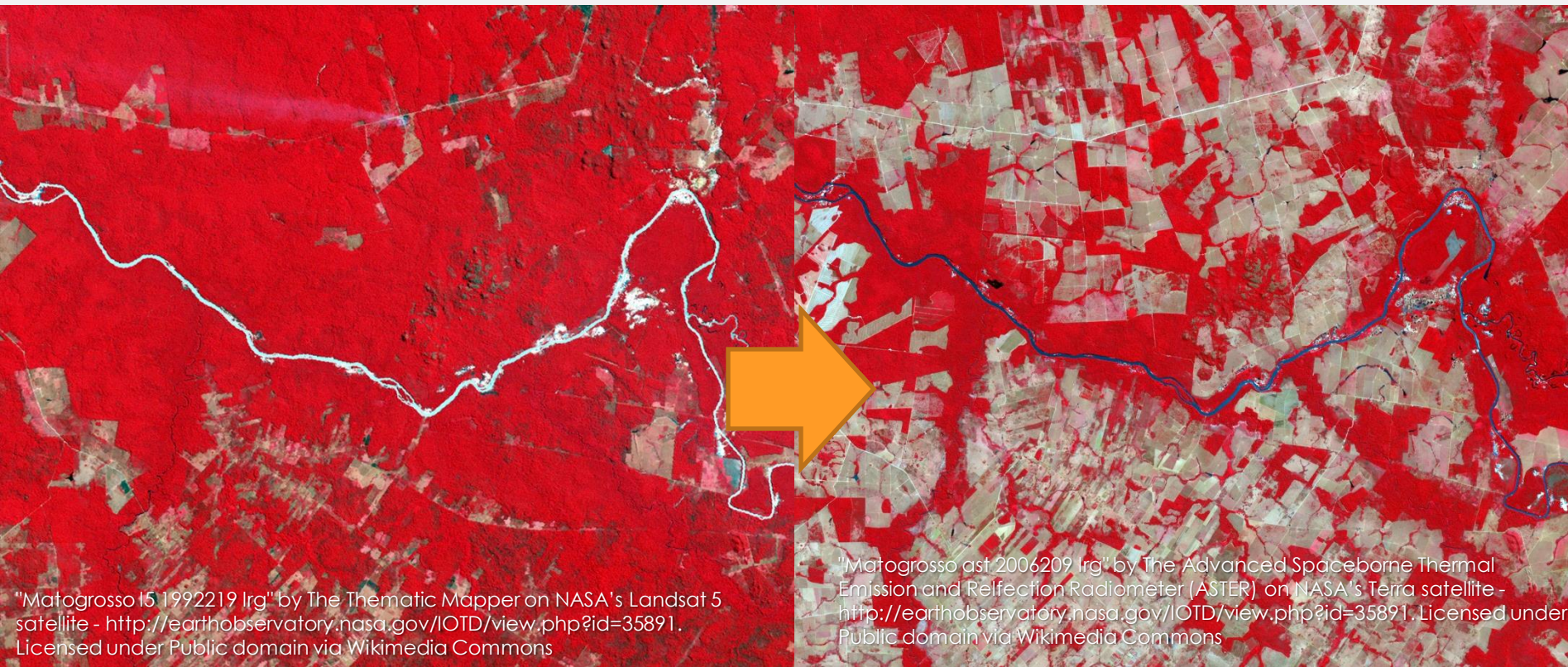


Agenda

- 1** Landscape change
- 2** Current habitat characteristics
- 3** Matrix Permeability
- 4** Regional pressures
- 5** Opportunity for improvement

Landscape change

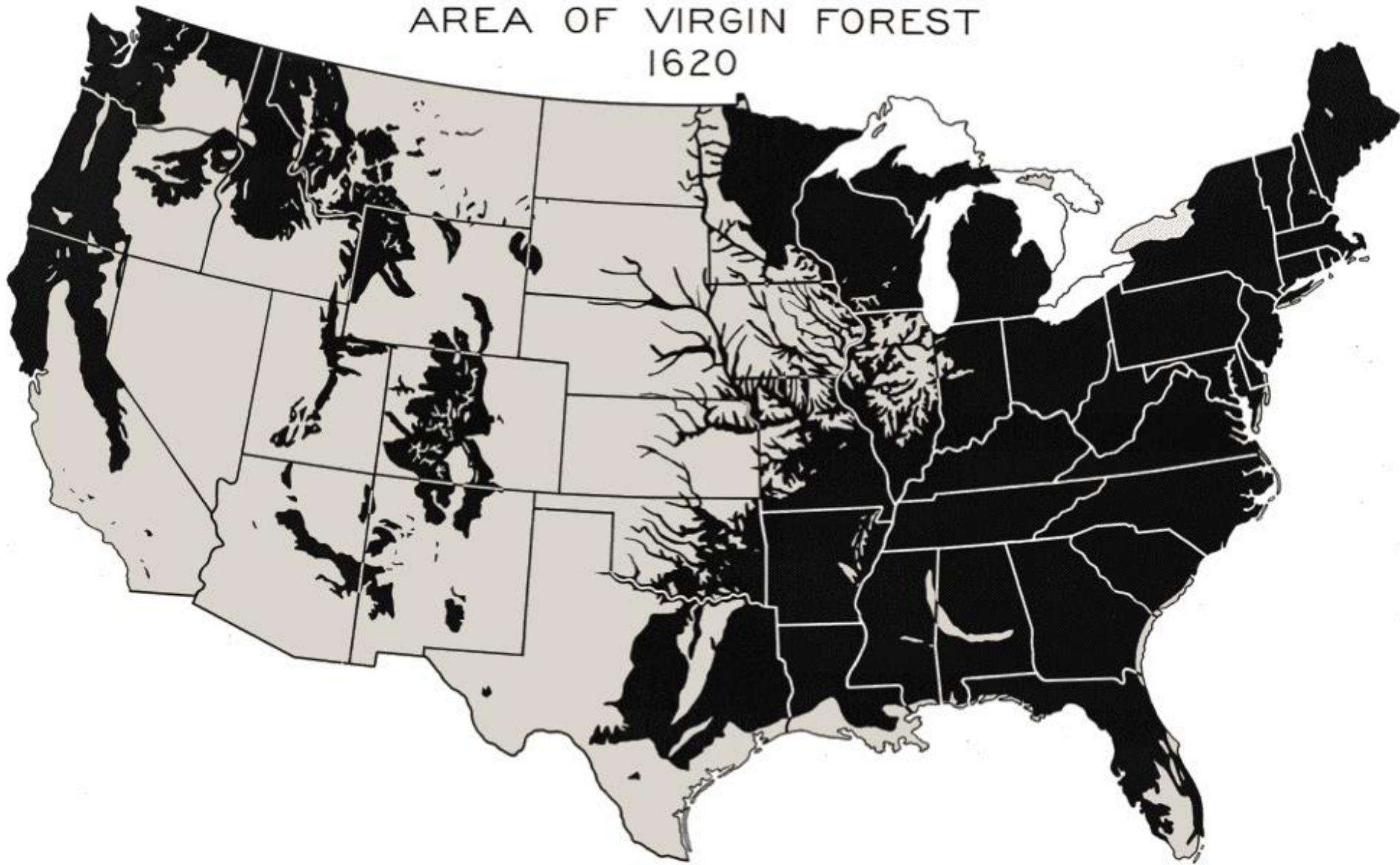
From essentially clear for movement to a patchwork of habitat blocks within a human-altered matrix.



"Matogrosso 15 1992219 Irg" by The Thematic Mapper on NASA's Landsat 5 satellite - <http://earthobservatory.nasa.gov/IOTD/view.php?id=35891>. Licensed under Public domain via Wikimedia Commons

"Matogrosso ast 2006209 Irg" by The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) on NASA's Terra satellite - <http://earthobservatory.nasa.gov/IOTD/view.php?id=35891>. Licensed under Public domain via Wikimedia Commons

AREA OF VIRGIN FOREST 1620



Areas of wild forest that were cut from 1620 to 1936.



"Aboveground Woody Biomass in the United States 2011" by Map by Robert Simmon, based on data from Woods Hole Research Center. - <http://visibleearth.nasa.gov/view.php?id=76697>. Licensed under Public domain via Wikimedia Commons



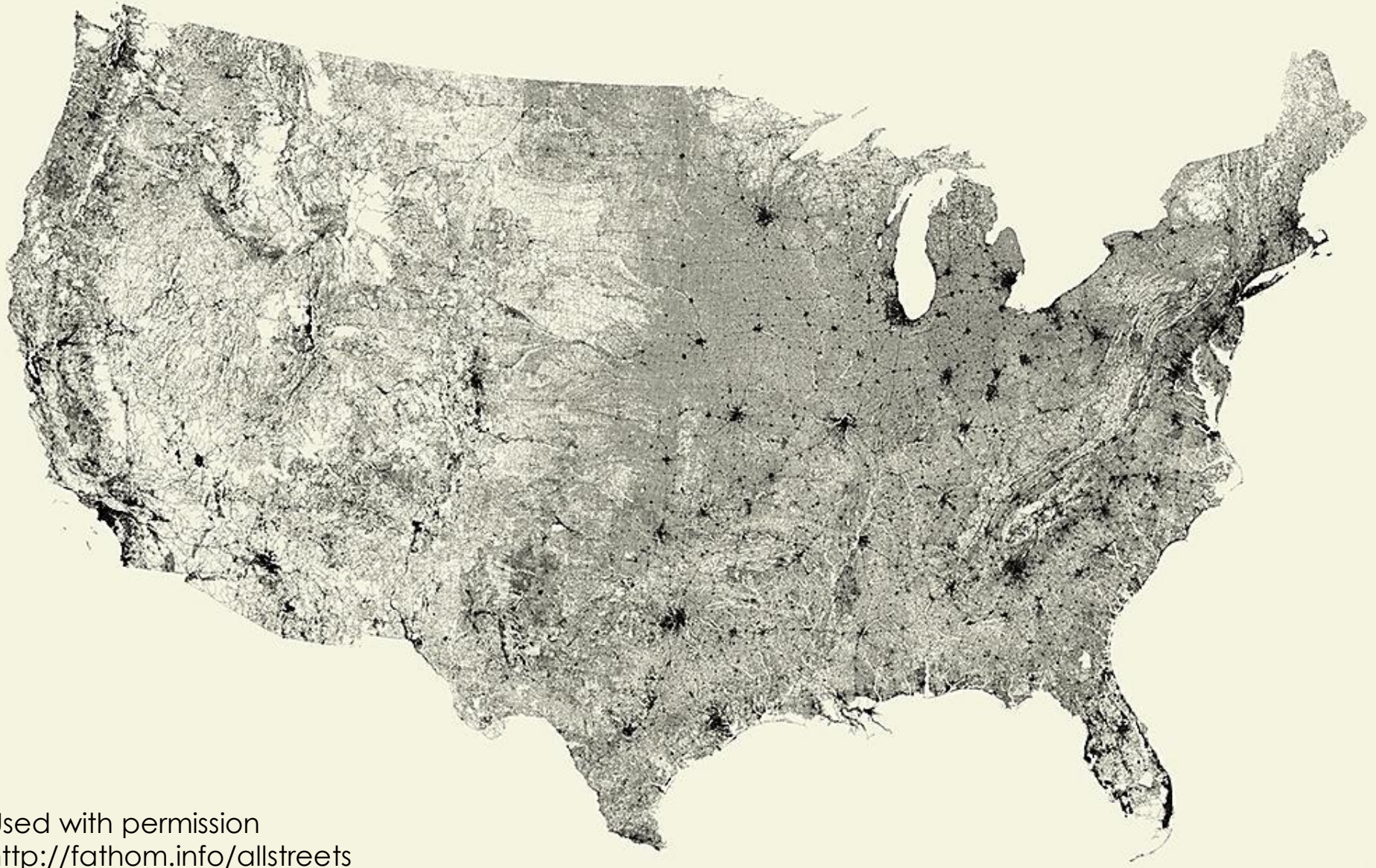
PLATE 57.—Location of existing routes tentatively selected as approximating the lines of a proposed interregional highway system.

The first map of a national interstate highway system. From *Toll Roads and Free Roads* (1939).



National Highway System (NHS)

- Eisenhower Interstate System
- Other NHS



Used with permission
<http://fathom.info/allstreets>

All streets
Ben Fry, 2008

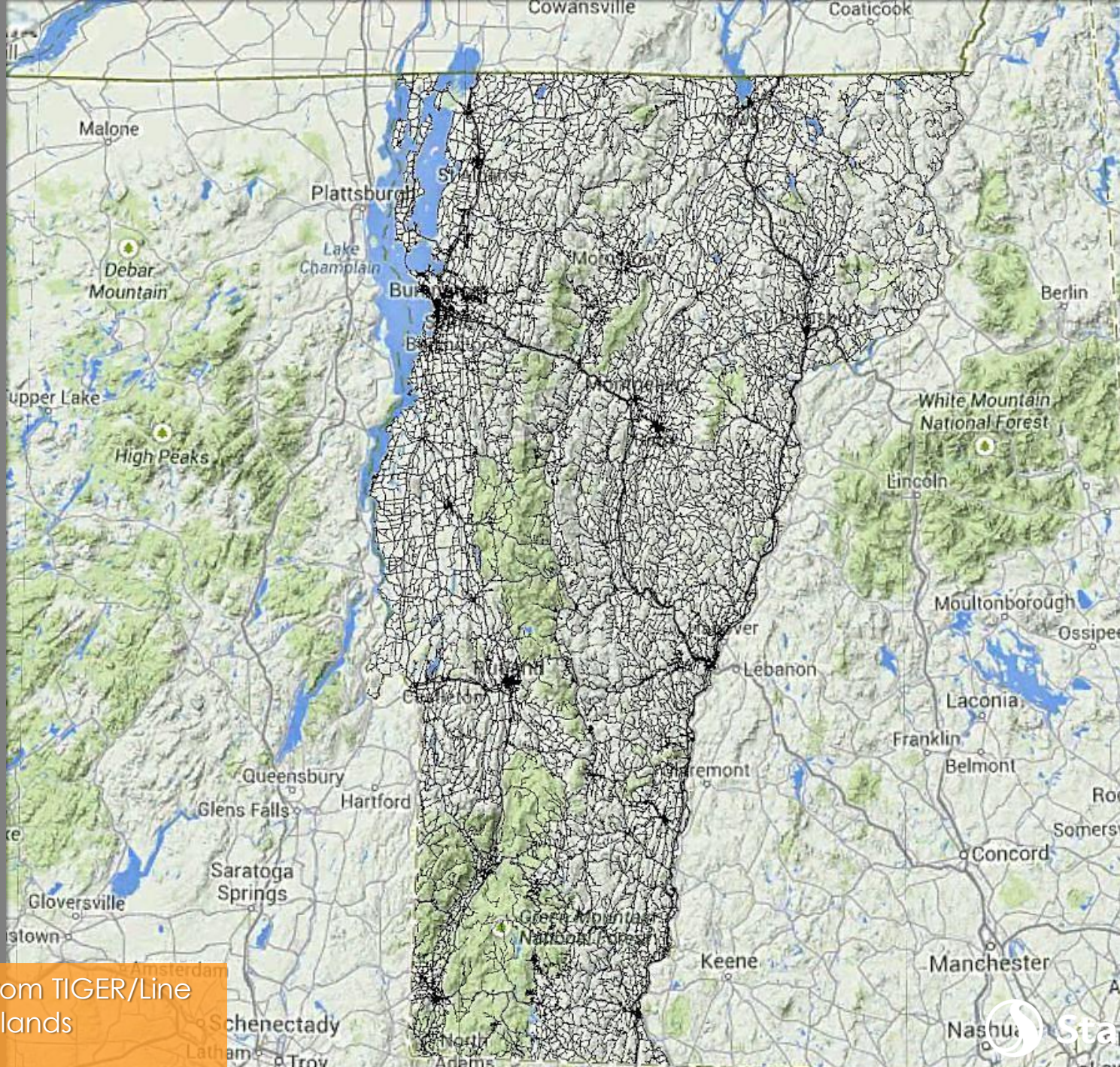
240 million individual road segments. No other features



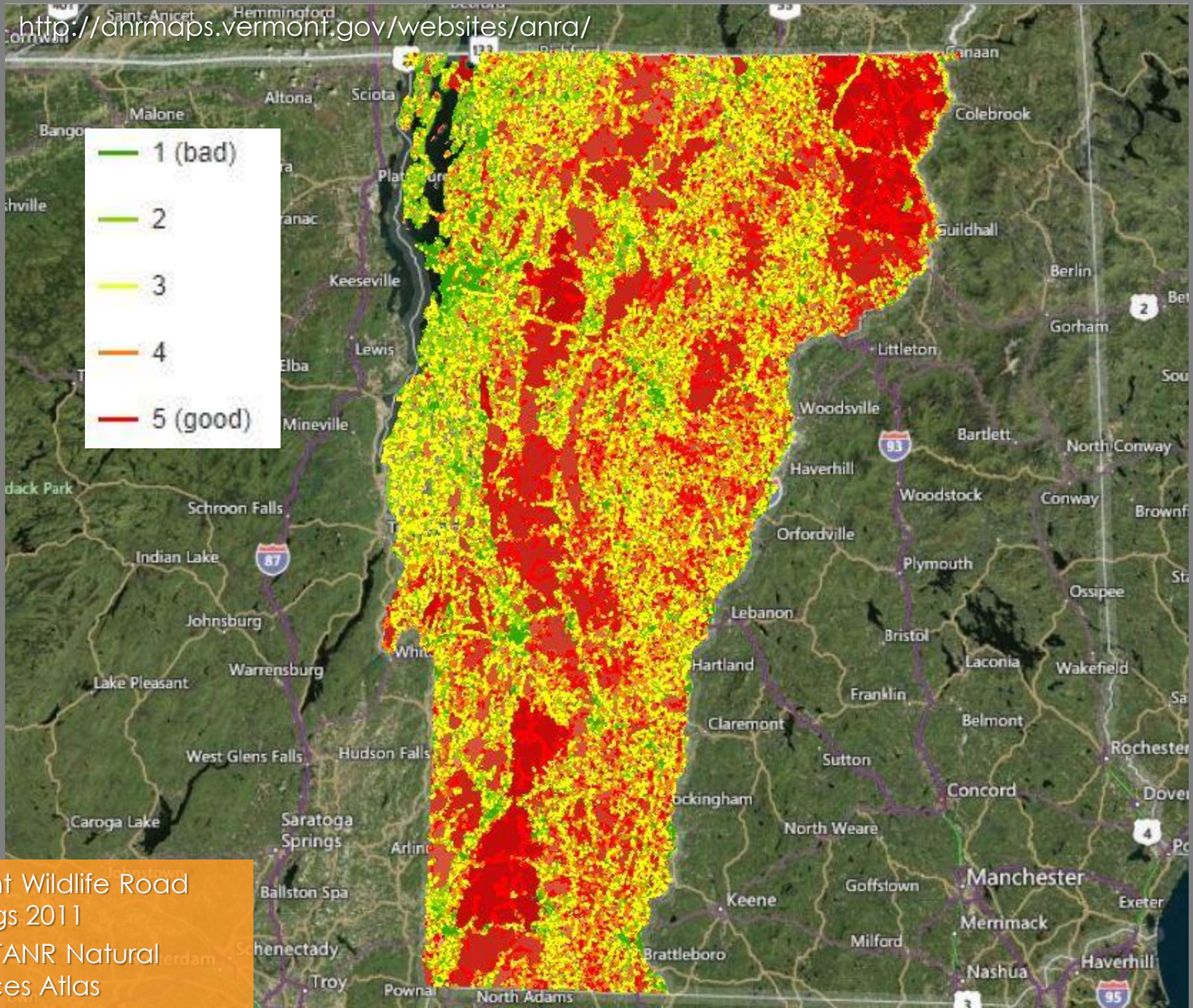
Vermont from TIGER/Line
data
Roads only



Vermont from TIGER/Line
Satellite background

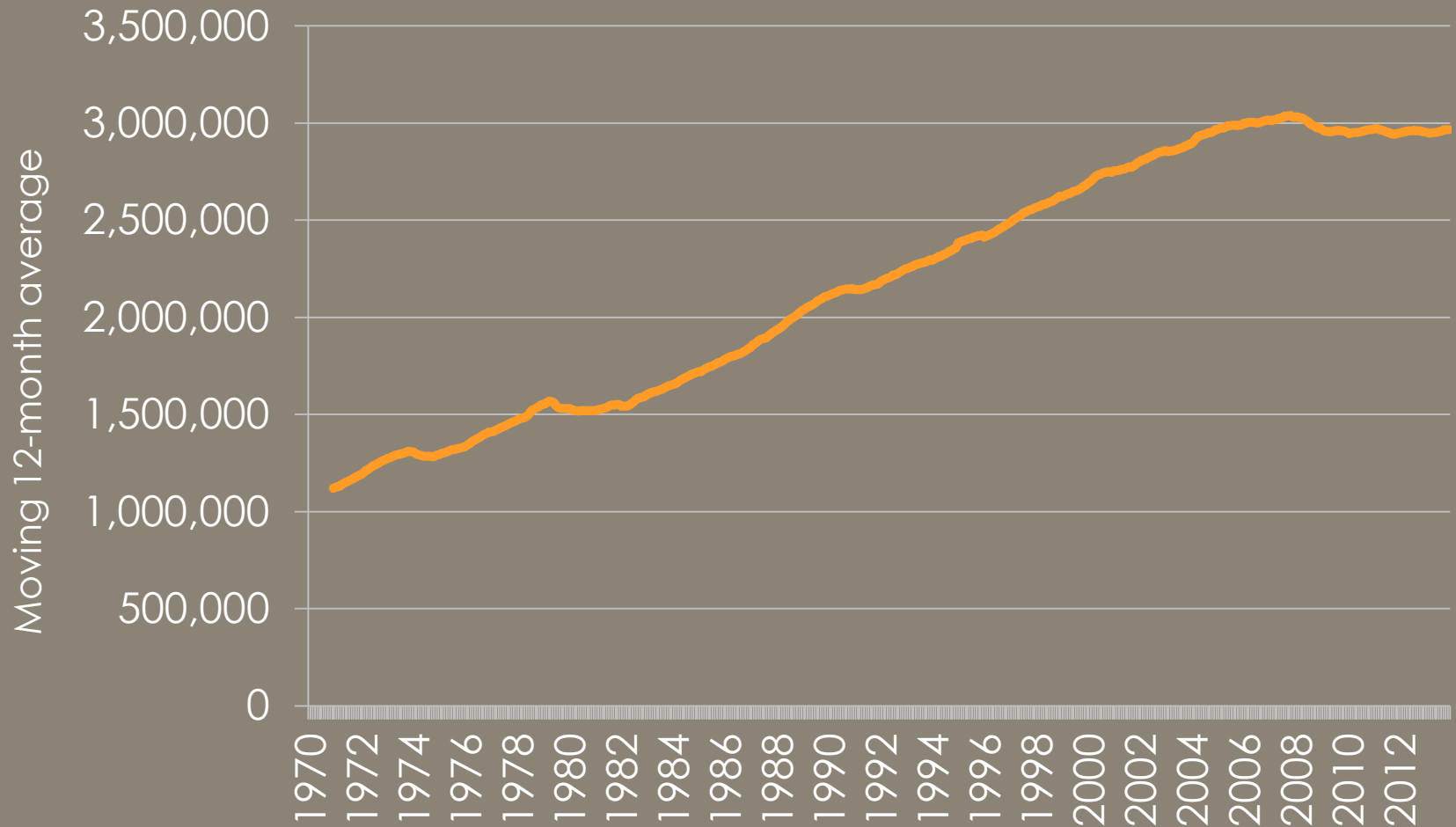


Vermont from TIGER/Line
Protected lands



Vermont Wildlife Road Crossings 2011
From VTANR Natural Resources Atlas

Historical Vehicle Miles Traveled



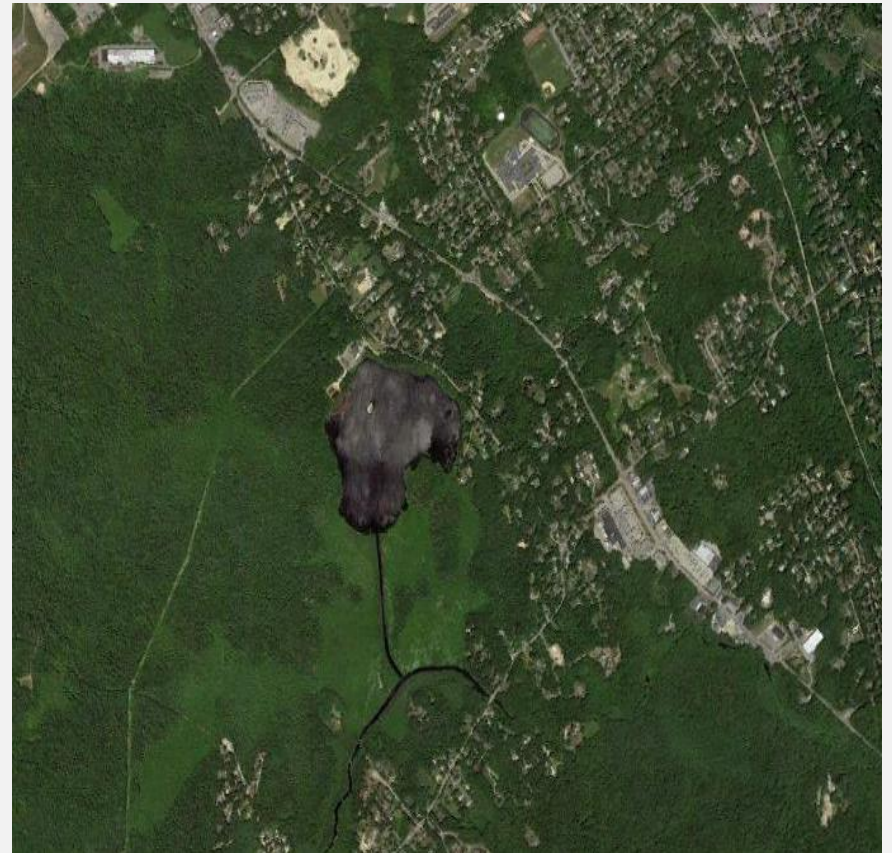
Data from Federal Highway Administration
https://www.fhwa.dot.gov/policyinformation/travel_monitoring/tvt.cfm

Current habitat conditions

Remnants of natural habitat within a human-altered matrix

Impact of Fragmentation

- Species characteristics
- Size and quality of remnants
- Characteristics of the surrounding matrix
- Regional pressures



Current habitat conditions

Species Characteristics

Impact varies according to life history.

- terrestrial?
- arboreal?
- aquatic?



Current habitat conditions

Species Characteristics

Highly mobile species least impacted by transportation infrastructure



Current habitat conditions

Species Characteristics

Less mobile species most impacted by transportation infrastructure.



Current habitat conditions

Remnant Size and Quality



Matrix Permeability

Matrix = landscape surrounding remnants of natural habitat



Matrix Permeability



Matrix Permeability

“A geographic information system (GIS) lets us visualize, question, analyze, and interpret data to understand relationships, patterns, and trends.” - Environmental Systems Research Institute



Matrix Permeability

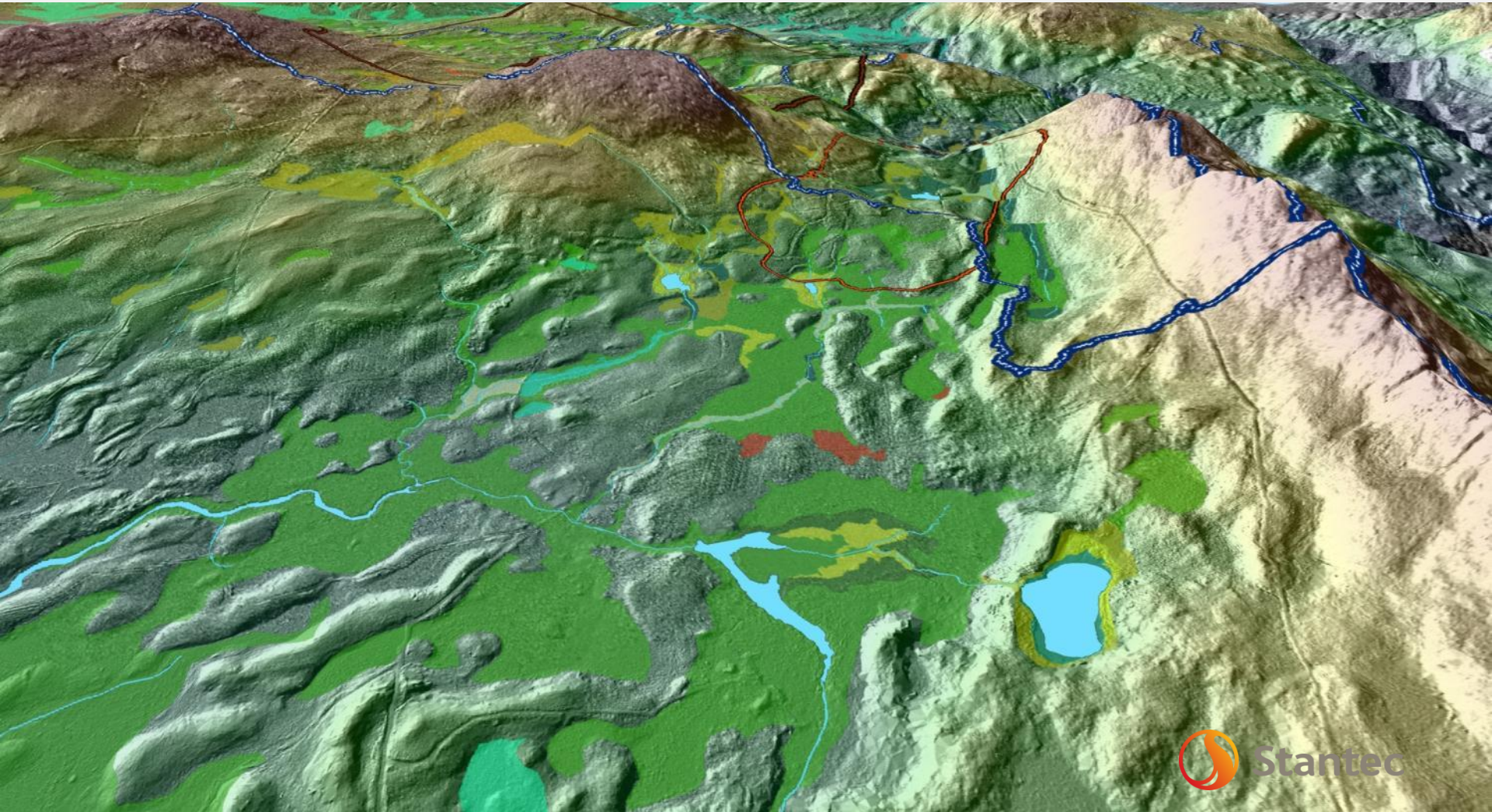
“A geographic information system (GIS) lets us visualize, question, analyze, and interpret data to understand relationships, patterns, and trends.” - Environmental Systems Research Institute

GIS mapping of relative characteristics is an extremely powerful tool for planning.

- Distance between remnants of suitable habitat
- Habitat block size and quality
- Shape/orientation
- Additional features

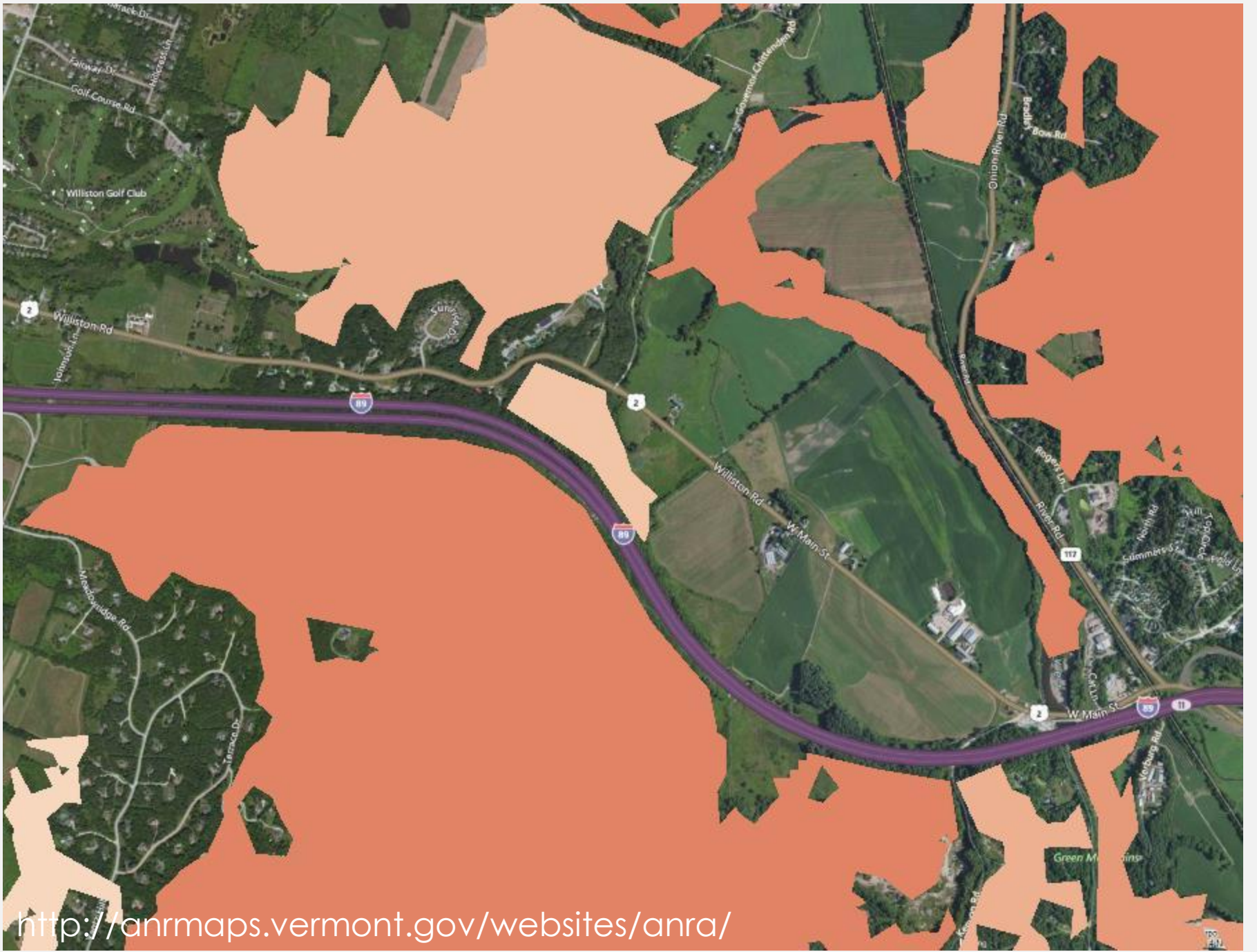
Matrix Permeability

GIS mapping of relative characteristics



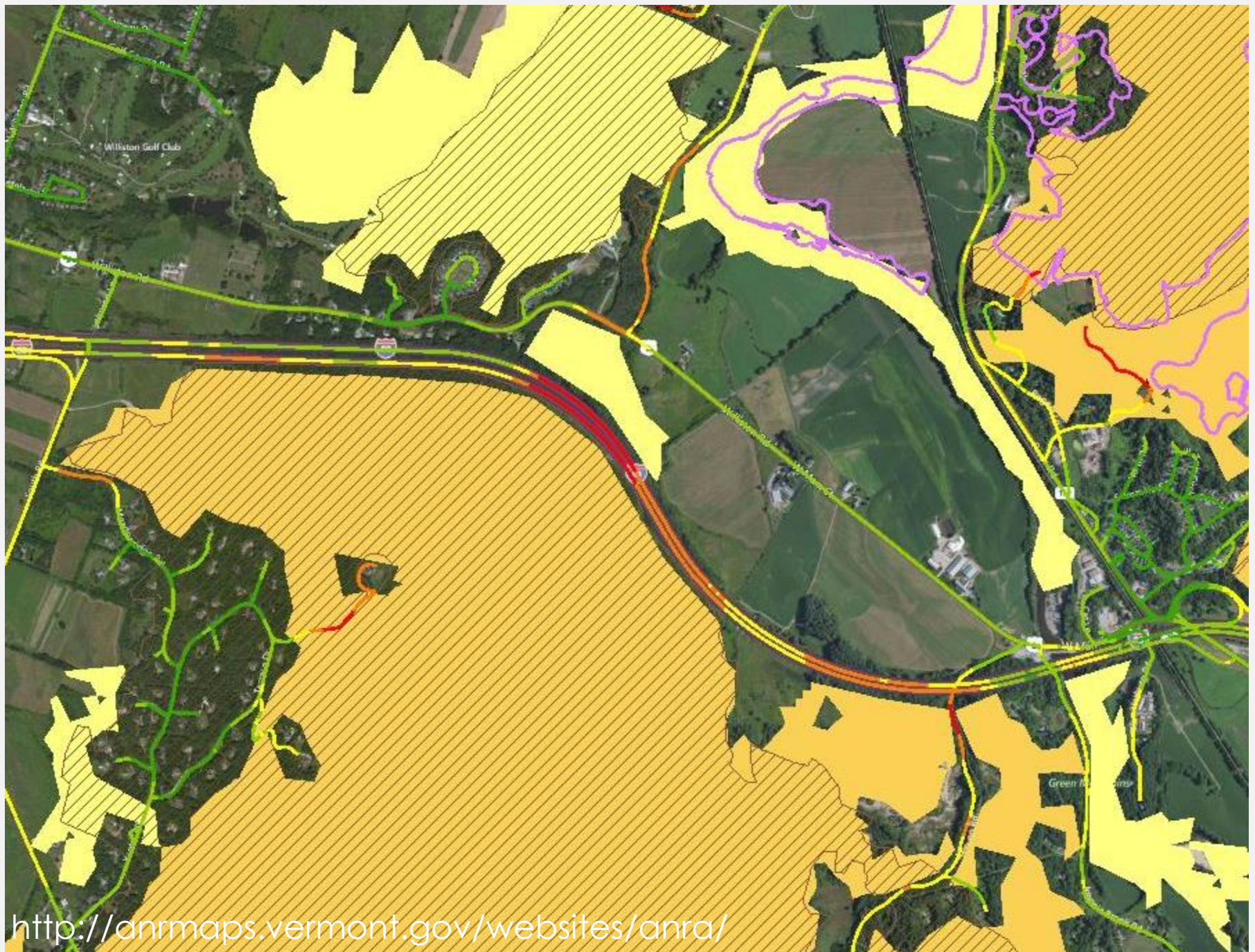


<http://anrmaps.vermont.gov/websites/anra/>



<http://anrmaps.vermont.gov/websites/anra/>





<http://anrmaps.vermont.gov/websites/anra/>

Matrix Permeability



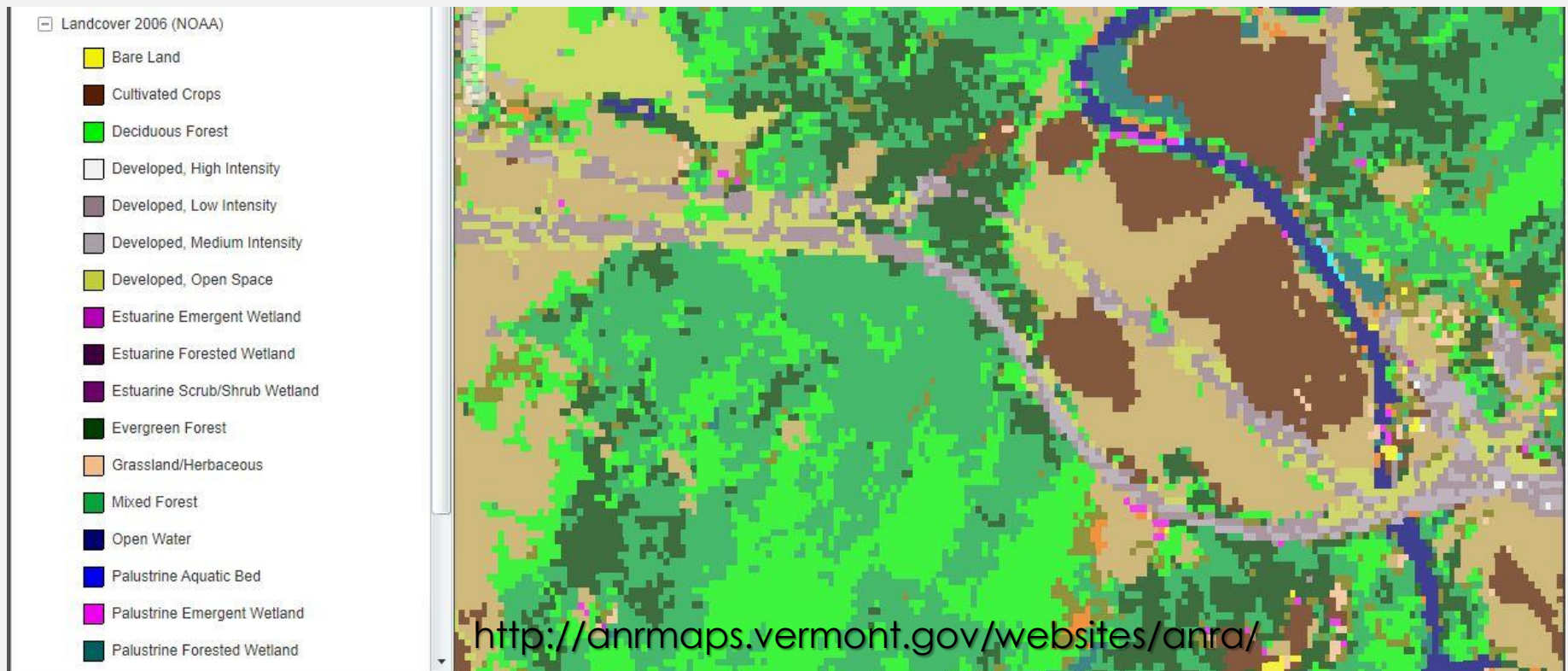
Matrix Permeability



Matrix Permeability

Relative characteristics

- Land use, land cover mapping



Matrix Permeability

Relative characteristics

- Infrastructure
 - Curb design
 - Road width
 - Traffic data
 - Barrier fencing
 - Crossing structures



Matrix Permeability

Relative characteristics

- Species activity patterns
 - Seasonal use



Matrix Permeability

Relative characteristics

- Species activity patterns
 - Seasonal use
 - Time of day



Matrix Permeability

Relative characteristics

- Species activity patterns
 - Seasonal use
 - Time of day
 - Breeding cycle



Regional pressures

Anthropogenic climate change is forcing species to shift ranges and reorganizing patterns of species diversity.

Current preservation practices will not work unless movement is enabled.

Songbirds (least affected by infrastructure)

Land mammals (in the middle?)

Reptiles and amphibians (most affected by infrastructure)

Regional pressures

Audubon's Birds and Climate Change Report:

“Our models indicate that 314 species will lose **more than 50 percent** of their current climatic range by 2080.”



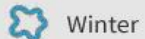
<http://endangerednj.blogspot.ca/2012/02/endangered-or-just-in-danger-amphibians.html>

<http://climate.audubon.org/>

Regional pressures

Audubon

Approximate Current Range



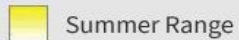
Winter



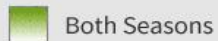
Summer



Winter Range



Summer Range



Both Seasons

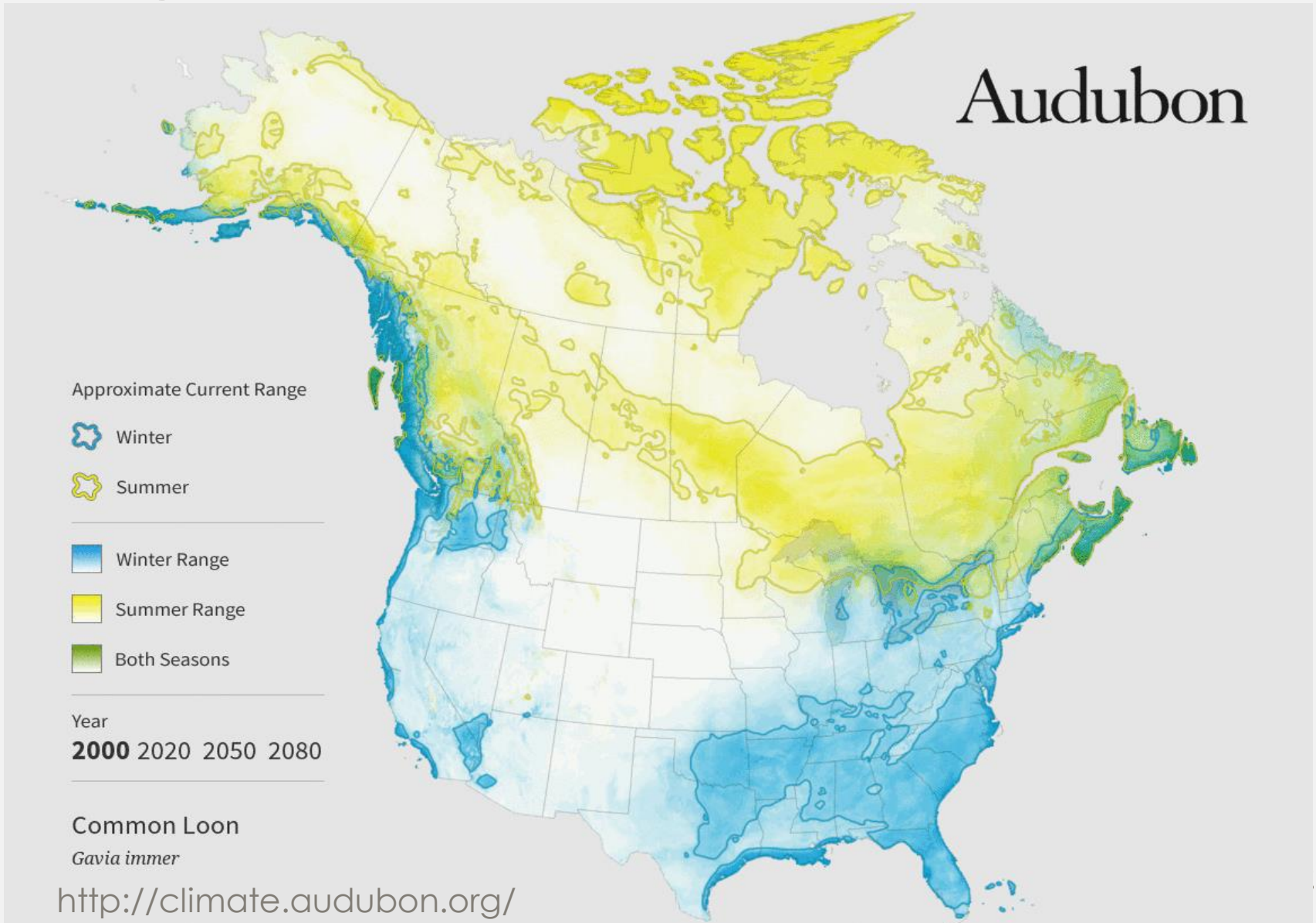
Year

2000 2020 2050 2080

Common Loon

Gavia immer

<http://climate.audubon.org/>



Opportunity

- Study species with data gaps to improve transportation infrastructure permeability



Opportunity

- Study species with data gaps to improve permeability



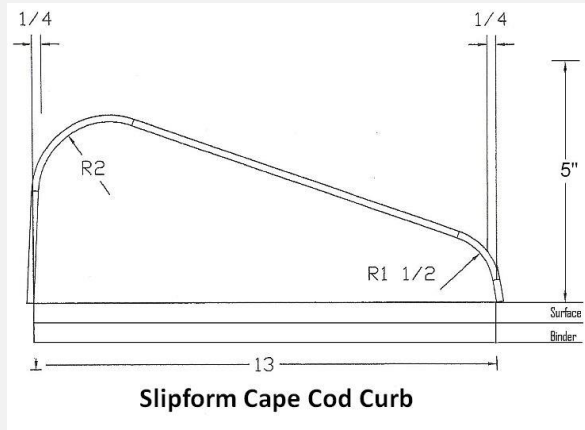
Infrastructure opportunity

- Incorporate wildlife mitigation needs early in the DOT programming, planning and Design process.
- Budget priority projects with scheduled upgrades



Infrastructure opportunity

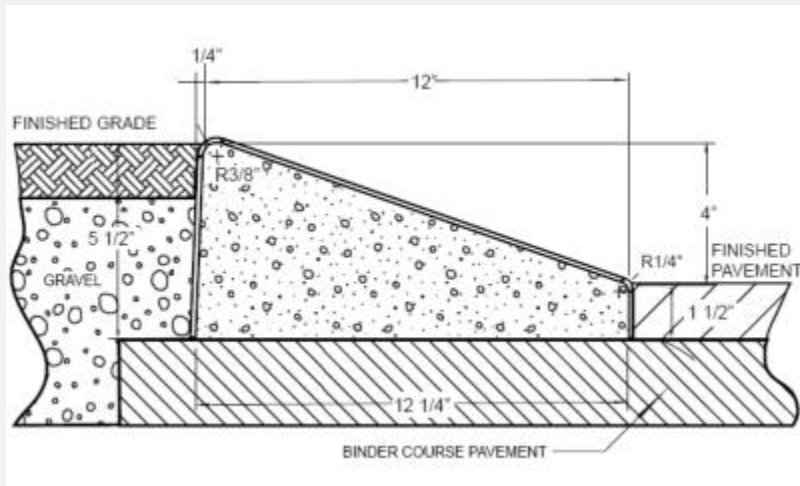
Expand material options



http://www.dirigoslipform.com/slipform_molds.html



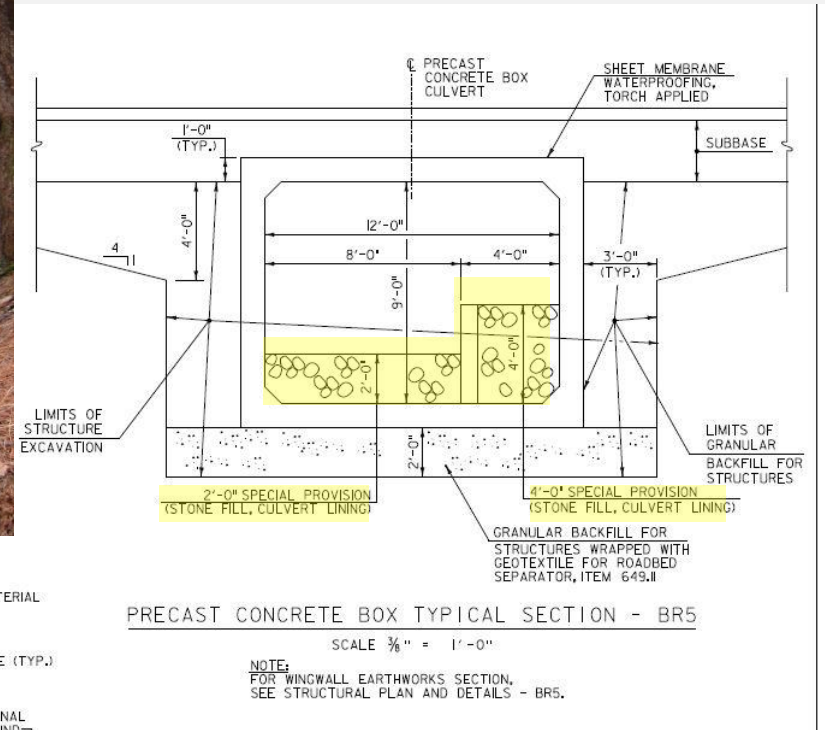
<http://www.bfrandassociates.com/curbing2.html>



http://www.nesc-inc.com/forms/forms_extruded.html

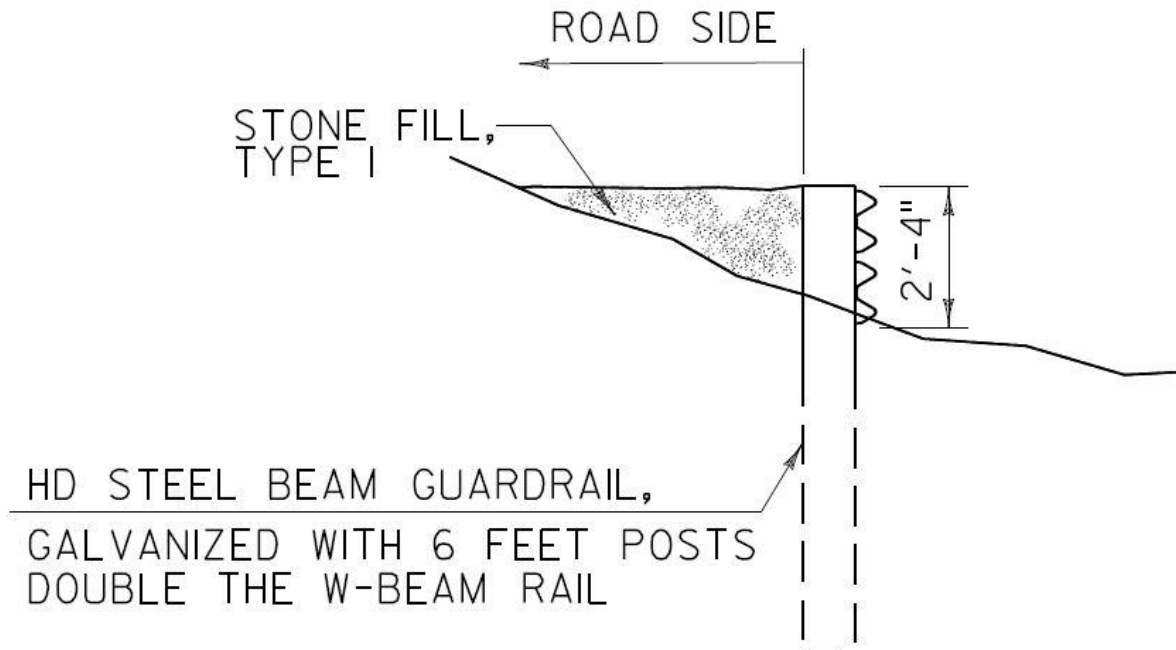
Infrastructure opportunity

Expand design options



Infrastructure opportunity

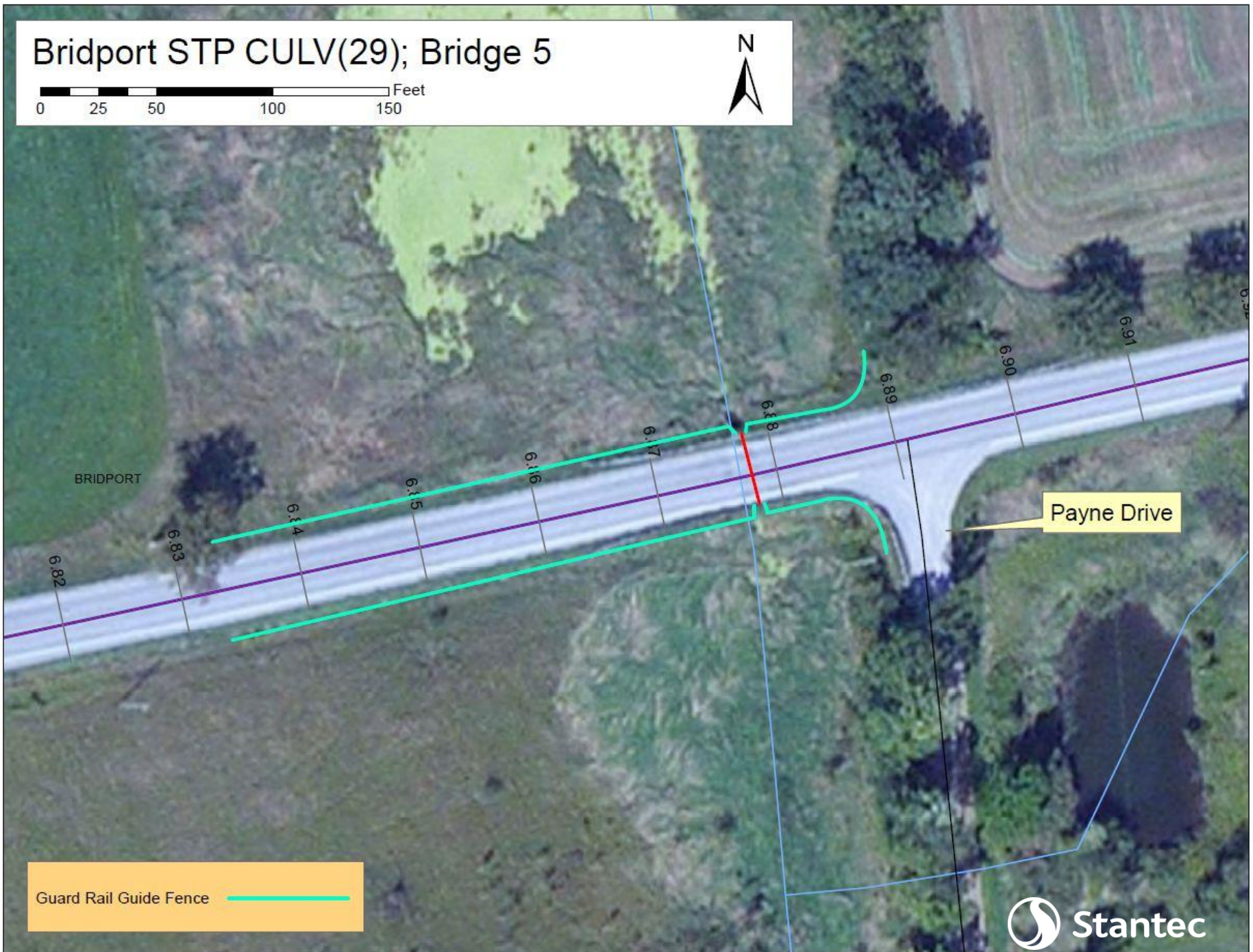
Expand design options



SPECIAL PROVISION (WILDLIFE GUIDE FENCE) DETAIL

NOT TO SCALE

Bridport STP CULV(29); Bridge 5



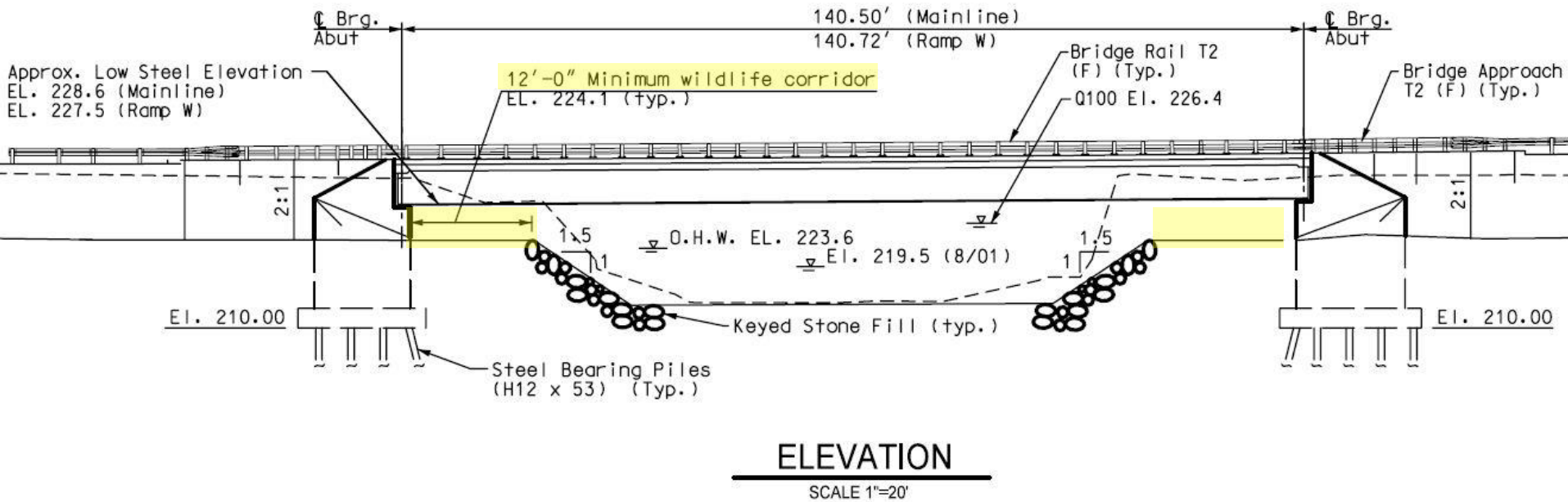
Payne Drive

Guard Rail Guide Fence



Infrastructure opportunity

Expand design options



Infrastructure opportunity

Land use planning and prioritization of preservation efforts.

Cost planning and quantification.

- Upgrade for wildlife passage cost increases
 - Box culvert upgrade = ~20% increase
 - wildlife plateau into bridge span ~20%

Additional benefits

- Increased flood resiliency

We as humans
are adaptable.
We can use our
abilities to
modify current
practices to
benefit wildlife
outpaced by
climate
change.

We can and should use what we know to improve how we build/improve/modify infrastructure to increase wildlife mobility without impacting the original intent of moving people and goods effectively.

Questions?

