NCHRP 25-25, Task 113

ROAD PASSAGES AND BARRIERS FOR SMALL TERRESTRIAL WILDLIFE SPECIES

CASE STUDY 7, CONCRETE BARRIERS FOR SMALL ANIMALS

Prepared for:

AASHTO Committee on Environment and Sustainability

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SPECIAL NOTE: This report **IS NOT** an official publication of the National Cooperative Highway Research Program, Transportation Research Board, National Research Council, or The National Academies.

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The project was managed by Ann Hartell, NCHRP senior program officer.

DISCLAIMER

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Likely the highest cost of barrier installation is installing it more than once or providing continual maintenance because of poor design or installation. Incorrect design specifications or inadequate installation increase maintenance costs or require barrier replacements. Replacement costs are considerable because the existing barrier needs to be removed and disposed of to allow a new barrier to be installed. This case study outlines an installation example of a permanent concrete barrier with two concrete bottomless underpasses for amphibians. The carefully selected design and installation has required minimal maintenance, and amphibians are successfully crossing the road.

The project was initiated by the Lewis Creek Association that worked with the Town of Monkton to fund completion of drawings completed for the design stage. James Andrews with Vermont Reptile and Amphibian Atlas and Chris Slesar with the Vermont Agency of Transportation provided expertise. The project was funded by a Transportation Enhancement Grant and U.S. Fish Wildlife Services State Wildlife Grant and with private grants and public funding campaigns. The site was designated an important amphibian sensitive area by the Atlas because of the species diversity and the road bisected breeding and overwintering habitat.

Name Road: Monkton-Vergennes Road, average annual daily traffic of (AADT) approximately 2,000 vehicles

Project Type: Existing road

Location: Amphibians crossed along a 0.8-mile section of the Monkton-Vergennes Road with AADT of approximately 2,000 vehicles. The road is located in Addison County, Vermont, and is maintained by the Town of Monkton. Funding was not available to mitigate along the entire road section; therefore, the project team selected the two road segments with the highest concentrations of amphibian crossings and installed two crossing structures with associated guide-walls.

Construction Year: Discussions for mitigation began with the Monkton Conservation Commission in 2005. Construction took place between August and November 2015.

Total Design, Construction, Oversight Costs: $342,397

- $55,000 for each amphibian crossing structure (materials and installation)
- $30.00 per linear foot of concrete barrier wall (materials and installation)

Crossing Structure Specifications: Pre-cast bottomless box culverts 8 feet high by 8 feet wide (2.4 meters high by 2.4 meters wide) with a natural substrate floor that mimicked the natural contours of the landscape but were raised enough so that water from the ditches did not drain through them. When the amphibians are walking downhill to the wetlands, they cross through a ditch and up a slight rise before the downward slope is continued through the culvert. Drainage from the road is maintained with drainage ditches and other below grade drainage culverts, so that the two amphibian crossing structures remain dry. To allow light, two slotted manhole covers were installed in the ceilings of each culvert.

Barrier Specifications: Keyed waste blocks with lifting loops were used that were not as expensive as the concrete used for crossing structures (Figure 3). These structures are 2 feet high by 2 feet deep by 4 feet long. Drainage from under and behind the blocks was built in to prevent movement of the blocks during the winter. The southernmost crossing structure has 228 feet of guide-walls on the upland side of the road and 398 linear feet on the wetland side. The northernmost crossing structure has 243 feet of guide-walls on the upland side of the road and 384 feet on the wetland side of the road All guide-wall ends have a semi-circle of hard plastic to turn amphibians back toward the tunnel crossing area. As constructed, 809 linear feet of walls and tunnels intercept moving amphibians. The mitigated sections account for 19.15% of the entire 0.8-mile crossing area.

Figure 3: *Installation (top) and completion (bottom) of a barrier wall for amphibians made from concrete waste blocks on Monkton Road, Vermont. Photo Credit: Chris Slesar, Monkton Conservation Commission.*

Target Species: Rare blue-spotted salamanders (*Ambystoma laterale*) and spotted salamanders (*Ambystoma maculatum*), which are both Species of Greatest Conservation Need in Vermont as well as spring peeper, wood frog, and eastern newt. Snakes are also subject to road-kill when crossing from the rocky uplands to summer foraging areas along the margins of the swamp.

Modifications to Barrier Structures for Target Species:

- Installed a drainage mechanism behind and under concrete walls (Figure 4)
- Added a plastic high density polyethylene (HDPE) curved piece at the fence-end to redirect amphibians away from road (Figure 5)
- Added cover objects every 6 feet along the barrier wall and in the tunnels
- Inserted slotted manhole covers at the top to allow additional light (Figure 6 and Figure 7)
- Used foam to seal off cracks between concrete blocks in the guide-wall

Figure 4: *Concrete guide-walls used to funnel amphibians into the bottomless underpass and drainage pipes (red circle) inserted underneath the guide-wall. Photo Credit: Chris Slesar, Monkton Conservation Commission.*

Figure 5: *Plastic corrugated HDPE pipe used at barrier end to redirect amphibians away from the road. Photo Credit: Chris Slesar, Monkton Conservation Commission.*

Figure 6: *Light shining into underpass through manhole cover. Note sandy bottom. Photo Credit: Stephen Pilcher with permission from James Andrews, Vermont Reptile and Amphibian Atlas.*

Figure 7: *Manhole covers on-top of the road to allow light into the underpass. Chris Slesar, Monkton Conservation Commission.*

Habitat: Huizenga Swamp and vernal pool amphibian breeding habitat within a large local farm and steep rocky upland hardwood forest for overwintering habitat owned by forestry company. The two habitats are separated by the road.

Effectiveness in Providing Connectivity: Monitored the underpasses with cameras to take pictures every minute from dusk to dawn during the spring migration period. Both before and after mitigation installation. Shown passage by thousands of amphibians and many small mammal species (Figure 8).

Figure 8: *Figure shows the inside of the underpass with cover objects; it is actually a video (.gif) that shows amphibians moving through. Video Credit: Chris Slesar, Monkton Conservation Commission.*

Effectiveness in Reducing Road-kill: Roadkill still occurs at each guide-wall end; however, deaths are far fewer than the thousands of amphibians that were road-killed annually prior to mitigation. Prior to mitigation, at least 50% of the amphibians found on the road surface during surveys were dead even when volunteers were helping the animals cross the road.

Conclusions: Concrete waste blocks were effective at guiding animals to the underpasses and reducing amphibian road mortality. Furthermore, the barrier required no ongoing maintenance other than vegetation clearing and trash removal. The minimal maintenance costs will likely offset the material costs in a short time.

Although animals are using the crossing structures, road-kill still occurs, primarily where the barrier wall is not present on both sides of the road. Also, the question remains regarding how many of the amphibians turn toward or away from the crossing structure when they reach the barrier. Furthermore, the effectiveness of the plastic turn-around at the fence end is presently unknown.

Alternative Designs: A concrete culvert trench system was installed along a rural road near the small city of Yverdon-les-Bains in Switzerland in 1992. The system was installed for Common toad (*Bufo bufo*) and Common frog (*Rana temporaria*) where the road separated wetlands from forests (Jolivet et al. 2008) (Figure 9).

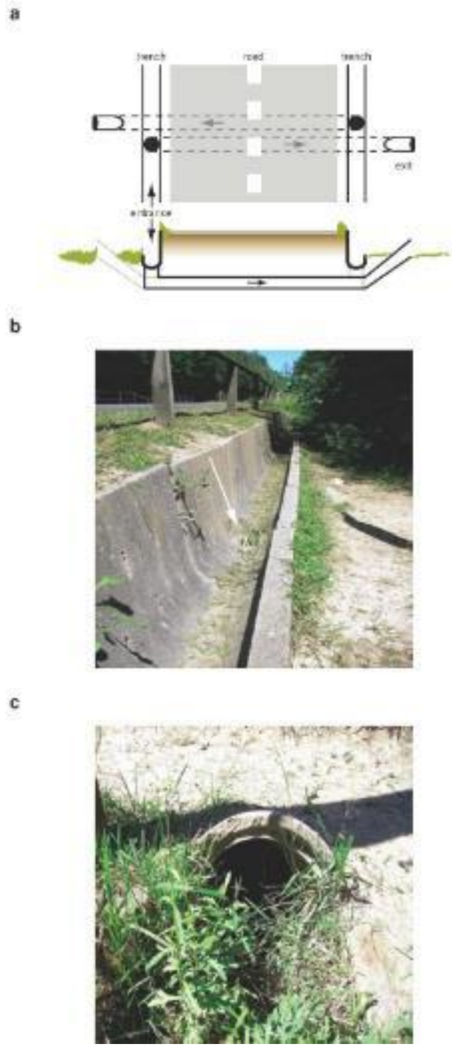

Figure 9: *Details of the amphibian tunnels. (A) Schematic of the installation on each side of the road; (B) A concrete trench used to convey water and prevent amphibians from accessing the road; and (C) The trench will lead the amphibians to a small tunnel that passes on both sides of the road and under the trench on the opposite side. Photo obtained from Jolivet et al. (2008).*

Supporting Repository Materials: VT-6 **(**Monkton STP EH08(4)-FinalPlans (2012_01_06) (2).pdf Technical drawings); VT-1-7 and VT-9-14 (various images)

REFERENCES

Jolivet, R., M. Antoniazza, C. Strehler-Perrin, and A. Gander. 2008. Impact of road mitigation measures on amphibian populations: A stage-class population mathematical model. arXiv preprint arXiv:0806.4449.

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