



moving FORWARD

FALL 2011

A quarterly review of news and information about Pennsylvania local roads.

Emergency Bridge Shoring Practices

by Clay Naito, Associate Professor, Lehigh University

On this bridge, the cyclic loading caused by traffic eventually resulted in fatigue cracking of the cantilevered beam-top connection. To ensure that the beam would not fail, temporary shoring was placed between the deck stringer and the main bridge girder.

Pennsylvania is home to approximately 25,000 state-owned and more than 6,000 locally owned bridges. More than 50 years old on average, these bridges face a harsh winter environment and are subject to significant age and weather-related damage. No wonder Pennsylvania leads the nation with more than 5,000 structurally deficient bridges.

Although the vast majority of the systems are safe, at times it becomes necessary to install temporary shoring to prevent failure of a bridge component. Proper design and installation of shoring should be carefully considered; the shoring

must be approved by a licensed professional engineer. When proper engineering oversight is not readily available, there may be a tendency to install the shoring anyway with the notion that a temporary fix is better than no action at all. Unfortunately, this is not always the reality.

Bridge systems are designed to support the weight of pedestrians, traffic, the self-weight of the bridge, and other loads caused by such environmental influences as temperature variations, snow, wind, and earthquakes. These loads can be quite substantial; a typical 50-foot-long, 3-foot-wide precast concrete box beam might weigh on the order of 30,000 pounds. Add on possible traffic loads, and the demands on the beam could increase to more than 50,000 pounds. If the supports for a beam this size are compromised,



Figure 1: Poorly executed shoring of box beams

temporary shoring may become necessary to prevent a possible local failure of a beam.

Figure 1 shows a bridge where the temporary wood shoring has not been properly executed. Without doing any calculations, one could envision the support under the right-most beam is at risk for failure, which would result in the beam rotating off of the wood shoring to drop to the abutment below. Such a scenario would endanger drivers on the bridge and any traffic below.

For the temporary shoring to work in this case, the corners of the wood blocks must be able to support 50,000 pounds. To safely support the beams against possible failure, the shoring should be installed so that the beams remain stable, the shoring does not walk out of position from traffic loads, and the shoring is sized to support the full demands for which the original supports were designed.

Failure of portions of bridges may require shoring to be braced back to the main structure. This type



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Potential Changes to Pavement Marking Retroreflectivity

by Cory H. Greene, P.E., PTOE, Pennoni Associates

Have you ever been driving at night and are startled when the headlights of your car shine on someone jogging with reflective clothing or the reflectors on a bicycle near the road? If you have, then chances are you experienced “retroreflectivity” in action. Simply put, retroreflectivity is the ability of a surface to return light back to the source.

So, what does retroreflectivity have to do with pavement markings? Similar to traffic signs, surface markings are designed to return a certain amount of light back to the source; in the context of driving, the source of light is a vehicle’s headlights. If traffic signs and pavement markings can return a certain amount of light back toward a vehicle, then the driver is able to see better during low-light and nighttime conditions. Better perception and advanced warning of the roadway during such conditions can improve safety for all road users.

Proposed Minimum Retroreflectivity Levels

Pavement markings are imbedded with tiny glass beads that provide retroreflective properties and improve visibility for motorists driving under low-light and nighttime conditions. Over time, the glass beads become worn down and do not reflect the same amount of light as when they were new. When the glass beads are so worn down that they do not reflect a certain minimum amount of light, the inherent safety benefit is lost.



Pavement markings are imbedded with tiny glass beads that provide retroreflective properties and improve visibility for motorists driving under low-light and nighttime conditions.

For this reason, the Federal Highway Administration (FHWA) has proposed a new standard for maintaining pavement marking retroreflectivity. The 2009 Manual on Uniform Traffic Control Devices (MUTCD) already contains information on maintaining minimum retroreflectivity for signs, but there is no guidance for pavement markings. Section 3A.03 of the 2009 MUTCD simply states: “Maintaining Minimum Pavement Marking Retroreflectivity (This section is reserved for future text based on FHWA rulemaking.)”

On April 22, 2010, the FHWA filed a Notice of Proposed Amendment that would include minimum standards in Revision 1 to the 2009 edition of the MUTCD. When Revision 1 will be adopted is uncertain at this time. FHWA has only indicated that comments submitted to the docket in response to the proposal are still being evaluated for consideration of next steps.

In any event, the chances are good that some form of minimum retroreflectivity will be adopted and required for pavement markings, as is currently required for signs.

Under the proposed change, three categories of pavement markings related to retroreflectivity will be established:

- 1) Not required to be retroreflective.
- 2) Required to be retroreflective but not subject to minimum requirements.
- 3) Subject to minimum retroreflectivity requirements.

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Table 3A-1. Minimum Maintained Retroreflectivity Levels¹ for Longitudinal Pavement Markings

	Posted Speed (mph)		
	≤30	35–50	≥55
Two-lane roads with center line markings only ²	n/a	100	250
All other roads ²	n/a	50	100

1. Measured at standard 30-m geometry in units of mcd/m²/lux
 2. Exceptions:
 A. When RRPMS supplement or substitute for a longitudinal line (see Section 3B.13 and 3B.14), minimum pavement marking retroreflectivity levels are not applicable as long as the RRPMS are maintained so that at least 3 are visible from any position along that line during nighttime conditions.
 B. When continuous roadway lighting assures that the markings are visible, minimum pavement marking retroreflectivity levels are not applicable.

Minimum maintained retroreflectivity levels proposed for Revision 1 of the 2009 MUTCD.

A retroreflectorimeter may be used to measure retroreflectivity.

In general, the items that may become subject to minimum retroreflectivity requirements are white and yellow longitudinal lines required or recommended in the MUTCD, such as edge lines, centerlines, lane lines, and channelizing lines. (More detailed information can be found through the additional resources listing at the end of this article.)



Measuring Retroreflectivity of Pavement Markings

FHWA has developed six different options for maintaining minimum levels of retroreflectivity:

- 1) Calibrated nighttime inspection – requires a trained inspector.
- 2) Consistent parameter nighttime inspection – requires a trained inspector.
- 3) Measured retroreflectivity – uses a retroreflectorimeter.
- 4) Service life based on monitored markings – requires monitoring and inspection based on performance of similar in-service markings.
- 5) Blanket replacement – requires replacement of pavement markings at certain shortest-life type intervals.
- 6) Other methods – requires an engineering study to determine when markings should be replaced.

Agencies can decide for themselves which method best matches their conditions.

Depending upon the adoption of Revision 1 of the 2009 MUTCD (officially known as “Final Rule”), the following compliance dates are proposed:

- Four years from the date of Final Rule for implementation and continued use of a maintenance method that is designed to maintain pavement marking retroreflectivity at or above the established minimum levels; and
- Six years from the date of Final Rule for replacement of pavement marking that are identified using the maintenance method as failing to meet the established minimum levels.

Compliance with proposed minimum retroreflective standards on roads within Pennsylvania is expected. The question is when? Although PennDOT will likely adopt the 2009 version of the MUTCD in November 2011, compliance with these retroreflectivity standards will not be required until the Final Rule of the MUTCD is adopted by the FHWA.

In the meantime, municipalities do not have to wait for the Final Rule on minimum standards for pavement marking retroreflectivity to start complying with these potential requirements. After all, the purpose of the Final Rule is to improve safety under low-light and

If traffic signs and pavement markings can return a certain amount of light back toward a vehicle, then the driver is able to see better during low-light and nighttime conditions.

nighttime conditions for all motorists. This can be accomplished by developing an asset management system, developing plans for inspection, acquiring tools, and vetting potential contractors. Such steps can move your municipality closer to compliance with the proposed standards while improving safety and minimizing liability at the same time. ♦

Pavement Marking Retroreflectivity Resources

- Summary of Proposed Standard
http://safety.fhwa.dot.gov/roadway_dept/night_visib/fhwasa10015/
- FHWA Nighttime Visibility Safety website
http://safety.fhwa.dot.gov/roadway_dept/night_visib
- Notice of Proposed Amendment
<http://edocket.access.gpo.gov/2010/2010-9294.htm>
- Proposed MUTCD text
http://mutcd.fhwa.dot.gov/knowledge/proposed09mutcdrev1/mutcd2009_pmretro.htm



The Every Day Counts Initiative

EDC is designed to identify and deploy innovation aimed at shortening project delivery, enhancing the safety of our roadways, and protecting the environment.

Please visit the website for more information:
www.fhwa.dot.gov/everydaycounts

Quality Control for Field-Placed Concrete

by Clay Naito, Associate Professor, Lehigh University

The quality of concrete placed in the field must be properly assessed to ensure both the performance and longevity of the structure being built. So that proper quality is achieved, concrete should be sampled at the construction site using standard testing methods.

For Pennsylvania Department of Transportation projects, execution of the test methods requires a certified field-testing technician. To become certified as a technician in Pennsylvania, a person must successfully complete the American Concrete Institute Concrete Field Testing Technician Grade I course and the PennDOT Concrete Field Testing Technician Certification Program.

An overview of the testing methods and their use is presented here to provide general guidance to field operations. Specific details about the certification program can be found in PennDOT Publication 536.

Starts with Proper Mixing

Quality control starts with mixing of the constituents. Concrete commonly consists of fine and coarse aggregates, Portland cement, and water. The proper relative quantities of each constituent are determined using standardized procedures and are often verified using smaller test batches prior to approval for field use. The mix design process accounts for the desired strength required for the concrete, the workability needed to place the concrete, and the proper air entrainment to survive freezing and thawing during the Pennsylvania winter season. Each of these properties can be examined through tests on the concrete both in its plastic state and after it has hardened.

Testing Methods

Testing methods follow the requirements of ASTM International, formerly known as the American Society for Testing and Materials. The use of ASTM standard test methods ensures that repeatable and reproducible results are achieved. Essentially, this means that a properly executed test on a sample of concrete would have the same result regardless of which technician or site it was conducted at. ASTM provides requirements for determination of temperature, slump, unit weight, and air content. In addition, methods are provided for proper sampling and fabrication of concrete test specimens in the field.

Strength assessment—Concrete strength is the most critical characteristic when considering structural performance. Concrete has both a tension and a compression strength associated with it. In most cases, however, the tension strength is low and

is neglected during design. To accommodate tension in a concrete member, steel reinforcement is added.

Compression strength is typically defined in terms of the concrete's strength at an age of 28 days after placement. PennDOT defines a number of classes of concrete based on application. Class AAA is used for bridge decks and is required to have a compressive strength of 4,000 psi at 28 days (i.e., one square inch of concrete supports a load of 4,000 pounds); class AA is used for paving and has a required minimum strength of 3,500 psi at 28 days.

Strength is most sensitive to the water-cement ratio (i.e., the weight of water divided by the weight of cement), which is part of the mix design and which typically ranges from 0.4 to 0.5 for standard ready-mix concrete. Addition of water on the job site can reduce the water-cement ratio and severely affect the strength of the concrete. Any additions should be approved by the concrete supplier. Strength is assessed through fabrication and testing of concrete cylinders fabricated during placement of the concrete at the job site. ASTM standards are followed for fabrication and curing (C31) and testing of cylinders (C39).

Slump test – Workability refers to the ability of the plastic concrete to flow. This is commonly assessed by a standardized slump test (ASTM C143). The method requires placement of three layers of plastic concrete into a standard 12-inch-tall slump cone. Each layer is tamped 25 times, the top surface is floated, and the area around the cone is cleared. Once this is done, the cone is slowly lifted upward. Without the support of the cone, the plastic concrete will slump from its original 12-inch height to a shorter height.

The slump is the measurement of the change in height. A stiff concrete will have a small slump (i.e., 1 inch) while a concrete with easy flow will have a large slump (6 to 8 inches). The slump is affected

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A) Fill cylinder in equal lifts

The concrete cylinders used to test concrete strength are fabricated on a site.

B) Rod cylinder 25 times

C) Finish cylinder surface

Bartering Has Its Benefits

Agility program allows municipalities to stretch their resources

During this period of limited revenue for commonwealth operations, PennDOT's Agility Program gains even more importance as a tool for PennDOT field staff and municipal officials to use to address budget shortfalls. Through the Agility Program, PennDOT and thousands of municipalities and other governmental organizations have formed partnerships to exchange transportation-related services with each other. By participating in what is essentially "bartering" of their services and equipment, Agility partners are able to stretch their resources while increasing their productivity and improving their relationships and communications at all levels.

Currently, municipalities comprise about 90 percent of all Agility partners with about 91 percent of these participants classified as repeat customers. (The other 9 percent are first-time users of the program.) Since 2007, municipalities have received significant amounts of PennDOT services, including 3,517 tons of asphalt paving, 835 lane miles of striped local roads, and hundreds of repaired lane miles that were fixed with 234,000 gallons of sealant. In return, municipalities have mowed more than 4,000 acres of PennDOT-owned medians and rights-of-way statewide and have performed a variety of other services for the department.

This past winter, as a way of keeping more money in the budget, PennDOT converted some of its "paid" winter contracts with municipalities to Agility agreements. Under this arrangement, municipalities receive PennDOT services instead of cash for performing winter services on state roads. Through this new approach to winter contracts, municipalities and PennDOT are able to accomplish their work for less money while ensuring that the transportation network stays as safe as possible for the motoring public.

The Agility Program also allows trading to cross county lines so that a county maintenance office may exchange services with a partner



PennDOT provides crack sealing as an Agility exchange at the Blair County Airport.

located outside of the county. This program change has increased the number and variety of potential service exchanges for everyone.

To exchange services through Agility, each party must sign an Agility agreement, which is essentially a contract between PennDOT and the partner. Each party must believe that it makes good business sense for its organization to be involved in a service exchange. To determine this, the party must decide if work conducted through an Agility agreement would be completed at a quicker pace, with a better result, and more economically than if the partner performed the work itself.

To learn more about the Agility Program, contact PennDOT's Agility Division at 717-705-1333 or www.dot.state.pa.us (select "PennDOT Organizations," "Bureaus & Offices," and then "Agility Division"). ♦

Concrete

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by the water-cement ratio, aggregate size, and air content. For most construction applications, concrete can be adequately placed with a slump from 1 to 4 inches.

Vibration methods—Proper consolidation of the concrete often requires vibration of the plastic concrete. This can be accomplished through immersion-type vibrators or form vibrators. In some cases, hand methods such as rodding or spading will be sufficient. The goal of the process is to provide adequate consolidation so that voids are eliminated. Excessive vibration can result in settlement of the aggregate, which can compromise the strength and durability of the hardened concrete.

Air assessment—Resistance to freezing, thawing, and deicing chemicals is achieved by the use of entrained air in the concrete.

Air entrainment creates closely spaced microscopic air voids in the concrete that allow freezing water to disperse in the hardened concrete without localized blowout. Air entrainment is achieved through the use of chemical admixtures or air-entraining Portland cement. Most PennDOT projects require air entrainment between 3.5 and 5.0 percent. The amount of air is assessed from the plastic concrete using ASTM C231 or ASTM C173. In addition, air content can be evaluated for existing structures by coring and optical examination of the internal surface in accordance with ASTM C457.

Quality concrete requires proper mix design and performance assessment using ASTM test methods. Further details on the methods and requirements for PennDOT projects are available in LTAP technical sheet #149. ♦

Managing Roadkill

by Bob Garrett, Executive Assistant, PennDOT

Roadkill. If you're a municipal official, roadkill is not someone else's problem; it's yours. Roadkill is one of the most unpleasant tasks that municipal road and street managers and their supervisors have to deal with. But it won't go away on its own. Roadkill-related crashes account for about one-quarter of all crashes in our state and a tenth of all road-related fatalities.

The policy on how and when to deal with roadkill on Pennsylvania's public roadways is found in the PennDOT Maintenance Manual, also known as Publication 23. Municipalities should have a copy of this manual available as a reference. It can be downloaded from the PennDOT website at <ftp://ftp.dot.state.pa.us/public/PubsForms/Publications> or purchased at PennDOT's Publications Sales office. The policy on managing dead animals also covers all foreign objects, such as rocks and dirt from slides and objects that might have blown out of improperly covered vehicles onto the roadway.

Foremost, the policy employs safety and common sense. When removing a dead animal or other object from the roadway, road crew members must remember that they're actually setting up a temporary work zone. No matter how short the duration of the cleanup, even if less than a minute, safety must be given top priority.

Workers must wear safety vests with full reflectivity and a helmet. When handling a dead animal that could be diseased or in some state of decomposition, crew members should protect themselves by wearing work gloves and full arm-length rubber liners.

If a roadkill involves a game species, municipal officials should contact their local wildlife conservation officer. "Further, if the roadkill is some type of protected animal or reptile," says Jerry Feaser of the Pennsylvania Game Commission, "it's absolutely critical that the municipality attempt to preserve the carcass and contact the Game Commission or the Fish and Boat Commission." Protected species include all birds of prey, Indiana bats, flying squirrels, and certain turtles and snakes.

A Game Commission research project a few years ago determined that the state's roadkill are made up of 80 percent mammals, 15 percent birds, 4 percent reptiles and amphibians, and 1 percent indiscernible.

PennDOT uses contractors to remove large mammals, such as deer, bear, and elk, from state-owned roadways. Most dead animal removal reports are made via the 1-800-FIX-ROAD system. If your municipality doesn't already have a similar call-in system that can be used for dead animal reports, it should consider adding this service.

Roadkill:
The remains of an animal that has been killed on a road by a motor vehicle.

Bridge Shoring

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of temporary shoring is illustrated on page 1. For this system, the cyclic loading caused by traffic eventually resulted in fatigue cracking of the cantilevered beam-top connection. To ensure that the beam would not fail, temporary shoring was placed between the deck stringer and the main bridge girder. To make sure the shoring performs, the designer must check to see that the wood braces do not buckle under the load and that the forces generated by the brace do not cause damage to another portion of the bridge.

Predesigned shoring systems can be installed on bridges with relative ease. These systems allow for safe continued operation of bridges even when significant damage is identified. A few examples are illustrated in Figure 2.

Temporary shoring of bridges is complex and should not be attempted without engineering support. Improper shoring can result in a false sense of security that may endanger drivers and pedestrians. Look for more information on this topic in an upcoming LTAP technical sheet. ♦



Figure 2: Examples of premanufactured shoring systems

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Do you have the Safety Edge?

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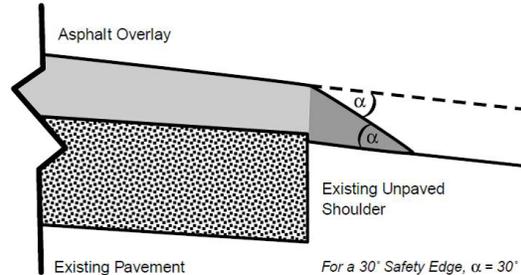
Want to incorporate a small, low-cost change into your roadway paving that could save lives in your community? Who wouldn't want to? With primary responsibility for your community's roadways, you are constantly looking for ways to improve roadway safety, and Safety Edge is a great way to achieve this goal. Safety Edge is part of the Federal Highway Administration's new Every Day Counts initiative.

The Federal Highway Administration recommends the Safety Edge technique—particularly on two-lane, rural roads with unpaved shoulders. Safety Edge is a 30-degree angle applied at the edges of a roadway. The angled edge eliminates shear pavement drop-offs caused by berm erosion and makes it easier for drivers to correct their vehicle and reenter the roadway after running off the road. Studies show providing a 30-degree angled edge eliminates tire-scrubbing, making the pavement edge safer for drivers and cyclists to recover after encountering a pavement edge drop-off.

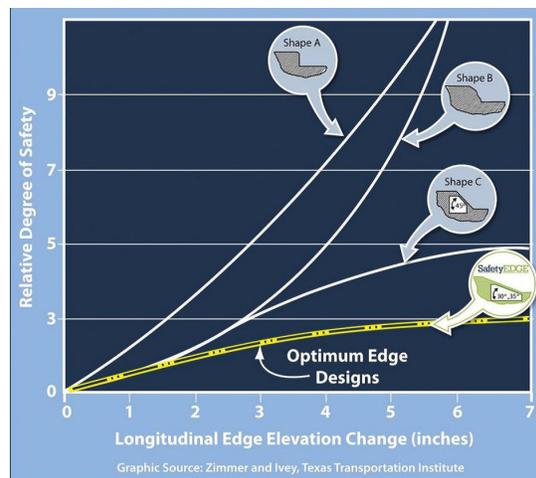
This angled edge can be easily installed at low or no cost during any paving project. A technical sheet that provides information on how to do this at the local level is available from the Ohio LTAP Center at www.dot.state.oh.us/Divisions/Quality/LTAP/Documents/The_Safety_Edge_Technical_Update_Ohio_LTAP_ROM_Series.pdf.

The key to creating a Safety Edge on your pavements is to have a specially designed shoe added to the paver, per manufacturer's instructions. While paving, the shoe should be monitored and adjusted to keep the bottom edge of the device in contact with the road shoulder surface. Using the Safety Edge should not affect the rate of production.

Placing a Safety Edge on your paved roads benefits your community in three ways: It saves lives, it can be implemented at low cost, and it improves durability for your roadways by reducing edge raveling. Ensure that your community benefits from Safety Edge by making it a part of your future project specifications.



Safety Edge is a 30-degree angle applied at the edges of a roadway to make it easier for drivers to correct their vehicle and reenter the roadway after running off the road.



The 30-degree angle of Safety Edge provides the safest roadway edge.

More information on Safety Edge is available at http://safety.fhwa.dot.gov/roadway_dept/pavement/safedge/ or by contacting Cathy Satterfield at Cathy.Satterfield@dot.gov. ♦

Note: This article has been edited to meet the needs of Pennsylvania LTAP.

Meet the LTAP Advisory Committee

who serve a critical role as program advocates and assist PennDOT by attending training courses, reviewing course materials and content, and functioning in an advisory role on a variety of LTAP issues. The following officials currently serve as members of the Advisory Committee:

- **Ann Simonetti**, Chair; Marysville Borough, Perry County, asimonetti@comcast.net
- **Glenn A. Coakley**, Cochair; Patton Township, Centre County, gcoakley@twp.patton.pa.us
- **Jeff Evans**, Ebensburg Borough, Cambria County, jevans@ebensburgpa.com
- **Michael H. Fleming**, Fairview Township, York County, mike@twp.fairview.pa.us
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The PennDOT LTAP Advisory Committee is comprised of an appointed group of municipal government (elected and/or appointed) officials

Upcoming Workshops

To Register:
PHONE: 1-800-FOR-LTAP (367-5827)
WEBSITE: www.ltap.state.pa.us

This represents some of our scheduled courses. Look for updates on the website.

November 15, 2011
York County
Americans With Disabilities
Act (ADA)

November 18, 2011
Bedford County
Asphalt Roads Common
Maintenance Problems

December 5, 2011
Lehigh County
Roadway Safety Improvement
Program

March 6, 2012
Lycoming County
Road Surface Management

November 15, 2011
Centre County
Posting & Bonding of Local
Roads

November 29, 2011
Lehigh County
Pavement Markings:
Applications and
Maintenance

December 6, 2011
Union County
Pavement Markings:
Applications and
Maintenance

March 27, 2012
Lycoming County
Work Zone (Temporary)
Traffic Control

November 16, 2011
Columbia County
Americans with Disabilities
Act (ADA)

December 2, 2011
Blair County
Equipment & Worker Safety

February 15, 2012
Lehigh County
Stormwater Facility Operation
and Maintenance

April 05, 2012
Lycoming County
Asphalt Roads Common
Maintenance Problems

April 19, 2012
Lycoming County
Roadside Vegetation Control

Congratulations to the following Roads Scholar recipients:

- Donald Johnson, Montgomery Township
- John Harbaugh Jr., Hamiltonban Township
- Andrew Blenko, North Huntingdon Township



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Roadkill

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Dead animals are not municipal waste and should not be disposed of with regular garbage. In rural areas, disposal can be fairly simple—just remove the carcass from the road or street, and let nature take its course. In populated areas, this task can be a bit more complicated. Work with your local wildlife or waterways conservation officer on a process to dispose of dead animals and birds. These individuals can also suggest deodorizers and decontamination products that a municipality should keep on supply.

To prevent or reduce roadkill from occurring in the first place, your municipality might want to institute leash laws and regulations against loose animals that help to keep pets and domestic animals off of roads and streets. Fencing might have to be considered in areas with high animal mortality rates. Wildlife crossing facilities for animals to travel over or under a roadway can even be used in some areas. These facilities can be as simple as a pipe for turtles and snakes to pass under a road or as complex as an overpass for elk and bears to cross over a roadway.

Remember, removing and disposing of roadkill from local roads and streets is the responsibility of the municipality. Dealing with it is a dirty job that no one enjoys. But, having a plan in place and knowing how to take care of the carcasses before you actually have to deal with them will make the unpleasant task of handling roadkill a bit more tolerable. ♦

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PennDOT Local Technical Assistance Program

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