STREAM PASSAGE IMPROVEMENT FOR INFRASTRUCTURE, FISH PASSAGE, AND FLOOD MITIGATION

Melinda Bubier, EIT, Wetlands Mitigation Program
Shane Csiki, Ph.D., CFM, New Hampshire Geological Survey
New Hampshire Department of Environmental Services
March 24, 2017
Why are stream crossings important?
Why do we care about stream crossings?
Who is coordinating the stream crossing initiative?
How is the work being completed?
Where have crossings been assessed?
What other initiatives are underway?
Where do we begin?
NEW HAMPSHIRE
STATE STREAM CROSSING STEERING TEAM

Lead by:

NH Department of Environmental Services
  - Geological Survey
  - Wetlands Bureau

Co-Leads and Partners:

NH Department of Transportation

NH Fish and Game Department

NH Division of Homeland Security and Emergency Management

• Partnership-based management
  – distributed management structure, across agencies, directing priorities

• Transportation and environmental concerns
  – Combined protocol

• Individual agency responsibility
  – Criteria development based on specific missions and expertise

• Assessments are coordinated
  – Minimize duplication of effort

• Consistent messaging to the public on data outputs and scoring
ROAD WASHOUTS: BAD FOR EVERYONE!

- Expensive
- Public safety
- Habitat destruction
- Inconvenient

Inconvenient
Flood hazards
Critical infrastructure
Increased Risk Due to:
  - Increased rain events
  - Increased development
  - Aging infrastructure
WILDLIFE DEPEND ON CROSSINGS AS MUCH AS WE DO!
### STREAM CROSSING ASSESSMENT PROTOCOL

- Training each spring for State funded stream collectors
  - Classroom session
  - Field training

- QAQC data “realtime” and provide feedback

- Field visits with collectors to provide guidance and feedback

- ~125 Parameters total:
  - Environmental
  - Transportation

- Three compatibility characterization types:
  - Geomorphology
  - Aquatic organism passage
  - Hydrology/Hydraulic

- Entry method:
  - iPad / ESRI Collector App
6 photos per crossing

Cross-reference of photos with data

Issues/comments to collectors

Work in turn to address comments and complete process to enable running of geomorphic and AOP passage tools
DATA STORAGE AND DELIVERY

- Common data delivery and QAQC interface
- Accessible to all project partners
- Maintained by DOT as an asset management database
<table>
<thead>
<tr>
<th>Category Name</th>
<th>Screen Score</th>
<th>Threshold Conditions</th>
<th>Description of structure-channel geomorphic compatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully compatible</td>
<td>20≤GC≤25</td>
<td>n/a</td>
<td>Structure fully compatible with natural channel form and process. There is a low risk of failure. No replacement anticipated over the lifetime of the structure. A similar structure is recommended when replacement is needed.</td>
</tr>
<tr>
<td>Mostly compatible</td>
<td>15≤GC≤20</td>
<td>n/a</td>
<td>Structure mostly compatible with current channel form and process. There is a low risk of failure. No replacement anticipated over the lifetime of the structure. Minor design adjustments recommended when replacement is needed to make fully compatible.</td>
</tr>
<tr>
<td>Partially compatible</td>
<td>10≤GC≤15</td>
<td>n/a</td>
<td>Structure compatible with either current form or process, but not both. Compatibility likely short term. There is a moderate risk of structure failure and replacement may be needed. Re-design suggested to improve geomorphic compatibility.</td>
</tr>
<tr>
<td>Mostly incompatible</td>
<td>5≤GC≤10</td>
<td>% Bankfull Width + Approach Angle scores ≤ 2</td>
<td>Structure mostly incompatible with current form and process, with a moderate to high risk of structure failure. Re-design and replacement planning should be initiated to improve geomorphic compatibility.</td>
</tr>
<tr>
<td>Fully incompatible</td>
<td>0≤GC≤5</td>
<td>% Bankfull Width + Approach Angle scores ≤ 2 AND Sediment Continuity + Erosion and Armoring scores ≤ 2</td>
<td>Structure fully incompatible with channel and high risk of failure. Re-design and replacement should be performed as soon as possible to improve geomorphic compatibility.</td>
</tr>
<tr>
<td>Score</td>
<td>% Bankfull Width</td>
<td>Sediment Continuity</td>
<td>Slope</td>
</tr>
<tr>
<td>-------</td>
<td>------------------</td>
<td>---------------------</td>
<td>-------</td>
</tr>
<tr>
<td>5</td>
<td>%BFW ≥ 120</td>
<td>No upstream deposition or downstream bed scour</td>
<td>Structure slope equal to channel slope, and no break in valley slope</td>
</tr>
<tr>
<td>4</td>
<td>100 ≤ %BFW &lt; 120</td>
<td>Either upstream deposition or downstream bed scour, without upstream deposits taller than 0.5 bankfull height or high downstream banks</td>
<td>n/a</td>
</tr>
<tr>
<td>3</td>
<td>75 ≤ %BFW &lt; 100</td>
<td>Either upstream deposition or downstream bed scour, with either upstream deposits taller than 0.5 bankfull height or high downstream banks</td>
<td>Structure slope equal channel slope, with local break in valley slope</td>
</tr>
<tr>
<td>2</td>
<td>50 ≤ %BFW &lt; 75</td>
<td>Both upstream deposition and downstream bed scour, without upstream deposits taller than 0.5 bankfull height or high downstream banks</td>
<td>Structure slope higher or lower than channel slope, and no break in valley slope</td>
</tr>
<tr>
<td>1</td>
<td>30 ≤ %BFW &lt; 50</td>
<td>Both upstream deposition and downstream bed scour, with upstream deposits taller than 0.5 bankfull height or high downstream banks</td>
<td>n/a</td>
</tr>
<tr>
<td>0</td>
<td>%BFW &lt; 30</td>
<td>Both upstream deposition and downstream bed scour, with upstream deposits taller than 0.5 bankfull height and high downstream banks</td>
<td>Structure slope higher or lower than channel slope, with local break in valley slope</td>
</tr>
</tbody>
</table>
## AQUATIC ORGANISM PASSAGE SCORES

<table>
<thead>
<tr>
<th>VT Aquatic Organism Passage Coarse Screen</th>
<th>Full AOP</th>
<th>Reduced AOP</th>
<th>No AOP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Updated 2/25/2008</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| AOP Function Variables / Values         | Green (if all are true) | Gray (if any are true) | Orange | Red |
|-----------------------------------------|-------------------------|-----------------------|--------|
| Culvert outlet invert type              | at grade OR backwatered | cascade               | free fall AND | free fall AND |
| Outlet drop (ft)                        | = 0                     | > 0, < 1 ft OR        | ≥ 1 ft OR |       |
| Downstream pool present                |                         | = yes ( = yes AND    | = no OR ( = yes AND |
| Downstream pool entrance depth / outlet drop | n/m                   | ≥ 1 )                 | n/a    | < 1 ) OR |
| Water depth in culvert at outlet (ft)   |                         |                       | < 0.3 ft |     |
| Number of culverts at crossing          | 1                      | > 1                   |        |
| Structure opening partially obstructed  | = none                  | ≠ none                |        |
| Sediment throughout structure          | yes                     | no                    |        |
ACCESSING THE DATA

- Contact the New Hampshire Geological Survey at NHDES
  - Tom Taggart – Primary Contact
    - Email: Thomas.Taggart@des.nh.gov
    - Phone: 603-271-5762
  - Shane Csiki
    - Email: Shane.Csiki@des.nh.gov
    - Phone: 603-271-2876

- Access directly via the New Hampshire Coastal Viewer
  - [http://nhcoastalviewer.unh.edu/](http://nhcoastalviewer.unh.edu/)
- Assessment status
  - ~7,500 structures are on SADES
  - ~1,100 are drainages and will not be scored
  - ~800 are incomplete
  - ~5,600 culverts or bridges to score

- ~4,500 crossings have been run through AOP and GC screens

- QC process on SADES

Total crossings 7,500
(~35% of known crossings in NH)
Who collects culvert data in New Hampshire?
CURRENT AND FUTURE DIRECTIONS

- **Hydraulic Capacity Estimates – Coarse Screening Model**
  - Streamworks – Trout Unlimited Model
    - 1st Order estimates of Hydraulic Capacity
    - Inputs: Topography, land cover, soils, wetlands/ponds, precip, streamflow
    - Basis: HY-8 (FHWA)

- **Flood Modeling**
  - Initial investigations of 1D/2D Flood models underway
  - Currently in literature review and inputs analysis phase

- **Protocol Refinement**
  - Sub-committees tackling reduction of assessment parameters
  - Streamlining of QAQC process to reduce data management overhead
HYDRAULIC CAPACITY ESTIMATES

Legend:
- Solid Red: Maximum 100-year flood
- Red: Maximum 50-year flood
- Yellow: Maximum 25-year flood
- Green: Maximum 10-year flood
- Blue: Highest headwater
- Gray: Reservoir

Culvert flow values represent the predicted 10-, 25-, 50- and 100-year flood discharges, presented clockwise in order from the top right of each four-quadrant symbol that represents a stream crossing.
- Additional wetland mitigation option available to applicants.

- Option for projects that have difficulty in finding good mitigation.

- Process of providing a payment into a fund that pools money together to be spent in the “watershed” where impacts occurred.

- Funds go toward wetland restoration, preservation of land adjacent to aquatic resources, wetland creation or aquatic resource improvements.
Assist and provide funds for improving a crossing that is deemed eligible for the stream mitigation program.

- Utilize information for mitigation option to replace deficient crossings for aquatic passage and address infrastructure needs.
STREAM PASSAGE IMPROVEMENT PROJECTS

- Aquatic resource of concern?
  - Species present/potential?
- Overall Mitigation Potential/Protection.
  - AOP and Geomorphic scores
- How much of the aquatic resource will be protected.
- Buffers.
- Connections.
- Likelihood of project success.
  - Project Partners
  - Concept Design
- Flood hazard.
- Critical infrastructure
Fall Brook Culvert Replacement, Swanzey, NH

Funding: = $165,000

Total Project Cost: $250,572

Project Objective: Increase access to cold water headwaters habitat

Project Partners: Trout Unlimited, Cheshire County Conservation District, Town of Swanzey, NRCS, Fish & Game, Harris Center for Conservation
Bankfull width, immediately upstream = 30 feet
Reference reach = 21 feet

Indicative of a frequently backwatered crossing inlet

Lack of natural substrate within the culvert

- Upstream (Inlet) side of culvert
  May 10, 2011
Downstream/Outlet side of structure
May 10, 2011

6-foot diameter, 50-foot long corrugated metal pipe
- Install 23-foot wide open bottom arch
- Connection to approximately ten miles of upstream, barrier free, spawning and rearing aquatic habitat.
- Access to spawning habitat on approximately 6 smaller tributaries.
DOWNSTREAM/OUTLET SIDE OF STRUCTURE
AUGUST 19/23, 2016
Funding: $354,000

Total Project Cost: Approx. $800,000

Project Objective:
- Increase access to 1,950 feet of brook,
- Reconnect 2.57 acres of wetland habitat
- Stormwater treatment

Project Partners:
Left: Eastman Upstream 2014

Right: Eastman Downstream 2014
Aquatic Organism Screen = Reduced AOP

Geomorphic Compatibility Screen:
Eastman = Mostly Incompatible
Wathen = Partially Incompatible
Completed 15’ foot span

Left: Eastman Downstream
April 29, 2016

Below Eastman Upstream
April 29, 2016

Below Left: Eastman Upstream
August 16, 2016
Wathen “Inlet” July 2016
Work overseen by John Fields
WATHEN AVE FLOODPLAIN RESTORATION
RESTORATION PROJECT

REQUIREMENTS

- Restoration Plan
  - Plan must be submitted and approved prior to commencing work. The restoration plan can often be part of the wetland permit.
  - Coordination with wetlands permitting staff and ARM staff

- Monitoring Plan
  - Must include measurable performance objectives and metrics to establish project success.
  - Must be developed in coordination with ARM Staff and approved by the ACOE.

- Post-Construction Report

- Five Years of Monitoring and Monitoring Reports
<table>
<thead>
<tr>
<th>Event</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Majority of watersheds with available funding</td>
<td></td>
</tr>
<tr>
<td>2 Page Pre-proposal deadline:</td>
<td>April 30, 2018</td>
</tr>
<tr>
<td>Final application materials deadline:</td>
<td>August 31, 2018</td>
</tr>
<tr>
<td>Site Selection Committee review:</td>
<td>Sept. – Oct., 2018</td>
</tr>
<tr>
<td>Army Corps and Wetland Council Review:</td>
<td>November, 2018</td>
</tr>
<tr>
<td>Awards Announced</td>
<td>December, 2018</td>
</tr>
</tbody>
</table>
QUESTIONS? / IDEAS?

Mindy Bubier
Melinda.bubier@des.nh.gov
603-271-0727

Beyond the Beaver Dam
The Success of the NHDES Aquatic Resource Mitigation Fund