

# Country Roads

WV Local Technical Assistance Program

# & City Streets

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Benjamin M. Statler College of Engineering & Mineral Resources

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## STORMPROOFING PRINCIPLES APPLICABLE TO LOCAL ROADS

Excerpted from material by Gordon Keller (USDA Forest Service geotechnical engineer, retired, and low-volume roads consultant)

In the last few years, West Virginia has experienced a number of extreme weather events, including a derecho, Hurricane Sandy, and intense rain events that brought flooding to different parts of the state. Among the significant impacts that such events have on the state is damage to local roads. Road closures and detours adversely affect the mobility of residents and visitors alike, and substantial resources are often needed to reconstruct the roads. Experts say the future likely holds more in the way of extreme weather events. While there are specific ways managers can minimize the impacts of storms with road assessment and prioritization of critical problem areas, many site-specific road measures can be implemented to help “stormproof” the road system. Stormproofing means implementing measures to lessen the potential damage to roads.

This article includes descriptions of considerations and measures that local road managers should think about when trying to reduce the potential impact of storm events on their road system, i.e., **storm damage risk reduction (SDRR)**. The list and descriptions are excerpted from material prepared by Gordon Keller (USDA Forest Service, retired, and low-volume



Extreme weather events may cause roads to wash out. Photo taken by Gary Ketcheson.



**Mark your calendar!**  
The 2016 Snow and Ice Control Workshop is scheduled for September 29 at the Summersville Arena and Conference Center.

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Ask an Engineer

*Country Roads & City Streets* is published three to four times per year. The purpose of this newsletter is to provide information that is beneficial to decision makers, elected officials, and roadway construction, maintenance, and management personnel.

The material and opinions included in this newsletter are those of the West Virginia LTAP and do not necessarily reflect the views of the Federal Highway Administration or the West Virginia Department of Transportation. Every effort has been made to ensure the integrity and accuracy of both original and borrowed material; however, the West Virginia LTAP does not assume responsibility for any information that is found to be incorrect.



The West Virginia LTAP is part of the National Local Technical Assistance Program, which is funded by the Federal Highway Administration. West Virginia LTAP also receives funding from the West Virginia Department of Transportation.

### **MISSION:**

The mission of the WV LTAP is to foster a safe, efficient, and environmentally sound surface transportation system by improving skills and increasing knowledge of the transportation workforce and decision makers.

To help achieve this mission, training, demonstrations, technical assistance, and resource materials are provided.

roads consultant) for the Transportation Research Board's 11th International Conference on Low-Volume Roads held in Pittsburgh, PA in July 2015 and from the publication "**Storm Damage Risk Reduction Guide for Low-Volume Roads,**" available at: [http://www.fs.fed.us/eng/php/library\\_card.php?p\\_num=1277%201814](http://www.fs.fed.us/eng/php/library_card.php?p_num=1277%201814)

### **Identify areas of historic or potential vulnerability.**

Certain high-risk sites are well known, others may be more subtle. Chronically undersized culverts will have a history of plugging or failure. Geologically unstable materials or slopes, roads on steep slopes with sidecast fills, roads that cross steep channels subject to debris flows, wet slopes, areas subject to flooding, or areas of high soil erosion near streams (inner gorges) all have increased vulnerability to storms.

### **Use appropriate minimum design standards.**

Road standards, particularly road width, should be minimized, while still considering traffic safety and road user needs. Because SDRR treatments involve existing roads, road standards are already in place. However, SDRR treatments may be used to lower the standard as appropriate and result in less earthwork, lower cuts and fills, and less concentration of runoff, all of which reduce risk of damage or failure during storms.

### **Employ "self-maintaining" concepts into the selection and implementation of treatments.**

Resources for road maintenance are often severely limited and the road systems are

extensive. Implementing those treatments that reduce the amount of road miles that need frequent and costly maintenance will allow limited resources to be applied to more of the road system where it is needed. Examples might include outsloping (on appropriate soil types), additional cross-drains, and redundant (back-up) or larger drainage structures.



This photo by Gordon Keller shows a slope failure, a common problem.

### **Incorporate relevant, cost-effective technology.**

Apply current, appropriate technology to improve identification of priorities and for planning, design, and reconstruction practices. This includes the use of GIS and GPS technology; geosynthetics for filters, separation and reinforcement; mechanically stabilized earth retaining structures; current riprap sizing criteria for bank stabilization; soil bioengineered and biotechnical slope stabilization/erosion control measures, etc.

### **Perform scheduled maintenance.**

Scheduled maintenance should be performed at a regularly planned frequency, to be prepared for storms. Ensure that culverts have their maximum capacity, ditches drain well, and channels are free of excessive debris and brush that can plug structures. Keep the roadway surface shaped to disperse water rapidly and avoid areas of water concentration. There may not be sufficient

time to do the routine work as a storm is approaching.

**Use simple, positive, frequent roadway surface drainage measures and use restrictions.**

Good roadway surface drainage should be provided so that water is dispersed off the road frequently and water concentration is minimized. Where soil properties are insufficient to support traffic when wet, restrict use during wet seasons to prevent rutting and gullyng. Outslope roads whenever appropriate and practical and use rolling dip cross-drains for surface drainage rather than a system of ditches and culverts that require more maintenance and can easily plug during major storm events. Frequent cross-drains, insloping and outsloping, and rolling road grades all need to be in good working order. Failed cross-drain culverts are very common after major storm events.

**Properly size, install, and maintain culverts.**

Improperly installed, undersized, and plugged pipes are common reasons for culvert failure during storms. Improper alignment or grade relative to channels and ditchlines, excessive woody debris in the channel, excessive channel constriction and headwater elevation, excessively wide inlet areas, and inadequate capacity all contribute to pipe plugging and subsequent failure. Concrete or masonry headwalls greatly improve the resistance of culvert to failure during overtopping. Another common cause of culvert failure is a lack of proper maintenance. Maintaining inlet configurations and removing debris that may plug the pipe are essential for proper function during storms.

**Stabilize cut and fill slopes.**

Unstable fillslopes should be removed or treated as necessary to improve stability. Cut and fillslopes should be



This photo by Gordon Keller depicts a plugged culvert that failed.

well covered (stabilized) with vegetation, to minimize surface instability problems as well as minimize surface erosion. Uncompacted sliver fills and settling or cracking fills are a high priority for stabilization or removal. Fill slopes may also be undercut and over-steepened by a stream or channel. Failing over-steep slopes from road construction where material enters a stream can cause downstream problems, both to the watershed and by promoting plugging of structures.

**Use deep-rooted vegetation to “anchor” soils.**

Promote slope stability by using deep-rooted vegetation for soil bioengineering and biotechnical treatments. Combine deep-rooted plants with a mixture of shallow-rooted grasses for good ground cover and erosion control on slopes; preferably using native species.

**Design high risk bridges and culverts with armored overflows.**

High risk bridges and culvert structures can often be designed with armored overflow areas near the structure in case of overtopping, or they have a controlled “failure” point that is easy to repair and minimizes environmental

damage. Alternatively, over-sizing the structure and allowing for extra freeboard on bridges will maximize capacity and minimize risk of plugging. Do not constrict the natural channel. Consider culverts with a span at least that of the bankfull channel width and bridges that span the floodplain.

**Eliminate diversion potential.**

All stream crossings, especially culvert crossings, should be designed and constructed (or upgraded) to have NO diversion potential. Stream crossings in steep stream channels that are subject to debris flows should be designed and constructed (or upgraded) to withstand such debris flows without being washed out or resulting in subsequent streamflow diversion. Structure damage from a plugged culvert may be minimal, but road damage from a stream diverted down the road can be extensive!

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*We appreciate Gordon’s willingness to allow us to adapt his material for this newsletter. The full paper, with his complete list of measures and considerations and resources on storm damage risk reduction, is available from the LTAP center.*

## MEET OUR NEWEST ADVISORY BOARD MEMBERS

### ADVISORY BOARD

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**Shaneka Owens**  
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The WV LTAP is pleased to welcome three new advisory board members: Shaneka Owens, Chandra Inglis-Smith, and Austin Macri. These individuals filled the three vacant slots that were open on our board, which means we currently have no vacancies. We extend a huge welcome to our newest members and a huge *thank you* to our entire board and our WV LTAP customers for continued support of our program.



#### Austin Macri

##### What is your official role and what are your main responsibilities?

I am the Traffic Records Coordinator for the Governor's Highway Safety Program. My responsibilities include being the coordinator for the WV Traffic Records Coordinating Committee (TRCC) and the project leader for the WV E-citation project. I work on supplying, updating, and refining many major data points for the office including crash Injuries and fatalities, distracted driving, and DUI's. I funnel this information to the rest of the office to help support the projects that they are working on.

##### Why did you decide to accept the invitation to join the WV LTAP Advisory Board?

The GHSP had a presence with LTAP before I joined the team and so when I was asked to fill that role upon my arrival I figured why not! In retrospect, it was a great decision to join the board; there is a lot of expertise in the room every time we meet and being able to contribute is rewarding.

##### What skills and knowledge can you bring to benefit the Advisory Board?

Representing the GHSP, I bring a lot information on what is happening on our roadways to the board. While many of the members are in the maintenance and construction fields, our overall goal is to help make roads safer. Being able to report on the number and types of motor vehicle crashes is a great way to confirm that all of our efforts are paying off.

##### What are some of your hobbies or interests outside of work?

Outside of work I enjoy going backpacking and hiking in many of our State and National Parks. To have the opportunity to get away from civilization and be able to enjoy the woods and the sound of your own thoughts is always a trip worth taking.



#### Chandra Inglis-Smith

##### What is your official role and what are your main responsibilities?

I am the Planner for the WV Division of FHWA. I am responsible for oversight and monitoring of the Statewide and Metropolitan Planning Programs, Air Quality Conformity Determinations, TMA Certifications, Freight, Ferry Boats, HPMS, HVUT, and Motor Fuel Oversight.

##### Why did you decide to accept the invitation to join the WV LTAP Advisory Board?

I am a strong believer that training and education are fundamental to the success of individuals and organizations, and I am excited to work with a group whose goal is to provide that.

## What skills and knowledge can you bring to benefit the Advisory Board?

I have a very diverse education and employment background. I started my professional career as an archaeologist with a museum, then moved to the DOH. After a few years with the WVDOH, I left to get my MS Degree in Physics, focusing on satellite imagery and GIS. I then went to work for a University Transportation Center, RTI, as a project manager, the Information Systems program area manager, and a trainer for software and GIS. I led multiple projects from linear referencing, to software development, to conducting statewide data surveys and analysis while at RTI.

## What are some of your hobbies or interests outside of work?

I love to walk/run, swim and ride my bike. I have two small children so we like to go to the park, walk in the streams, or shoot hoops on our basketball net. I coach my daughter's soccer team, and cheer on my son's. Reading is a passion and I always have at least one book I'm reading at a time. The whole family loves to travel and visit new places any chance we get.



**Shaneka Owens**

### What is your official role and what are your main responsibilities?

As Safety & Traffic Operations Specialist in the West Virginia Division Office I am responsible for policy, procedural and technical coordination and interpretation within the Division and with state and local personnel on safety and traffic operations.

### Why did you decide to accept the invitation to join the WV LTAP Advisory Board?

In addition to being an excellent learning opportunity, I thought it would be an excellent way to stay in touch with and assist our partners. The Board is a great way for me to share my expertise and helps me to gain perspective being a part of such a dynamic diverse group. Coordination and fostering relationships is an important part of my job and being on the LTAP Advisory Board gives me the perfect opportunity to achieve those goals.

## What skills and knowledge can you bring to benefit the Advisory Board?

I have a diverse background that has helped me become a well-rounded engineer and a well-rounded person. I've held a variety of positions during my 11 years at the Maryland State Highway Administration (SHA). During that time, I gained valuable experience in public involvement, roadway design, traffic safety, traffic operations, traffic signal inspection, traffic signal construction inspection, roadway maintenance and roadway construction inspection. In addition to my strong technical background, my love for learning new things inspired me to broaden my skills in public affairs. I was fortunate enough to hold positions that allowed me to foster those skills and it has been invaluable. As a staff engineer, team leader and Assistant Division Chief at SHA I was tasked with meeting with the public including local, state and federally elected officials. Now I am able to take information gained from my peers in the technical fields and translate it for the general public. I believe my previous experience combined with my current position as Safety and Traffic Operations Engineer at FHWA makes me an asset to the advisory board.

## What are some of your hobbies or interests outside of work?

My hobbies/interests include traveling (Europe is my favorite place to visit.), sewing, painting, yoga and spending time with my dog Carson. I'm also a dancer specializing in hip hop and modern.

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# RECOMMENDED NOISE PROTECTION SAFETY PRACTICES

Information taken from OSHA Safety and Health Topics



The WV LTAP recognizes that you may be exposed to hazardous noise levels at work. Noise-related hearing loss is a widespread concern, and, according to the Occupational Safety & Health Administration (OSHA), approximately 30 million people in the United States are exposed to hazardous noise levels each year. Since 2004, almost 125,000 workers have endured permanent hearing loss. Being aware of potential risks and warning signs as well as following recommended practices can help keep you and your coworkers safer in noisy workplace environments. The health effects and recommended practices detailed below are from OSHA.

## WHAT IS NOISE?

OSHA defines noise as being, “fluctuations in the pressure of air (or other media) which affect the human body. Vibrations that are detected by the human ear are classified as sound. We use the term ‘noise’ to indicate unwanted sound. Noise and vibration

can harm workers when they occur at high levels, or continue for a long time.”

## HEALTH EFFECTS OF HAZARDOUS NOISE EXPOSURE

Short term exposure to high levels of noise can result in a temporary change in hearing (ears may feel stuffed up) or tinnitus (ringing in your ears). Short-term effects may go away within minutes or hours after leaving the noise exposure site. Repeated exposure to high levels of noise could lead to permanent tinnitus or hearing loss. It is important to note that permanent hearing loss cannot be reversed with surgery or hearing aids.

Loud noises can also create complications at a work site. Physical and psychological stress, reduction in productivity, interference with concentration, and the possibility of workplace accidents due to difficulty hearing warning signs are all possibilities within environments with high levels of noise.

## WHAT’S TOO LOUD?

OSHA states, “Noise is measured in units of sound pressure levels called decibels, using A-weighted sound levels (dBA). The A-weighted sound levels closely match the perception of loudness by the human ear. Decibels are measured on a logarithmic scale, which means that a small change in the number of decibels results in a huge change in the amount of noise and the potential damage to a person’s hearing.”

***Some warning signs that your workplace environment may be too loud include:***

- Ringing or humming in your or your coworkers’ ears after work
- Temporary hearing loss after work
- You must shout to a coworker at an arm’s length away to be heard

## RECOMMENDATIONS TO REDUCE HIGH LEVEL NOISE EXPOSURE

- Replace or modify noise equipment; make physical changes at the noise source or along the transmission path to reduce noise level to the worker’s ear.
- Maintain and lubricate equipment.
- Place a barrier such as sound walls between the noise source and worker(s).
- Isolate noise source.
- Limit the amount of time a worker is placed at a noise source.
- Provide a quiet area where workers can recover from noise exposure.
- If possible, keep workers a suitable distance from noisy equipment.
- Although considered a less desirable option, use hearing protection devices such as earmuffs or plugs.
- Establish an effective hearing conservation program.

For more information regarding occupational noise exposure, visit OSHA’s website at <https://www.osha.gov/SLTC/noisehearingconservation/index.html>.

# MILLING SCOOP - AN INNOVATIVE IDEA FROM COLORADO

*An Innovative Idea from Colorado*

This innovative solution, **milling scoop**, is from the Arapahoe County Road & Bridge agency in Englewood, Colorado, and it was an entry in the 2015 LTAP/TTAP National Build a Better Mousetrap Competition. If you would like to know more about this innovation, please contact Kim at the WV LTAP and she will put you in touch with Arapahoe Country Road and Bridge agency personnel.



**Problem Statement:** Arapahoe County Road and Bridge had purchased an asphalt milling attachment to use with a skid steer for milling cracks, bumps and soil mixing. The crew had success with the milling machine, but found they were spending extended time on the cleaning of the milled area. Shovels were fine for removal of the first inch or two of millings, but then near impossible once touching the milled surface. Push broom were also not an acceptable tool for the job.

**Solution:** The patching crew came up with a very innovative and creative solution. They took a standard 6-ft wide skid steer bucket that was 18-in tall and turned it into a custom milled surface trench cleaner. The bucket has a 22.5-in center scoop that sits 2.5-in below the standard front cutting edge. It extends out from the cutting edge a total of 8.5 in, has a 2-ft flat section and then a 10-in taper to the back of the bucket. This bucket is 100% custom designed to work the trench behind our mill attachment to clean out millings and dirt from the hole.

**Labor/Materials/ Cost:** The total cost of the project was just under \$400 with parts and labor. It was less than a full-day for the labor.

**Savings/Benefits to the Community:** The bucket has saved, on average, about 10 minutes per crack (2' x 24') that we clean out and repair. With an average of about five cracks a day, that gives us close to a full hour of available labor time every time we use the bucket. The patch crew is able to finish work faster and more efficiently, and reopen roads sooner to the traveling public. There are additional safety benefits from crew not being needed in the roadway to clean the milled areas around the heavy machinery.



## ROADS SCHOLAR II GRADUATES



Rick Cosner

**Congratulations Rick Cosner, WVDOH-5 employee and Bill Dorsey, WVDOH-D1 employee for becoming our latest Roads Scholar II graduates!**

Every Roads Scholar II graduate receives a framed certificate and a leather padfolio, along with getting recognized in our newsletter and on our webpage. If you have any questions about this program, please contact Kim at 304-293-9924 or email your questions to [kim.carr@mail.wvu.edu](mailto:kim.carr@mail.wvu.edu).



Bill Dorsey

## ASK AN ENGINEER

Is there an engineering or maintenance issue that is troubling you? Are you confused on how to address a specific road problem? Email or call us with your questions, and the WV LTAP staff engineers will do their best to answer your question. Also, don't forget, the WV LTAP staff is also available to come to your community and provide guidance based on our site visit.

Q

I know that I need to keep brush and vegetation away from my signs to make them visible. How much visibility do I need in advance of a sign?

A

Answer: Drivers need to be able to see the signs and other traffic control devices far enough in advance to be able to react to the message. How far we cut the brush or grass in front of the sign depends upon the speed of the traffic and the type of sign. Signs are broken up into two categories, critical and non-critical. Critical signs are Stop, Yield, One Way, Do Not Enter, Wrong Way and other signs that might require the public to stop. All others are non-critical. The following table from the **FHWA's Vegetation Control for Safety** booklet is a great guide on the minimum distance to trim in advance for sign visibility.

Table 1. Clear Distance to See Sign

| Speed Limit (mph) | Critical Signs (feet) | NonCritical Signs (feet) |
|-------------------|-----------------------|--------------------------|
| 30                | 250                   | 150                      |
| 40                | 350                   | 200                      |
| 50                | 450                   | 250                      |
| 60                | 600                   | 300                      |

Check out the entire booklet for additional guidance on sign visibility and other types of sight distance at [http://safety.fhwa.dot.gov/local\\_rural/training/fhwasa07018/](http://safety.fhwa.dot.gov/local_rural/training/fhwasa07018/).

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The WV LTAP encourages you to share this newsletter with others or direct them to the electronic version on our website [wvltap.wvu.edu](http://wvltap.wvu.edu).

- Road Supervisors
- Elected Officials
- Public Works Department
- Road Crew
- Managers
- City Engineers
- Others