

# STREAM CROSSING REPLACEMENTS FOR AQUATIC RESTORATION AND MITIGATION



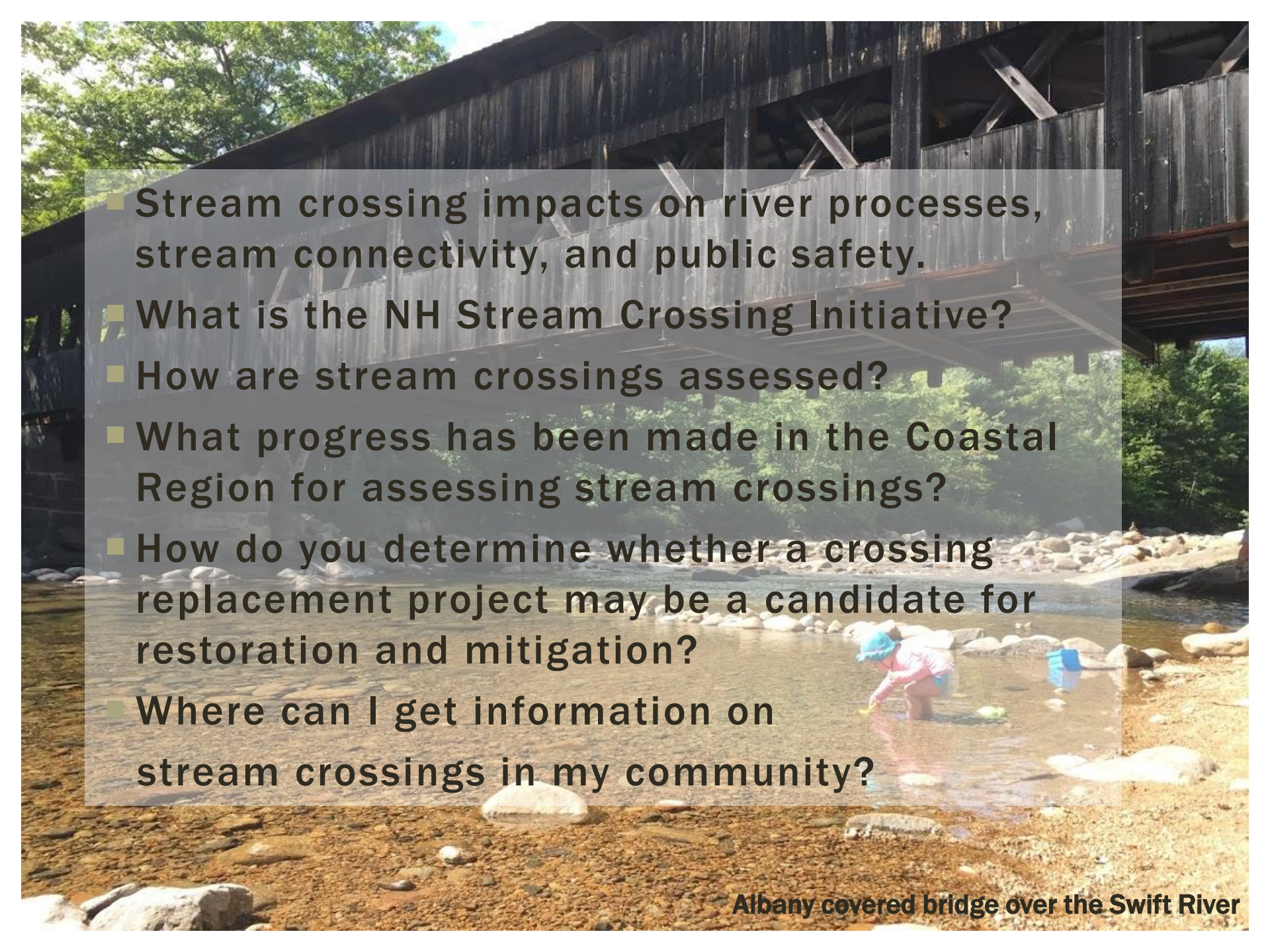
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Cheryl Bondi, PhD  
Flood Risk Specialist  
NH Department of Environmental Services





- 
- Stream crossing impacts on river processes, stream connectivity, and public safety.
  - What is the NH Stream Crossing Initiative?
  - How are stream crossings assessed?
  - What progress has been made in the Coastal Region for assessing stream crossings?
  - How do you determine whether a crossing replacement project may be a candidate for restoration and mitigation?
  - Where can I get information on stream crossings in my community?



# STREAM CROSSINGS: INTERSECTIONS OF OUR ROADS AND RIVERS





# STREAM CROSSINGS IMPACT HOW WATER AND SEDIMENT MOVE DOWNSTREAM

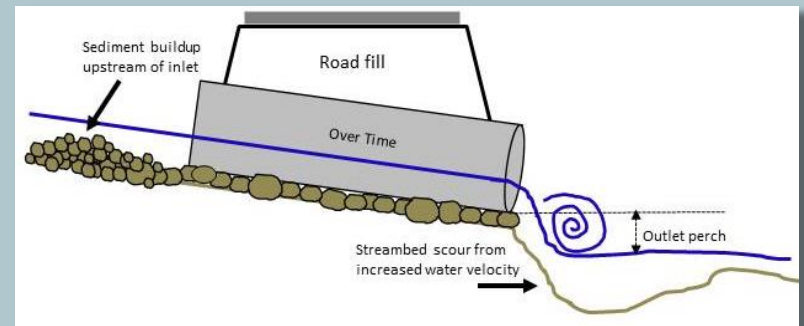
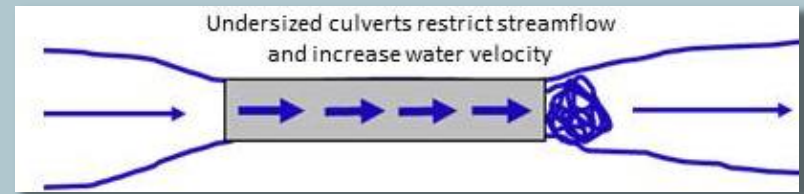
## Geomorphic Compatibility

- How well does a crossing fit the natural form and sediment transport processes of a river?



# STREAM CROSSINGS IMPACT HOW WATER AND SEDIMENT MOVE DOWNSTREAM

- Undersized culverts increase water velocity
  - “Fire hose effect”
- Over time crossings become:
  - Clogged US
  - Channel widens upstream
  - Bank erosion
  - Bed scour
  - Perched





# UNDERSIZED AND CLOGGED CULVERTS CAN CAUSE EXTREME DOWNSTREAM FLOODING

- Ponding can occur upstream of undersized culverts
- During high flow events send a wall of water crashing downstream
  - Catastrophic damage



# CULVERT WASHOUTS: A PUBLIC SAFETY AND WATER QUALITY ISSUE



Water overtops a culvert in Lee and the river crosses the road



Culvert failure on Blake Brook in Epsom



Catastrophic culvert failure in Alstead lead to loss of life

- Roads are a critical piece of our infrastructure
  - Inconvenient
  - Expensive to repair
- Public safety hazard
  - Harm to people and property
- Instream and riparian habitat destruction
  - Bank and streambed erosion
  - Washed out sediment and road material into rivers
- Increased risk due to:
  - More frequent large rain events
  - Development
  - Aging infrastructure



# ROAD WASHOUTS: A PUBLIC SAFETY AND WATER QUALITY ISSUE



**InDepthNH**  
The New Hampshire Center for Public Interest Journalism

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## Water overtops a culvert in Lee and the river crosses the road

Report: Inadequate Culverts Imperil Town Road Budgets And Wildlife

By Chris Jensen, InDepthNH.org

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### Culvert failure on Blake Brook in Epsom

Complete culvert failure in Alstead caused 30 foot road embankment to collapse

A Bethelham resident struggles to cross a road that has been washed away by a culvert failure. Photo by Chris Jensen

By Chris Jensen  
InDepthNH.org

BETHLEHEM — Amid concern that similar storms will be happening more often, a new report has worrisome news for towns: up to 47% of culverts investigated will fail in such downpours.

By "failure" the researcher, "it necessarily wash out. But so much water will back up that it will flow over the top of the culvert and across the top, such as a road or trail."

**NH1**

News Weather Dining NH1



## Road Collapse Highlights Problems with Tens of Thousands of Culverts in NH

Written by Don Himsel on October 19, 2017 9:32 am.



# STREAM CROSSINGS CAN BE BARRIERS TO AQUATIC LIFE

Many turtles require connected wetlands



Brook Trout / Bob Michelson

Brook Trout need access to cold water streams for spawning



# STREAM CROSSINGS CAN BE BARRIERS TO AQUATIC LIFE

Most of the fish species identified as greatest conservation need by NH Fish and Game need rivers and stream corridors to reach critical spawning areas!





# WHAT MAKES A CROSSING IMPASSABLE TO FISH AND OTHER ANIMALS?

## No Passage



- Perched outlet
- No resting pool
- Lacks natural substrate



- Screen is barrier
- Clogged with debris



- Extremely high velocity

## Full Passage



- Low velocity
- Sufficient water depth
- Natural substrate



- Channel banks enhance animal passage



- Natural substrate throughout the structure
- Step-pools

# NEW HAMPSHIRE STATE STREAM CROSSING INITIATIVE

Lead by:

NH Department of  
Environmental Services



- Geological Survey
- Wetlands Bureau

## MISSION

**Inventory stream crossings throughout the state to inform data-driven decisions on culvert replacement and stream restoration**

Co-Leads and Partners:



NH Department of  
Transportation



NH Fish and Game  
Department



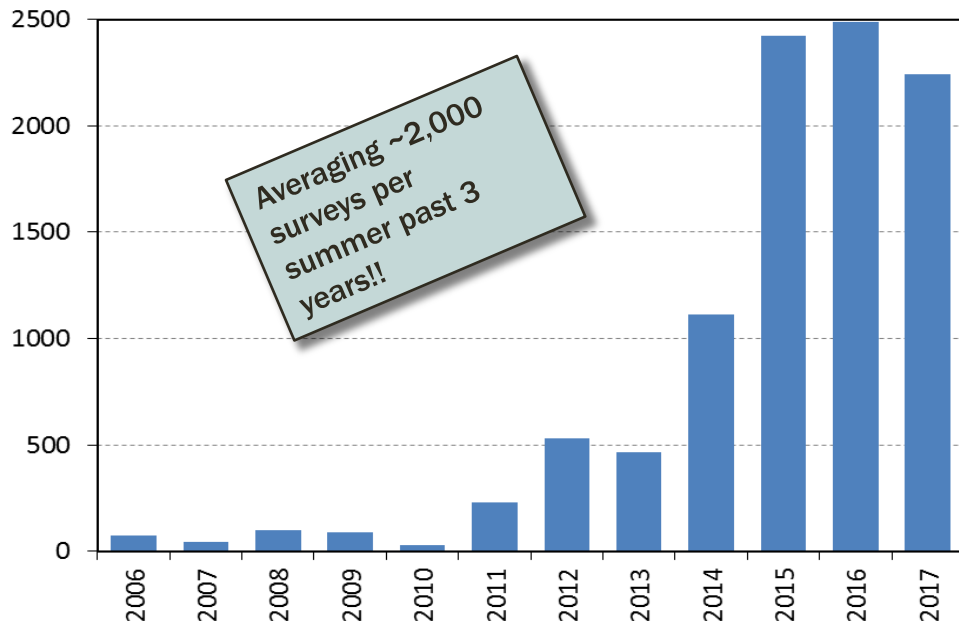
NH Division of Homeland  
Security and Emergency  
Management

- Multi-agency effort to document transportation and environmental concerns
  - Combined protocol
  - Individual agency responsibilities clear on specific missions and expertise
- Field assessments are coordinated
  - Minimize duplication of effort
- Consistent analysis methods and reporting results to the public



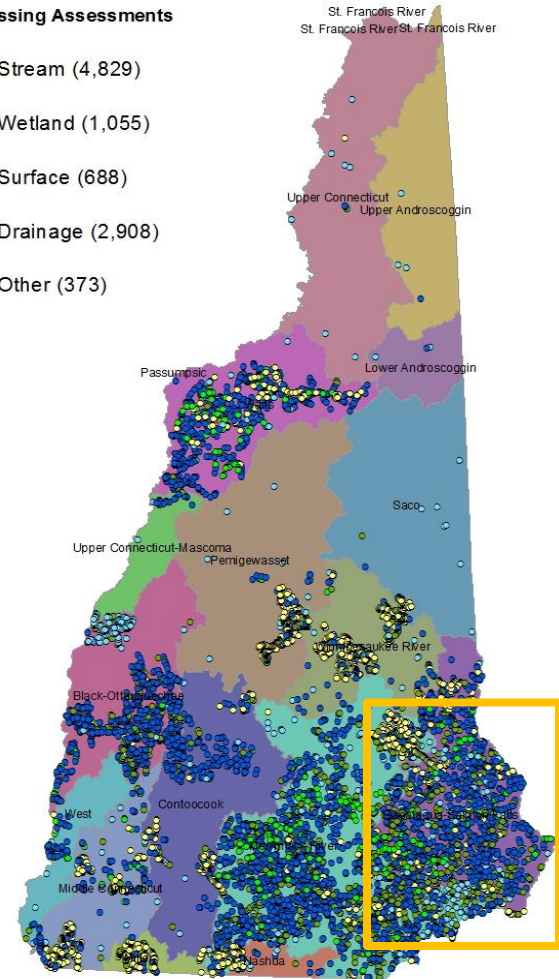
# PROGRAM HAS GAINED SIGNIFICANT MOMENTUM IN RECENT YEARS!

- ~10,000 surveys across the state
- About 1,500 planned for 2018
- Project partners are doing field assessments all over the state



## Stream Crossing Assessments

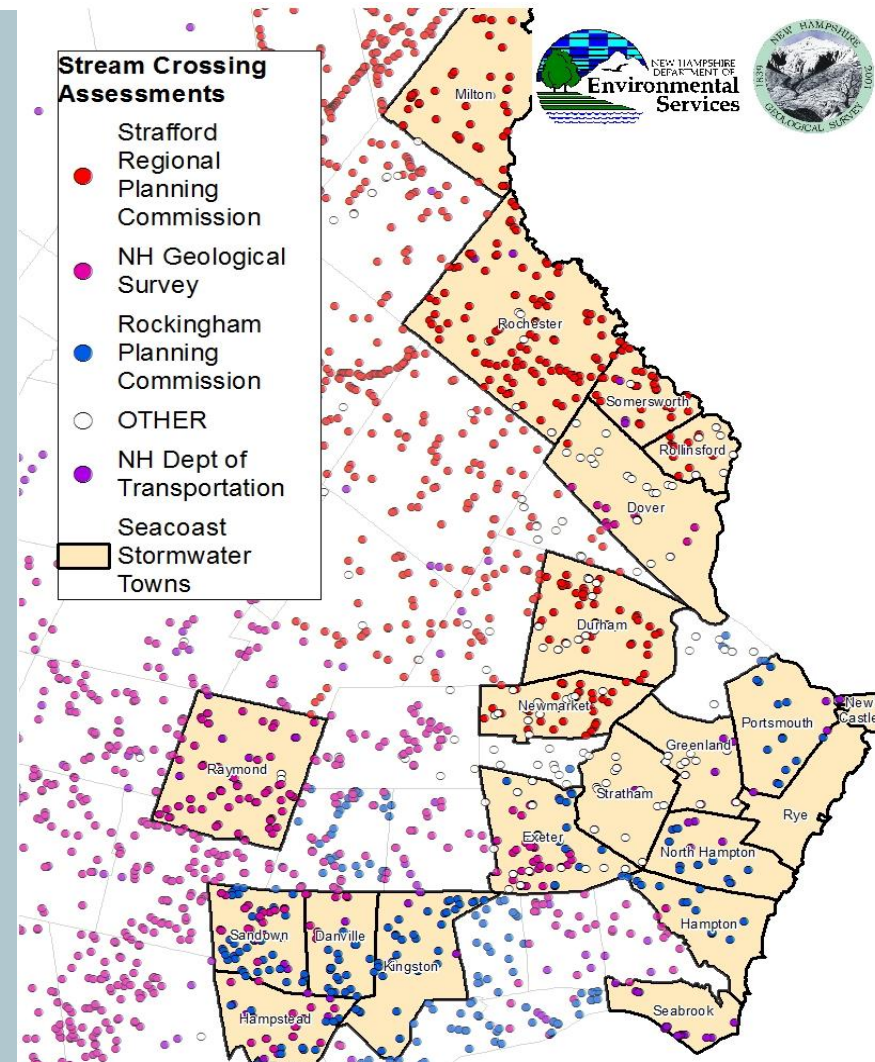
- Stream (4,829)
- Wetland (1,055)
- Surface (688)
- Drainage (2,908)
- Other (373)



# WHAT PROJECT PARTNERS HAVE BEEN DOING ASSESSMENTS IN THE SEACOAST?

- Regional Planning Commissions collect most of the data on the seacoast
  - SRPC
  - RPC

Crossing Type	Total
Drainage	66
Not Surveyable	27
Stream	490
Surface	96
Wetland	147
<b>Grand Total</b>	<b>826</b>







Statewide Asset Data Exchange System  
(SADES)

## New Hampshire Stream Crossing Initiative



Field Manual

*In Partnership With:*

NH Department of Environmental Services  
NH Department of Transportation  
NH Fish and Game Department  
NH Division of Homeland Security and Emergency Management  
NH Regional Planning Commissions  
UNH Technology Transfer Center

Version: 6.0



# CROSSING ASSESSMENTS

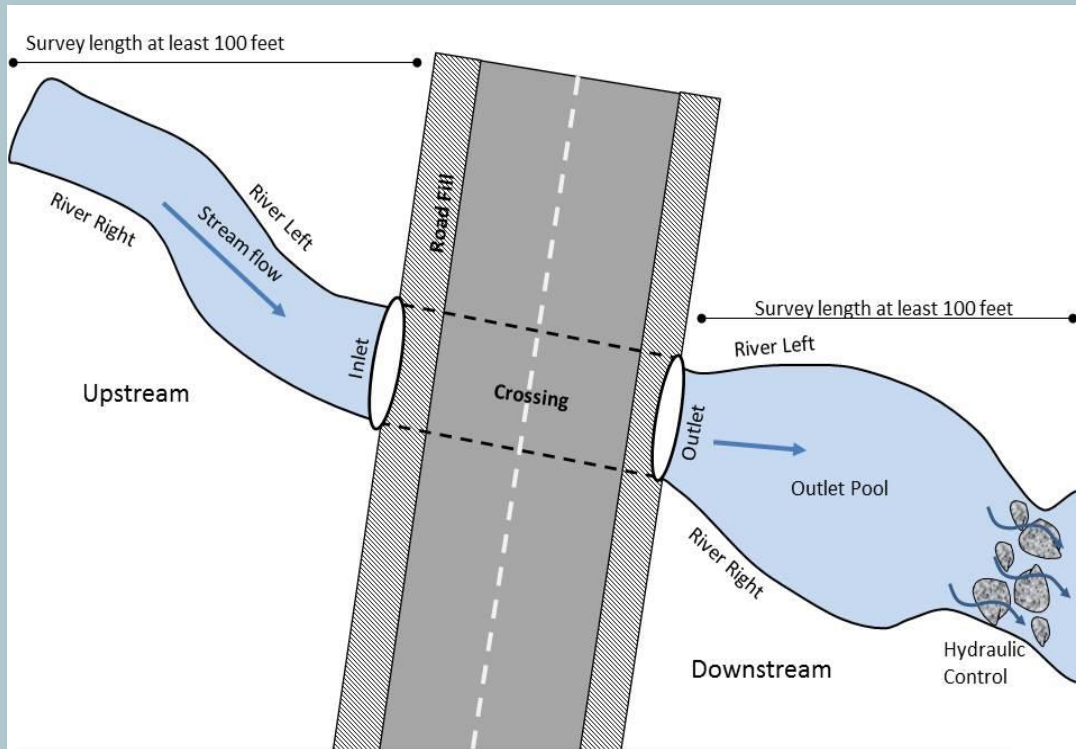
## NH Stream Crossing Assessment Protocol

- Training each spring
- Environmental and Transportation data
  - Input for 3 screening tools used to rank culverts
- Electronic data collection

# CROSSING ASSESSMENTS

## ■ Geomorphic Compatibility

- Collect data on stream channel size and shape
- Observations of bank erosion and bed scour recorded
- Sediment deposition





# CROSSING ASSESSMENTS

## ■ Aquatic Organism Passage

- Inlet obstructions
- Outlet grade
- Substrate and water depth throughout the structure



Freefall



> 1 foot final vertical drop

Cascade



# CROSSING ASSESSMENTS



- Hydraulic Capacity
  - Structure elevations and measurements

## DOT Asset Condition

- Headwall
- Structure material
- Bank armoring

### Rusted

The metal pipe has visible signs of rust or parts have rusted away



### Collapsing

The culvert pipe has become bent or deformed



### Eroding

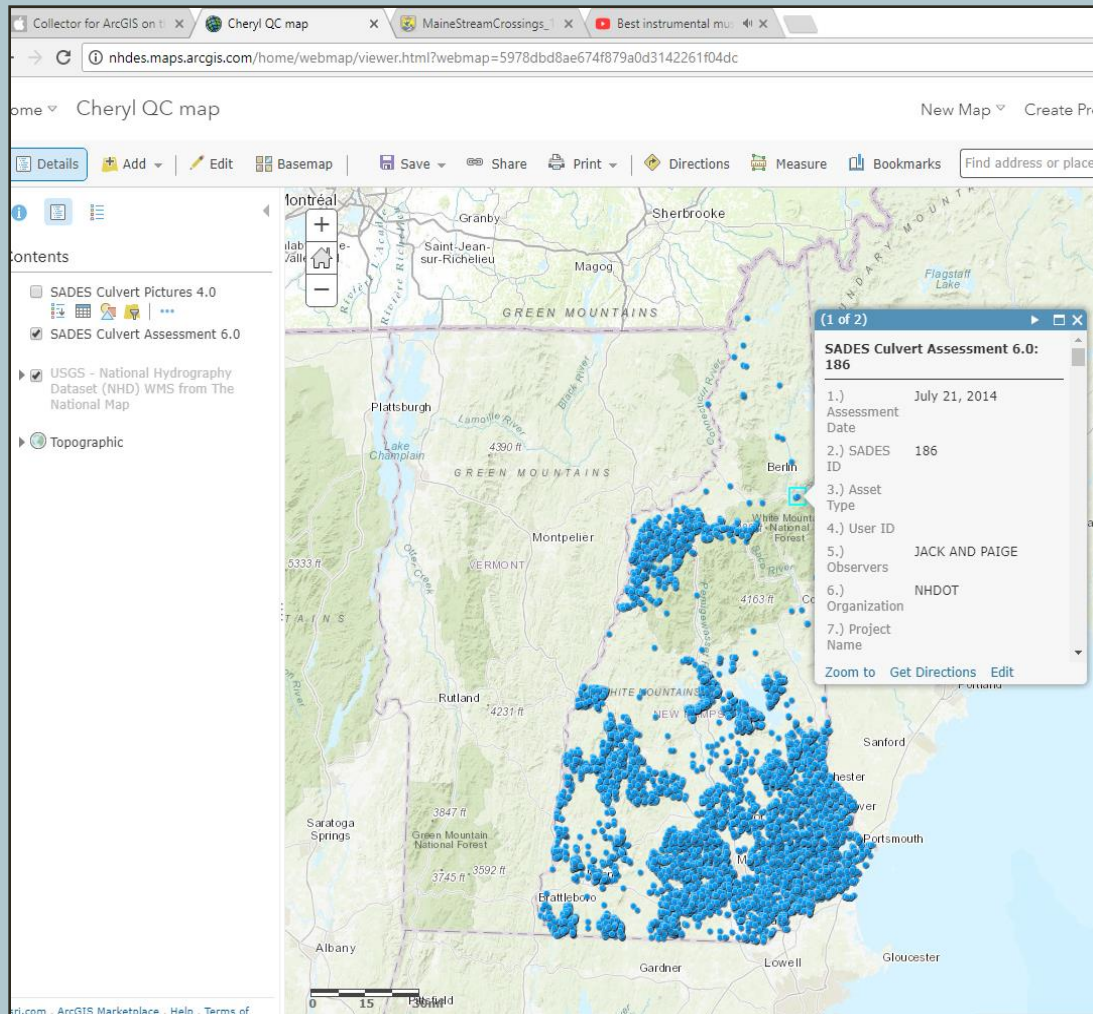
The concrete is wearing away and has spalling that compromises the pipe shape



Combination of rusting (pipe), collapsing and eroding (concrete)



# “SADES” Statewide Asset Data Exchange System



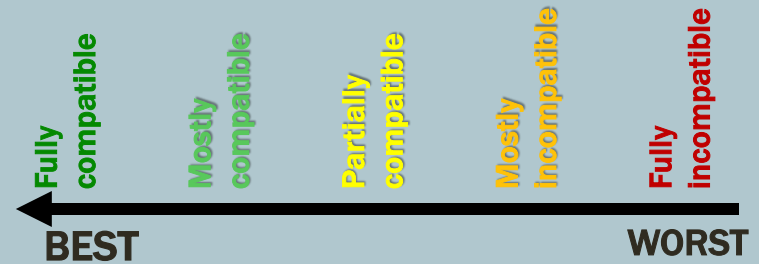
## DATA STORAGE AND DELIVERY

- Online geodatabase
  - Data storage, delivery, and QAQC
- Real-time data collection
  - Synched at the end of each workday
- Hosted by Technology Transfer Department at UNH

# SCREENING TOOLS TO RANK STREAM CROSSINGS FOR REPLACEMENT

## ■ Geomorphic Compatibility

- Scores reflect how well the crossing fits river shape and if it impedes sediment transport



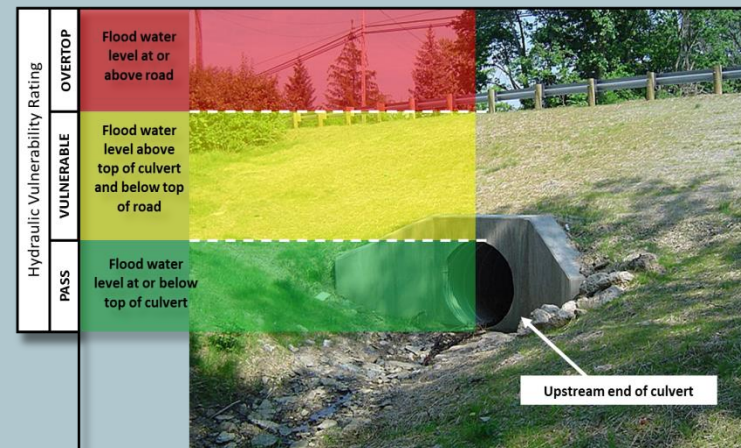
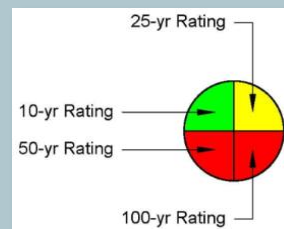
## ■ Aquatic Organism Passage

- Describes whether structure is likely passable by fish and other animals



## ■ Hydraulic Vulnerability

- Hydraulic Capacity Model based on runoff predictions and structure data





# Dover, NH Multi-Hazard Mitigation Plan Update 2013



Prepared for New Hampshire Homeland  
Security & Emergency Management

By  
Strafford Regional Planning Commission  
Rochester, NH 03867

February 5, 2013  
Final

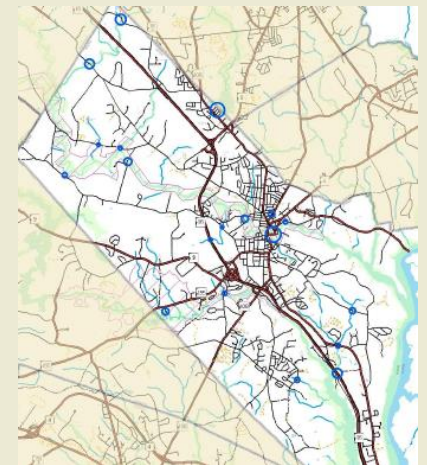
Multi-Hazard Mitigation Plan Update

Table 19  
May 2006 Flood Damaged Locations

Street	Location	Description of Damage
Appleton St	Dam	Washout at embankment
Auburn St	Water Tank Rd	Road washout
Birchdale Rd	At bridge	Shoulder washed out at bridge
Blackwater Rd		Shoulder
Blackwater Rd	Junction of Warner & Horse Hill Rd	Shoulder
Bog Rd		Shoulder and pavement wash and undermining
Bog Rd		Railroad bed at culvert washed away
Bow St	At Carter St	Channel Inlet washout
Broadcove Dr		Culvert road and sub grade
Broadcove Dr		Shoulder and pavement
Broadcove Dr		Shoulder
Clinton St	Culvert Crossing	Culvert/roadway flooding
District #5 Rd		Shoulder washed out
Dunbarton Rd	2 Locations	Shoulder/curbing/road
Eastman St		Channel washout under building
Elm St		Shoulder and roadway washout
Elm St	2 Locations	Shoulder and swale washout by culvert
Elm St		Shoulder & roadway washout
Flume St		C/B collapsed & edge of road and reset
Franklin St	West of Liberty St	
Hall St	Under I-93 Overpass	C/B collapsed
Hooksett Tpke		Shoulder and road washed out
Horse Hill Rd		Culvert surcharged road washed

## LOCAL FLOOD REPORTS

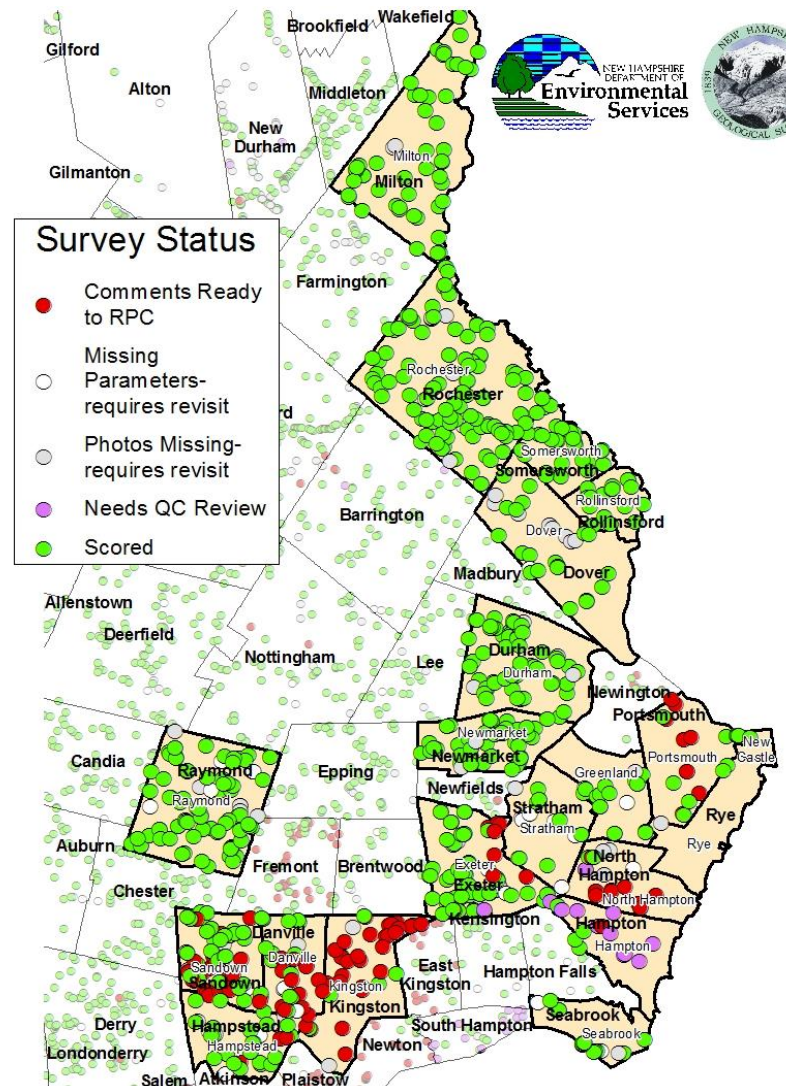
- Town's Hazard Mitigation Plan
  - Identify culverts that have flooded in the past and areas of road washouts
  - NHGS digitized and compiled all towns' data into a single spatial dataset



# SCREENING RESULTS FOR THE SEACOAST

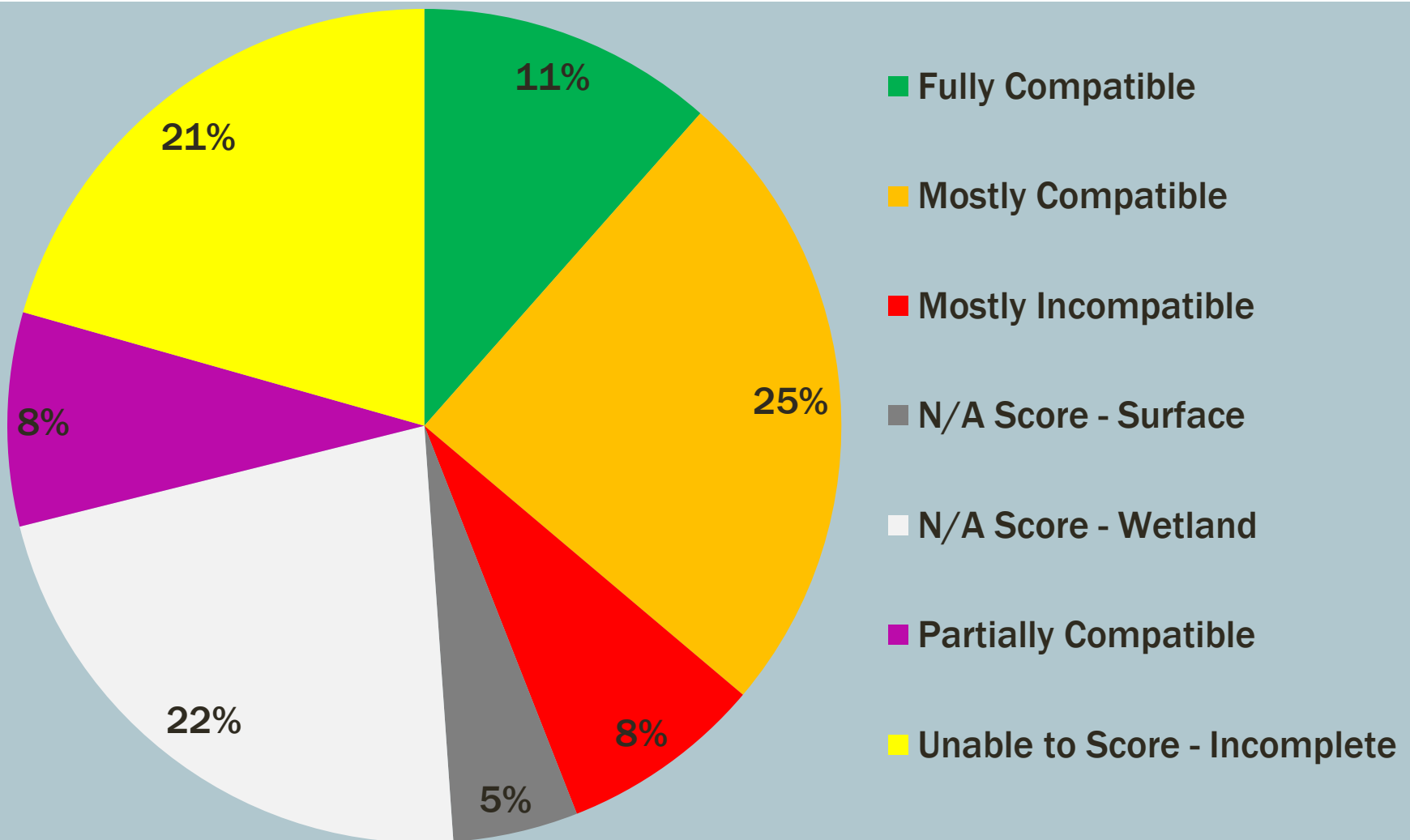
- Significant progress has been made in the region on getting data scored for AOP and GC
- Still have many records that need to be completed by data collectors (red dots in map)

Quality Control Status	Total
Comments Ready	103
Missing Parameters	52
Missing Photos	66
New	12
Scored	593
<b>Total Data Records</b>	<b>826</b>

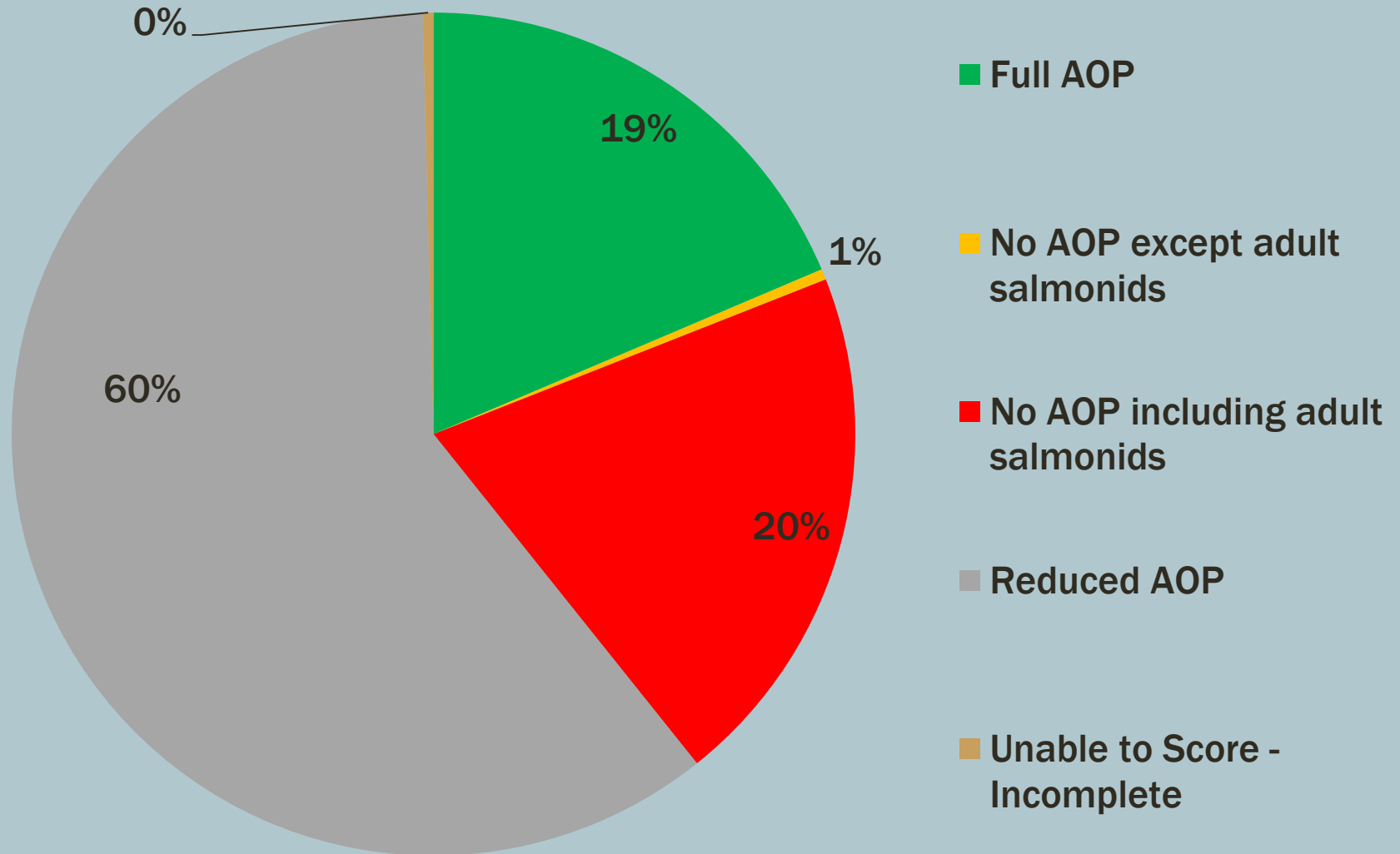




# GEOMORPHIC COMPATIBILITY RESULTS FOR THE SEACOAST



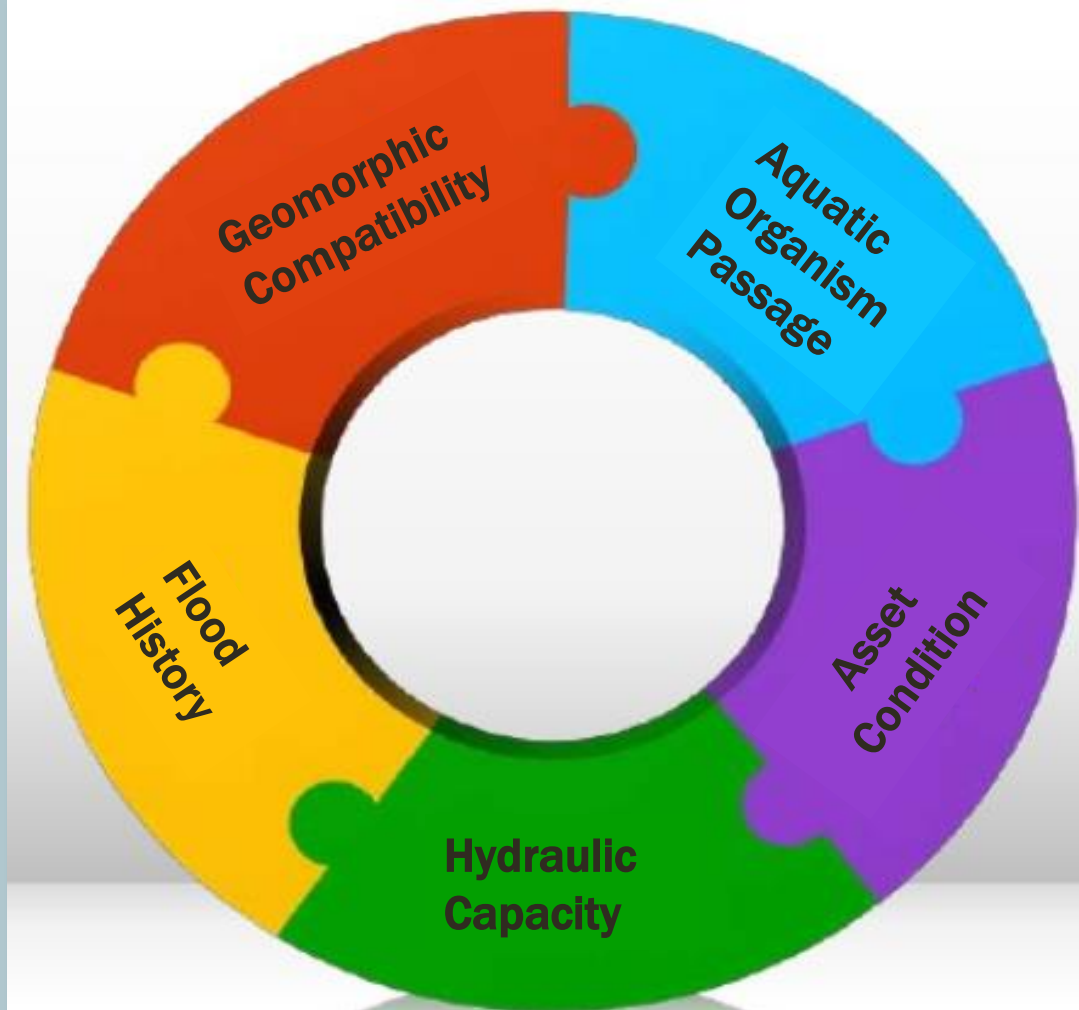
# AQUATIC ORGANISM PASSAGE RESULTS FOR THE SEACOAST





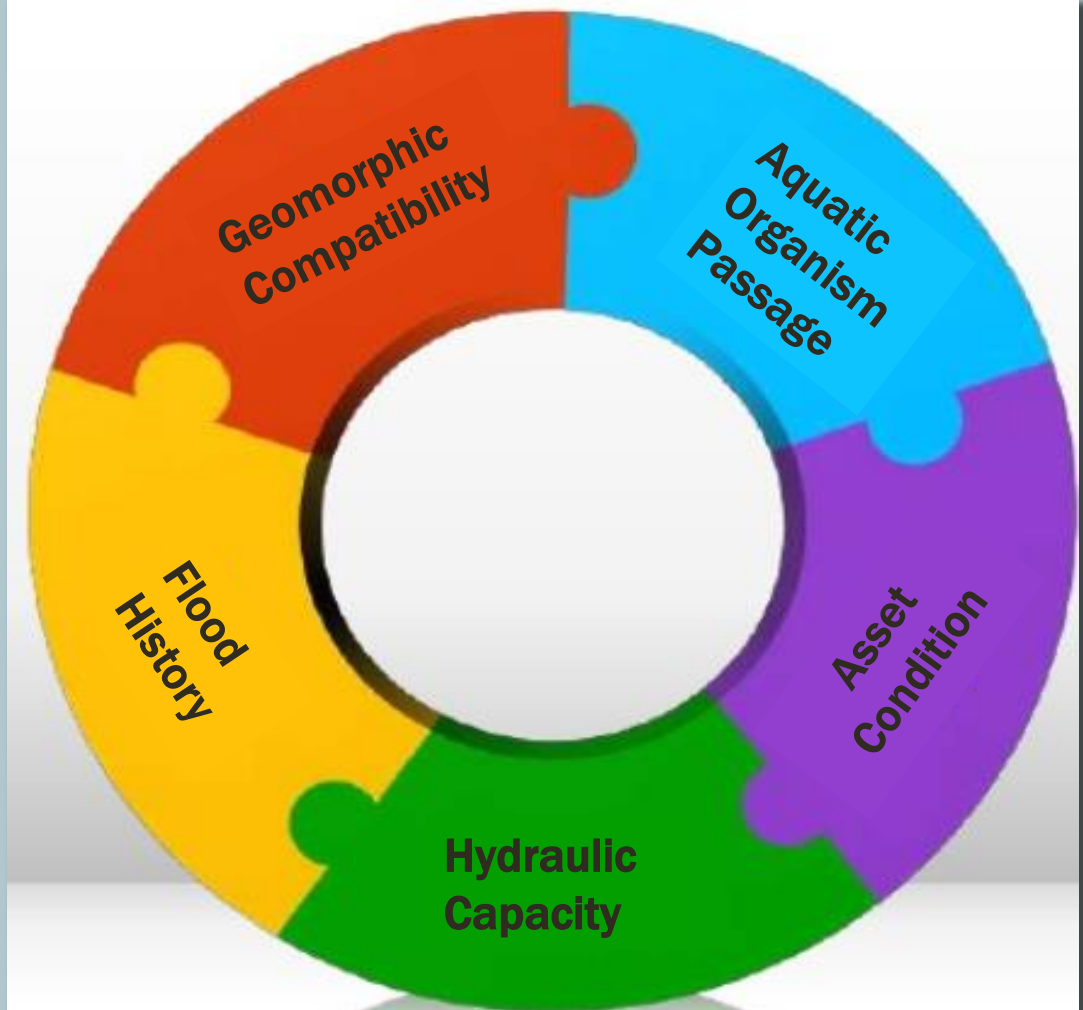
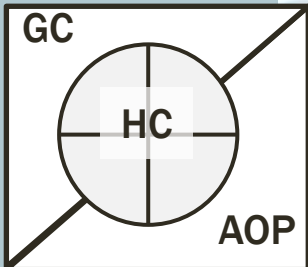
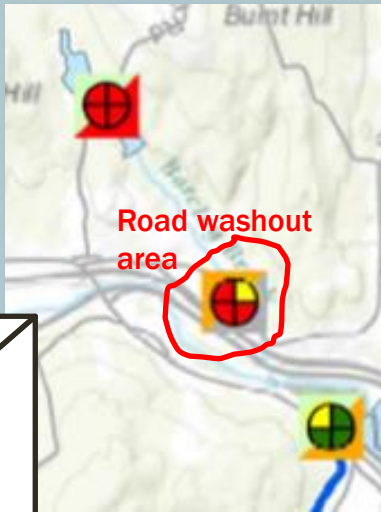
# PUTTING THESE PIECES TOGETHER PAINTS THE FULL PICTURE OF A CROSSING

- Provide guidance when prioritizing which culverts are in most need of replacement



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# FUNDING FOR STREAM CROSSING REPLACEMENTS AND UPGRADES



## ■ DES Wetlands Mitigation Programs

- Permittee is required to provide mitigation for certain projects from four options:
  1. Local wetland & **stream restoration**
  2. Upland preservation
  3. Wetland Creation
  4. Payment to **NHDES Aquatic Resource Mitigation** Fund
    - Pools money together to be spent in the watershed where impacts occurred.
    - Grant competition
    - Funds go to wetland restoration, preservation of land adjacent, wetland creation, or **stream restoration**



# LOCAL MITIGATION IS THE PREFERRED OPTION

- Procedure requires permittee to check **FIRST** with Conservation Commissions
  - “Priority List” (Env-Wt 801.03a)
  - Locally identified stream and wetland restoration projects.
    - **Stream crossings are greatly encouraged to be included in this list!!**
- Stream Passage Improvement Program (SPIP)
  - Partner program between DES and DOT
  - Goal is to improve AOP, Geomorphic Condition, and flood resiliency, while improving State/municipal stream crossings.
  - DOT will review local options as potential mitigation for their projects.
    - **Stream crossings are greatly encouraged to be included in this list!!**





# NH DES AQUATIC RESOURCE MITIGATION FUND (ARM)

- Provides grants to restore and conserve wetlands, streams, and wildlife habitats
- Eligible Projects
  - Construction costs associated with restoration
  - Acquisition of land/conservation easements
  - Dam removals, **culvert replacements**, stream and floodplain restoration projects
  - Tidal resource improvements, living shoreline projects in coastal areas
    - **Including storm water improvements!**

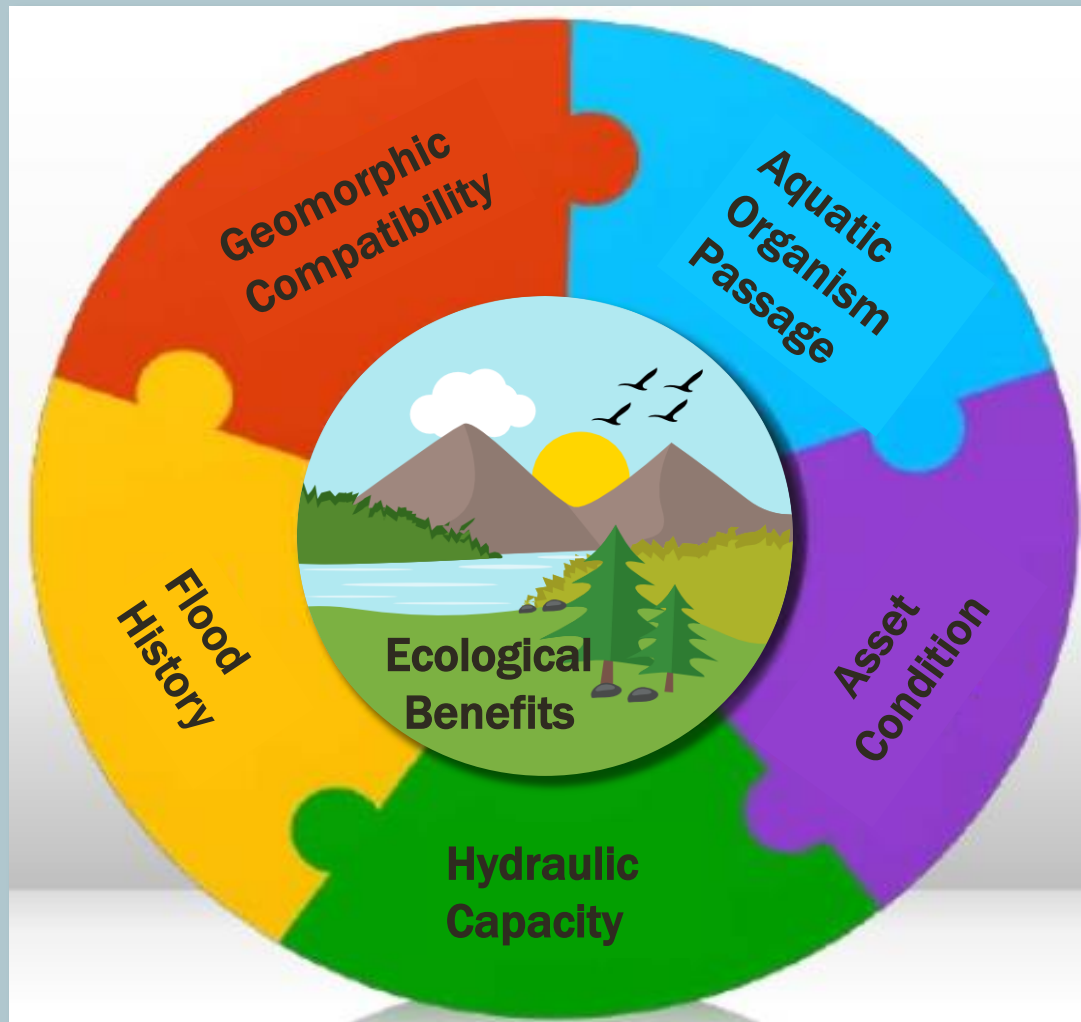
## **\*\*\*2018 ARM Fund Grant Round Deadlines\*\***

- 2 Page Pre-proposal- April 30, 2018
- Final application- August 31, 2018
- Site Selection Committee Review- Sept
- Army Corps/Wetland Council Review- Nov.
- Awards Announced- December



# REPLACING STREAM CROSSINGS FOR STREAM RESTORATION AND MITIGATION

- Provide guidance when prioritizing which culverts are in most need of replacement
- **Potential for mitigation and ARM grant funds**





# REPLACING STREAM CROSSINGS FOR STREAM RESTORATION AND MITIGATION

- Good restoration/mitigation projects will replace structures that are:
  - doing the most environmental damage
  - Barriers to fish and aquatic animals
  - Not compatible with stream geomorphology
  - Predicted to fail frequent storm events
  - Known to flood and cause road erosion

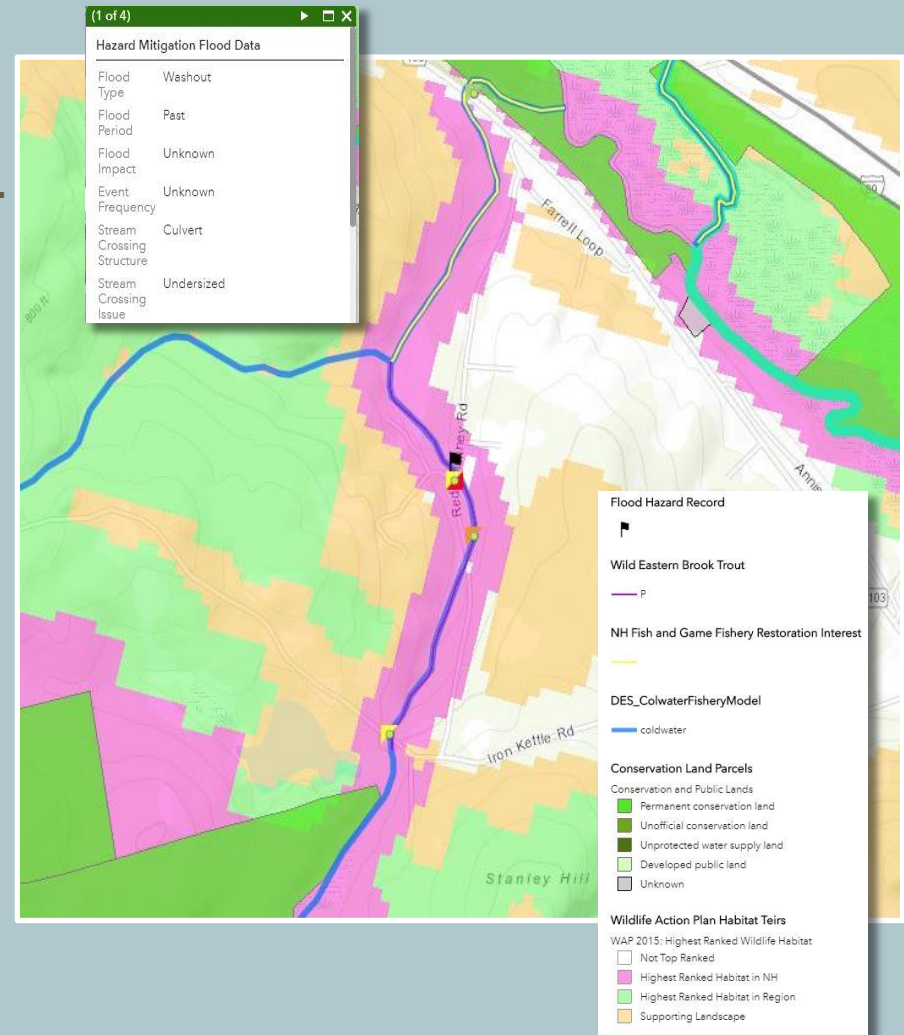
AND have the greatest environmental benefits

- High fish and wildlife habitat quality
- Significant amount of upstream habitat gained
- Reconnects conservation land
- Presence of threatened, endangered, species of concern



# REPLACING STREAM CROSSINGS FOR STREAM RESTORATION AND MITIGATION

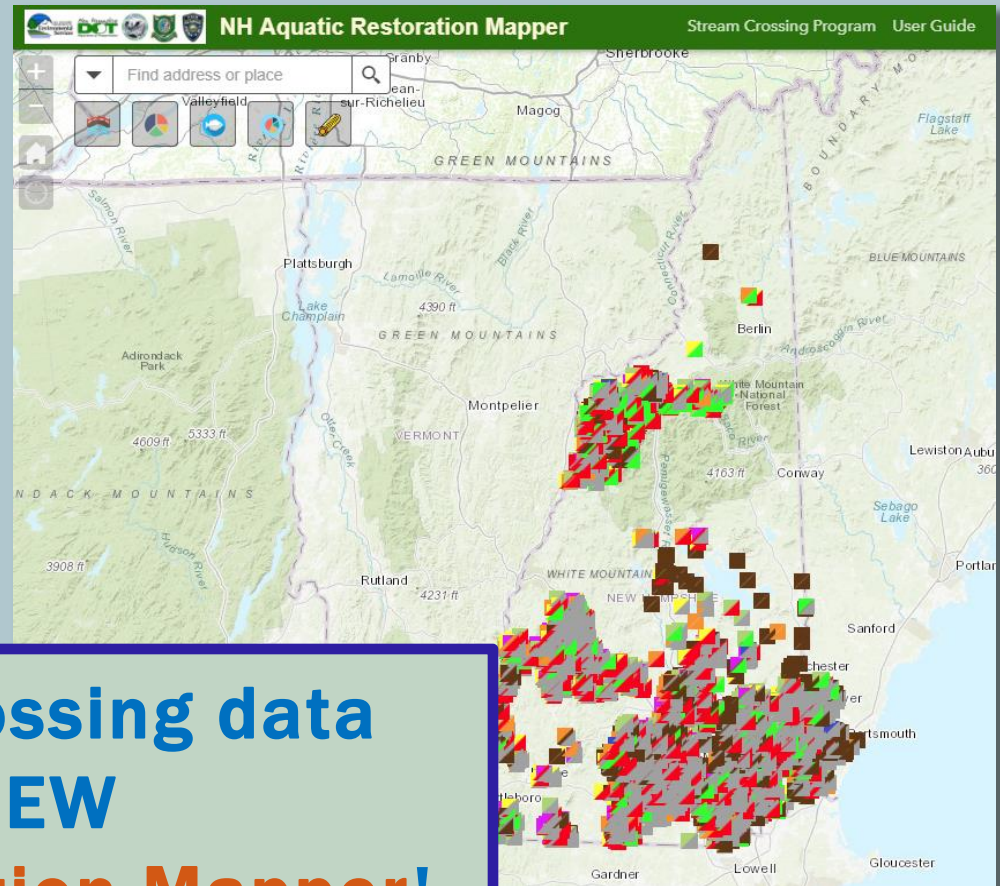
- How to evaluate the ecological benefits of a project:
  - High quality wildlife habitat area.
  - Significant amount of upstream habitat will be gained.
  - Project reconnects conservation land and important habitat corridors.
  - Presence of threatened, endangered, species of concern.
  - Will improve water quality and bank erosion issues.
  - Stream is identified in a conservation plan as a key element to threatened aquatic species restoration.





# HOW CAN YOU ACCESS STREAM CROSSING DATA?

- Download GIS data layer from the [New Hampshire Coastal Viewer at GRANIT](#)



Explore stream crossing data  
using the **NEW**  
[NH Aquatic Restoration Mapper!](#)

# CONTACT US WITH QUESTIONS

- NHDES Wetlands Bureau Mitigation Program
  - Lori Sommer
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- NHGS Flood Hazards Program
  - Cheryl Bondi
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