Issues and Methods for Transdisciplinary Planning of a Combined Wildlife and Pedestrian Highway Crossing

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Introduction

• Highways as barriers to wildlife and human movement

• Highways as major cause of landscape fragmentation, especially in suburban and peri-urban areas

• FHWA TCSP (Transportation, Community and Systems Preservation Program) innovative solution to reduce impacts of highways on communities

• Walden Passage: First TCSP study addressing combined wildlife:pedestrian crossing
Transdisciplinarity

- Disciplinary: Research or consulting service provided by a single discipline.

- Multidisciplinary: multiple disciplines working on a project, integration at conclusion of project.

- Interdisciplinary: multiple researchers collaborate and exchange ideas, methods, data and interpretations throughout a research or consulting project.

- Transdisciplinary: interdisciplinary + stakeholders + decision makers, full-mutual-integration throughout research or consulting project.
Transdisciplinary Project Team

• **Academic Disciplines:** Landscape Architecture, Wildlife Biology, Civil Engineering, Urban Planning, Landscape History


• **Non-Governmental Organizations:** Walden Woods, Mass. Audubon, Bay Circuit, Walden Wildlife Task Force

• **Stakeholders:** residents, neighbors
Walden Passage: Project Method

- Transdisciplinary Process: beyond public involvement
- Steering Committee (large and diverse membership)
- Website: [www.umass.edu/waldenpassage/](http://www.umass.edu/waldenpassage/)
- 3 Public Workshops: Introduction/Scoping, Development of Alternatives, Evaluation of Alternatives
Walden Passage: context

- SR 2, Major E-W divided highway, peri-urban Boston

- Host communities (Concord and Lincoln) conservation-oriented, well planned, politically-active citizens
Study Area: Land Use

Walden Passage Feasibility Study Area: Land Use

Legend
- LANDUSE
  - Creepland
  - Pasture
  - Forest
  - Wetland
  - Mining
  - Open Land
  - Participation Recreation
  - Transportation
  - Spectator Recreation
  - Waste Disposal

- Residential Multi-Fam
- Res Less than 1/4 acre
- Res 1/4-1/2 acre
- Res: Larger than 1/2 acre
- Commercial
- Industrial
- Urban Open
- Orchard
- Cemetery
- Transportation Facilities
- Urban Public
- Marina
- Golf
- Water

WALDEN PASSAGE FEASIBILITY STUDY
Lincoln and Concord, Massachusetts

Prepared by: University of Massachusetts Amherst
Departments of Landscape Architecture and Regional Planning,
Natural Resource Conservation, Engineering and UMass Extension

Prepared for: Metropolitan Area Planning Council
60 Temple Place, Boston, MA 02111
Wildlife and Highway Conflicts

**Problem** | **Solution**
--- | ---
Roadkill | Fencing

Barrier to Movement | Passage Structure
3 Hierarchical levels for analyzing Connectivity for wildlife movement

Metapopulation
Genetics
Re-colonization
Metapopulation
Genetics
Re-colonization
Population
Breeding
Metapopulation
Genetics
Re-colonization
Population
Breeding
Individual
Access to habitat
## Existing Wildlife Tunnels

(4 in Study Area)

### Number of crossings of species detected via track beds and cameras in all tunnels

<table>
<thead>
<tr>
<th>Species</th>
<th>Number of Crossings</th>
</tr>
</thead>
<tbody>
<tr>
<td>raccoon</td>
<td>🐻</td>
</tr>
<tr>
<td>human</td>
<td>🏡</td>
</tr>
<tr>
<td>house cat</td>
<td>🐾</td>
</tr>
<tr>
<td>small mammal</td>
<td>🐨</td>
</tr>
<tr>
<td>chipmunk</td>
<td>🐿️</td>
</tr>
<tr>
<td>groundhog</td>
<td>🐦</td>
</tr>
<tr>
<td>red fox</td>
<td>🦊</td>
</tr>
<tr>
<td>rabbit</td>
<td>🐇</td>
</tr>
<tr>
<td>weasel</td>
<td>🐿️</td>
</tr>
<tr>
<td>fisher</td>
<td>🐱️</td>
</tr>
<tr>
<td>mink</td>
<td>🐿️</td>
</tr>
<tr>
<td>canid</td>
<td>🦊</td>
</tr>
<tr>
<td>salamander</td>
<td>🐸</td>
</tr>
<tr>
<td>frog</td>
<td>🐸️</td>
</tr>
<tr>
<td>squirrel</td>
<td>🦉</td>
</tr>
<tr>
<td>bird</td>
<td>🕷️</td>
</tr>
<tr>
<td>deer</td>
<td>🦌</td>
</tr>
<tr>
<td>gray fox</td>
<td>🦊</td>
</tr>
<tr>
<td>opossum</td>
<td>🐿️</td>
</tr>
<tr>
<td>rat</td>
<td>🐭</td>
</tr>
<tr>
<td>muskrat</td>
<td>🐭</td>
</tr>
<tr>
<td>skunk</td>
<td>🐾</td>
</tr>
<tr>
<td>mink or weasel</td>
<td>🐿️</td>
</tr>
<tr>
<td>snake</td>
<td>🐏</td>
</tr>
<tr>
<td>caterpillar</td>
<td>🌿</td>
</tr>
<tr>
<td>unknown</td>
<td>🤔</td>
</tr>
<tr>
<td>beaver</td>
<td>🐻️</td>
</tr>
<tr>
<td>otter</td>
<td>🐶️</td>
</tr>
</tbody>
</table>

### Existing Wildlife Tunnel

1.8 M * 2.4 M * 18M

[Image of a wildlife tunnel with animals]

[Image of a graph showing species crossings]
Species-based Method for Determining Need for wildlife crossing

1A. Are there any unique habitats that only exist on one side of road?  
   Yes → 2. Identify species that need access to this habitat, whether they would need to cross the road and what the expected crossing rates would be.

1B. Are there any rare species?  
   No → 3. Conduct analysis of habitat needs and movement patterns of rare species to determine expected crossing rates for this species.
   Yes → Community level analysis

4. Identify size of smallest parcel of interest, and compare to densities and home ranges of local species to determine appropriate scale of analysis for each species
   Metapopulation → Population → Individual

5. Monitor current crossing rates of species

6. Are current crossing rates sufficient?  
   a few per generation → Yes → 7. Would reducing roadkill mortality without increasing road permeability be sufficient to maintain populations?
   a few per breeding cycle → No → Additional passage structures may be needed
   a few per month → No

7. Fencing may be the best solution
Route 2 Highway is Not a Barrier for:

Questions persist about:

Not Detected in Study Area:
Cultural Landscape Context

- Internationally Significant
- American Revolution, Minute Man National Historic Park
- Walden Pond and Walden Woods
- Birthplace of Transcendentalism, American Environmentalism Ralph Waldo Emerson, Henry David Thoreau
Pedestrian/Trail Use

- Extensive Local Trail Systems
- Bay Circuit Regional Trail
Considerations for Combined Crossings

Box 2. Considerations for Combined Human-Wildlife Crossing Structures

Locational-Context Considerations
(1) Siting in the landscape context
(2) Drift fencing (to guide wildlife to the crossing)
(3) Integration with roadside/landscape context (vegetation, topography, moisture)

Specific Design Considerations
*Overpasses*: shape (hourglass, straight), length, width, vegetation cover, soil depth, side walls/fencing, target species/species expected, other users (pedestrians, equestrian, bicyclists) monitoring
*Underpasses*: openness (height/width/length), substrate, other users (pedestrians, equestrian, bicyclists) monitoring
Alternative Walden Passage Locations

Walden Passage Feasibility Study Area

Sudbury River

Goose Pond

Fitchburg RR Underpass

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January 2007
Alternative 1:
**Sudbury River Bridge Crossing**
- New elevated bridge
- Provide shore passage beneath new bridge (Low and high water stages)
- Make people aware of the river and wildlife, connect to new potential trails

*Existing Sudbury River Bridge*

*Proposed Sudbury River Crossing*
Alternative 2:
Fitchburg Railroad Underpass

- Expand existing underpass
- Separate pedestrian trail from Railroad
- Wildlife already using with minimal conflicts: deer, coyote, fox, moose
- Historic significance of Thoreau’s “Deep Cut Woods”
Alternative 3: Goose Pond Overpass

- New combined overpass (Ecoduct)
- Well-located for pedestrian linkages (Walden Pond/Walden Woods)
- Wildlife already using nearby tunnel
- High visibility, symbolic and public educational value

Potential wildlife/pedestrian overpass crossing

Crossing location: Route 2

Recommended crossing

- Reduced width
- Arboreal species
- Significant trail linkage
# Evaluation of Alternatives

<table>
<thead>
<tr>
<th>Issue/Item/Criteria</th>
<th>Sudbury River</th>
<th>Railroad Underpass</th>
<th>Goose Pond: Brister’s Hill</th>
<th>No-build</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passage Type</td>
<td>Underpass incorporated into Rte 2 –Sudbury River bridge (needs structure improvement)</td>
<td>Underpass, widening of existing structure on one or two sides of RR tracks</td>
<td>Overpass, with low native vegetation, earth berms and overhead structure.</td>
<td>No new structure, the four existing mitigation tunnels will remain.</td>
</tr>
<tr>
<td>Highway Safety</td>
<td>Not visible to drivers, no impact.</td>
<td>Not visible to drivers, no impact</td>
<td>Visible from Rte 2, sited away from Crosby’s corner realignment, and Rte. 126 crossing.</td>
<td>No impact on current situation.</td>
</tr>
<tr>
<td>Wildlife Use</td>
<td>Potential to enhance regional habitat connectivity (Great Meadows NWR), especially for larger species that do not presently use the existing tunnels in the area.</td>
<td>Existing wildlife crossing use at location likely to continue, crossing possibly to accommodate additional species. Wildlife could become trapped along railroad tracks due to safety walls/fencing.</td>
<td>Potential use by species currently in the study area, possible use by arboreal species, less beneficial for reptiles, amphibians.</td>
<td>Existing wildlife species will continue to use existing tunnels, future land use change in study area may increase fragmentation.</td>
</tr>
<tr>
<td>Trail Connections</td>
<td>Few existing trails in vicinity, difficult to build new trails due to flooding/wetlands.</td>
<td>Linkage with Walden Pond St. Reservation and Concord Carlisle High School, improved safety for current (informal) users. Potential for rerouting Bay Circuit Trail through underpass.</td>
<td>Linkages with Goose Pond, Walden Reservation, Bay Circuit, Brister’s Hill, and Emerson-Thoreau Amble.</td>
<td>Continued informal use of RR underpass, some existing trails cross Rte 2, continued human use of wildlife tunnels likely.</td>
</tr>
<tr>
<td>Evaluation Criteria</td>
<td>Sudbury River</td>
<td>Railroad Underpass</td>
<td>Goose Pond</td>
<td>No-build</td>
</tr>
<tr>
<td>-------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Cultural Landscape Interpretation</td>
<td>Low potential, access for pedestrians limited</td>
<td>Medium potential, Thoreau’s historic route to town, access to Walden</td>
<td>High potential, Walden Pond, Brister’s Hill, Emerson-Thoreau Amble, proximity (potential link to Minute Man NHP)</td>
<td>No new potential for cultural landscape interpretation</td>
</tr>
<tr>
<td>Cost</td>
<td>$8-10 Million to replace the entire bridge with $0.5-1 Million additional to provide wildlife crossings beneath the bridge.</td>
<td>$5-8 Million, depending on replacement of 1 or both abutments.</td>
<td>$2-6 Million, depending on dimensions and design.</td>
<td>No cost</td>
</tr>
<tr>
<td>Archaeological Resources</td>
<td>Potential impacts due to presence of Native American Shell middens in vicinity</td>
<td>No known impacts</td>
<td>No known impacts</td>
<td>No known impacts</td>
</tr>
<tr>
<td>Neighborhood Impacts</td>
<td>Potential impacts: Southfield Rd, Elisonore St., Coolidge Rd.</td>
<td>No neighborhoods affected</td>
<td>Potential for parking impacts on Sandy Pond Road neighborhoods, Concord and Lincoln.</td>
<td>No impacts</td>
</tr>
<tr>
<td>Walden Pond Reservation Access</td>
<td>No impact</td>
<td>Could affect northwestern access control from RR tracks</td>
<td>Little or no increase in pedestrian access expected</td>
<td>No impact</td>
</tr>
<tr>
<td>Potential national landmark</td>
<td>Low, not visible</td>
<td>Low, not visible</td>
<td>High, prominent location, overpass</td>
<td>No potential</td>
</tr>
</tbody>
</table>
Conclusions

• Transdisciplinary Approach
• Sound Monitoring data essential
• Transparency of Process
• Recommended Goose Pond Combined Crossing
• Significant multifunctional benefits for recreation/cultural landscape tourism
• Opportunity for experiments, monitoring and public education
• Model for a multi-functional solution to address a common barrier to connectivity
• Now under consideration for funding
Resources and Contacts

- Paper Included in TRB Compendium of Papers DVD
- Project website and final report: www.umass.edu/waldenpassage/
- Jack Ahern  jfa@larp.umass.edu, http://www.people.umass.edu/jfa

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