NCHRP 25-25, Task 113

ROAD PASSAGES AND BARRIERS FOR SMALL TERRESTRIAL WILDLIFE SPECIES

SUMMARY CONSIDERATIONS FOR DESIGNATED UNDERPASSES

Prepared for:

AASHTO Committee on Environment and Sustainability

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DISCLAIMER

USE OF DESIGNATED UNDERPASSES BY SMALL ANIMAL SPECIES

This is a summary of considerations for designing an underpass, enclosed structures under the road, that are less than 3 meters (m) in width, height, and diameter that are specifically designed and located for safe passage of small animal species to the other side of the road. This summary is based on a literature review, survey report, materials in the repository, and the knowledge and experience of the authors. The literature review and survey report are available as separate documents produced for this project (NCHRP 25-25, Task 113).

A. GENERAL CONSIDERATIONS

General considerations include design, operation, and maintenance for underpasses for which small animal species were explicitly listed as one of the target species or species groups. This means that the location of the structure, structure type, structure dimensions, and habitat near or adjacent to the structure were at least partially designed for small animal species, specifically amphibians, reptiles, or mammal species smaller than a coyote (*Canis latrans*).

In most cases, exclusion barriers and/or funneling guide-walls are required to direct small animals to existing structures; therefore, the adjacent terrain and road features must also be evaluated for this installation. Considerations for these structures are found in the 'Barrier' document.

Characteristics:

Location: The underpass (like other structures designated for wildlife) is (or should be) located where improved connectivity for the target species would have the greatest benefit for survival of the population. This type of design is fundamentally different from modifying an existing structure that was originally located, designed, and built for other purposes, other than the connectivity needs for the target species.

Structure Type: Underpass structures considered here are equal to or less than 3 m in all diameter, height, and width specifications. Structures vary in shape from round, elliptical, arched, or box and are made of materials that range from metals (e.g., corrugated steel pipe), plastics (e.g., high-density polyethylene), polyvinyl chloride, or cement. In most cases, these structures have a bottom but, in some cases, arched culverts may be installed on footings to maintain natural substrate under the road. When structures have a bottom, they may be buried into the ground, and natural substrate may be placed on top.

Some small animal species move very slowly, and to move across the landscape they may need continuous suitable habitat with similar soil, hydrology, light, temperature, and vegetation. Although continuous habitat is most easily provided with an overpass, several design features can be integrated with an underpass structure that partially compensate for loss of openness, including:

- Oversize the structure to maximize light and air at the entrance of the structure and allow for multiple design features such as shelving for multiple species and animal groups.
- Keep structure length to a minimum, e.g., consider two structures for wide roads with a median.
- Include openings such as manholes or grates along the structure.
- Maintain natural substrate on the bottom of the structure so animals move through natural terrestrial or aquatic environment, e.g., bury culvert, line culvert with substrate, or construct arched culvert (bottomless).

- Provide cover objects such as blocks or woody debris for resting or hiding.
- Provide dry rest areas, e.g., rocks, especially for amphibians moving upstream.
- Provide dry crossing areas, e.g., shelving above high water levels for terrestrial animals.
- Create openings in the top, e.g., a grate or engineered open slots (structure must be at grade with road).

Maintenance: The functionality of designated crossing structures can be compromised by erosion, flooding, and overgrown vegetation and debris blocking the entrances (Expert survey report). In the literature review, common issues were garbage and debris blocking passage in the smaller tunnels. In some cases, screens may be added to culvert entrances to deter debris and beavers from damming or plugging culverts. Because these screens may trap other wildlife and block animals from entering through culverts, thought must be given to the design, e.g., mesh size or spacing of rods. Open-slotted or open-grate tunnels may accumulate chemicals such as salts and metals from run-off from road and require 'wash-outs' with hose (White et al. 2017). In some cases, heavy storm events may also wash out tunnels.

Species-specific Considerations: Various designated underpasses have been installed for small animals as follows:

- Box culverts are on average from 2.4-m wide by 1.8-m high and have been installed and shown use by amphibians, reptiles, and small mammals (see Literature Review, Table 5).
- Open-slotted tunnels are primarily installed and considered effective for amphibians (Case Study 4), and have recently been installed for snakes and freshwater turtles in Ontario, Canada (50-centimeters [cm] high by 50-cm wide; Figure 1).

Figure 1: *A Snapping turtle exiting an open-slot tunnel on the Long Point Causeway. Photo Credit: Long Point World Biosphere Reserve.*

- Open-bottom tunnels are installed for all three animal groups (amphibians, reptiles, and small mammals), but are not as commonly installed as the other tunnel types (6.1% of the time, see Literature Review, Table 5). A specialized open-bottom, open-top tunnel was installed for Massasauga Rattlesnakes in Ontario, Canada (Case Study 5) and for amphibians in Monkton, Vermont (Case Study 6).
- Round or pipe culverts (corrugated steel piple, pipe, or elliptical) that range from 0.2 to 1.2 m diameter, have been installed for snakes, amphibians, and small mammals (Case Study 2); however, in wet areas, these structures should be designed accordingly to reduce heavy flow and flooding during amphibian migrations.

REFERENCES

White, K.J., W.M. Mayes, and S.O. Petrovan. 2017. Identifying pathways of exposure to highway pollutants in great crested newt (*Triturus cristatus*) road mitigation tunnels. Water and Environment Journal 31:310–316.