TECHNOLOGY NEWS

Iowa's Local Technical Assistance Program (LTAP): providing transportation technology transfer for Iowa's cities and counties

September–October 2003

Acronyms in this issue

AASHTO	American Association of State Highway and Transportation Officials
CTRE	Center for Transportation Research and Education
FHWA	Federal Highway Administration
Iowa DOT	Iowa Department of Transportation
ISU	Iowa State University
LTAP	Local Technical Assistance Program
MUTCD	Manual on Uniform Traffic Control Devices

Build better pavements: stabilize the subgrade

UNSTABLE SUBGRADE is the number-one cause of pavement failure. Although stabilizing subgrade soils may increase up-front construction time and cost, the extra expense will generally be recovered—and more—over the pavement's lifetime.

What is "stable" soil?
Stable subgrades are those that can support loads. Soil *quality* and *uniformity* contribute to its stability.

Some soil types naturally provide better drainage and support beneath pavements than other soils; they are considered to be more stable. "Loam or clay loam of glacial till origin or clean sand is typically desired," according to David Heer, assistant soils design engineer and former earthwork field engineer at the Iowa DOT.

Other types of soil cause differential movements that can lead to dips or cracks in pavements. Such "unstable" soil types generally include those with a high volume of expansive clay minerals or silt, organic material, or water.

In addition to being composed of stable soil that provides good drainage and support, a critical characteristic of a stable subgrade is *uniformity*. That is, subgrades are generally stable if they are composed primarily of one type (and grade) of soil and uniformly compacted at optimum water content.

The problem with a subgrade composed of different soil types and/or gradations, according to Dale Harrington, CTRE's associate director for pavements, is that "different materials absorb water differently. So, they have different densities and, consequently, they expand and contract at different rates."

With varying densities and rates of expansion/contraction, different soils in the subgrade provide different levels of support under the pavement slab. Different levels of support can cause the slab to settle and/or break up. A subgrade composed of uniform materials provides a more uniform level of support under the slab.

Harrington emphasizes, "It isn't only the quality of the soil that counts, but the fact that the quality—whether excellent or fair—is the same throughout the subgrade. Uniform, stable soil is the key."

He adds, "Iowa has many different kinds of soils, and this has to be considered in pavement design and construction planning." In fact, it's not unusual in Iowa to find several kinds of soil along one roadway construction site. Agencies generally have to work with whatever kinds of soil are naturally present, using engineering techniques to improve, or stabilize, them.

PAVEMENTS . . . continued on page 2

In Iowa, fly ash can be a cost-effective additive for stabilizing soils.

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The mission of Iowa's LTAP:
To foster a safe, efficient, environmentally sound tranportation system by improving skills and knowledge of local transportation providers through training, technical assistance, and technology transfer, thus improving the quality of life for Iowans.

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PAVEMENTS . . . continued from page 1

This involves, primarily, making the subgrade material more uniform. As much as possible, it also involves developing a subgrade composed of stable soils. One way to achieve both objectives is to remove and replace some of the soil.

Stabilizing with select backfill or special backfill
First, "select" soil—the best (i.e., most stable) material found during the exploration of a site—is typically excavated from roadcuts or borrow sites and reserved for the final two feet of fill placed beneath the pavement structure.

If loam or clay loam, clean sand, or other stable soils aren't available for select fill, or if an agency simply wants to provide additional support, "special" backfill may be placed on top of the subgrade.

Special backfill is a uniform mixture of crushed concrete or crushed limestone, or a mixture of gravel, sand, and soil (with or without crushed stone), that meets specific gradation requirements. Recycled asphalt pavement (RAP) is reclaimed hot-mix asphalt pavement that is processed to meet Iowa DOT special backfill requirements. (See Article 2102.04 and Section 4132 of the DOT Standard Specifications for material requirements for special backfill.)

Because of the expense associated with applying special backfill, "the depth is normally limited to eight to twelve inches," according to Harrington.

A layer of polymer geosynthetic called geogrid may be used as a foundation for special backfill. Geogrid acts as an underlying tension reinforcement to prevent failure at the base of special backfill. And a course of fairly rigid fill material, sometimes cement- or asphalt-treated, may be placed on the special backfill to provide a stable platform for the concrete pavement slab.

Stabilizing with additives
Another way to stabilize subgrades is with additives. Through chemical reactions with the soil, these additives can alter soil characteristics in ways that improve its stability. Lime, fly ash, and portland cement are the most common stabilizing additives.

Lime. Lime is an effective stabilizing agent for a variety of soils. Either quicklime or hydrated lime, in both high calcium and dolomitic types, is an especially effective stabilizer of granular materials and clays because it reduces soil plasticity and increases compressive strength through chemical reactions.

In fact, using lime "may easily triple or quadruple" the strength of clay soils, according to Dr. Robert Parsons, assistant professor of civil engineering at the University of Kansas. "In some instances, strength has improved by an order of 10 or more."

The National Lime Association recommends that when mixing lime with soils, the moisture content should be five percent above optimum during mixing to promote the necessary chemical reactions.

Portland cement. When added to soil, portland cement hardens the mixture through hydration of the cement.

Portland cement can be used for a variety of soils. However, well graded, sandy, and gravelly materials with 10 to 35 percent fines have the best reaction. Soils with little or no fines and clay soils normally require a greater proportion of cement.

Fly ash. Fly ash, a byproduct of coal burning, is commonly used to improve the uniformity of subgrade materials. Self-cementing Class C fly ash is used for subgrade treatment, according to Iowa DOT specifications.

Typically, fly ash is incorporated into soil at rates of 5 to 20 percent to form a low-grade concrete; the soil is the aggregate and fly ash is the cement, according to Heer. Sometimes, partially hydrated fly ash is applied as a crushed product in the upper pavement support layer.

Because fly ash is plentiful in parts of Iowa near coal-burning plants, it can be a cost-effective additive for stabilizing soils. Stabilizing subgrades with fly ash is also an environmentally sound recycling practice.

No stabilization "formula"
When it comes to stabilizing subgrades, there is no single solution. Because of the diversity of soils in Iowa, each project must be analyzed and treated on a case-by-case basis. The result will be smoother, stronger pavements; less traffic congestion due to road maintenance and rehabilitation; and dollars saved over the pavement's lifetime.

For more information
For general information about soil and subgrade stabilization, contact David White, assistant professor of civil engineering at ISU specializing in geotechnical engineering, 515-294-1463, djwhite@iastate.edu.

For information on stabilization additives, contact the National Lime Association, 703-243-5463, www.lime.org; the American Coal Ash Association, 703-317-2400, www.acaa-usa.org; or the Portland Cement Association, 847-966-6200, www.Cement.org.

For related publications, contact Jim Hogan, library coordinator, 515-294-9481, hoganj@iastate.edu. •

Build a Better Mousetrap

Adding a *heavy-duty wing wheel*

Editor's note: The "heavy duty wing wheel" is the first in a series of several winning innovations from the Better Mousetrap competition at the Iowa Maintenance Training Expo in 2003. In each issue of Technology News *we'll highlight one of the winners. For information about other winning mousetraps, see CTRE's website, www.ctre.iastate.edu/ (Popular Links).*

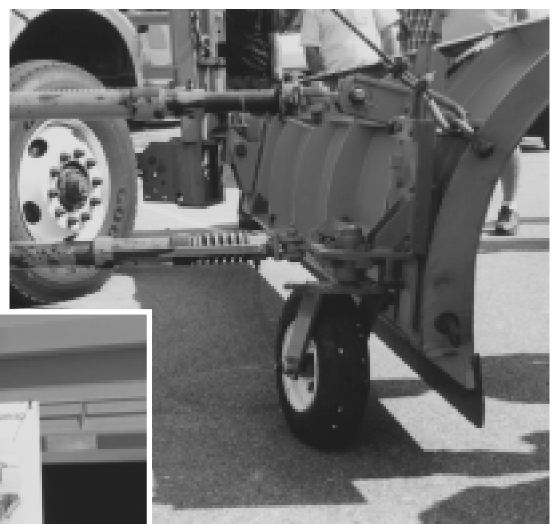
HERB MORLEY, mechanic with the Iowa DOT in Elkader, found that, during snow removal, the wing blade on his snowplow sometimes scraped gravel from the shoulders into the ditches.

Morley wanted to keep gravel from being plowed away, so he added a heavy-duty wheel to the wing blade. The wheel holds the outer end of the wing up, and since the wheel follows the contours of the shoulder, less gravel is scraped into the ditch.

He used hardware and old plow wheels for his innovation. And he's currently perfecting the invention by making it hydraulic.

For more information about adding a wing wheel to your plow, contact Herb Morley, 563-245-2724, herbert.morley@dot.state.ia.us. •

The heavy-duty wing wheel installs easily on the end of the plow blade.



The heavy duty wing wheel prevents the snowplow blade from scraping gravel off the shoulders.

Herb Morley (right) explains his innovation as Al Olson, a competition judge, looks on.

Iowa Department of Transportation

IOWA LTAP

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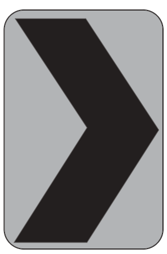
Incorporating safety into 3R

Tom McDonald, Safety Circuit Rider

Editor's note: Two recent articles in Technology News *addressed the benefits of and suggestions for rural agency roadway safety programs. One recommendation was to integrate safety enhancements into programmed roadway improvements.*

A SPECIFIC CATEGORY of roadway improvement projects—rehabilitation, restoration, and/or resurfacing, commonly referred to as 3R—can provide excellent opportunities to correct or mitigate existing safety-related issues, often at lower cost than addressing the safety issues independently.



Curve signs and chevrons should be used consistently on the same road.

Potential safety improvements during 3R projects
Many potential roadway safety improvements may not be good candidates for correction during 3R projects because of relatively high cost and the need to acquire additional right-of-way. However, lower-cost mitigation strategies that can result in a high benefit-cost return should be considered. Some of these strategies might include

- removing trees,
- relocating or delineating utility poles,
- modifying driveways/entrances,
- flattening slopes in critical locations,
- replacing outdated guardrail,
- adequately marking or shielding narrow structures,
- removing high headwalls from culvert ends,
- replacing non-crashworthy signs supports and mail boxes, and
- upgrading signs.

Other safety benefits can be realized from a variety of low-cost traffic safety enhancements. For example, consider

- installing rumble strips in advance of STOP signs at problem intersections,
- outlining site-specific locations like sharp curves with chevrons or delineators,
- marking T-intersections with double-arrow signs, W1-7, and, if possible, constructing safety ramps, or
- installing durable pavement markings that will provide desired visibility longer than will standard markings.

All of these potential safety improvements are located within the roadway clear zone, and thus will not require additional right-of-way.

Planning 3R safety improvements
The ideal time to consider appropriate safety enhancements is before or during the concept stage for a future road or street improvement.

Using a previously compiled list of roadway safety concerns or one developed specifically for the project, agency staff can select possible options for mitigation, with removal or relocation of potential hazards the most ideal choices.

As with higher cost improvements, review crash history carefully as part of the process. In addition, some desired modifications will require consulting with other interested parties, like property owners for mailbox supports, driveway slope flattening, and/or tree removals near farmsteads, or utility companies for pole relocation or delineation.

Consistency promotes safety
Consistent application of safety enhancements is critical; treat similar situations uniformly. For example, if a curve with a certain degree of curvature and superelevation is marked with chevrons in response to a crash recorded at that location, then a similar curve on the same road should probably also be marked with a chevron, even if no crashes have been noted during the study period.

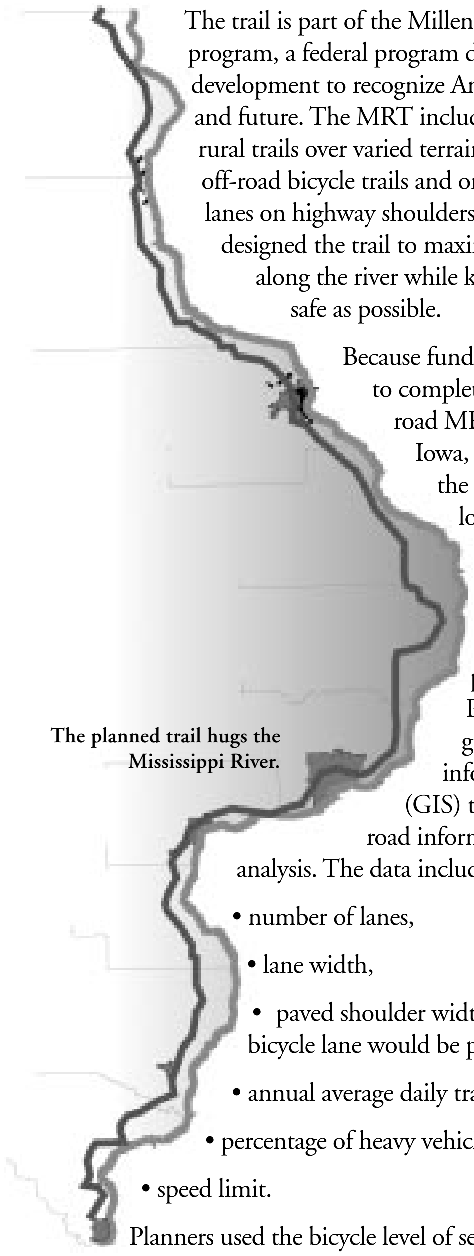
Urban improvements
Safety improvements can also be beneficial on some urban street projects:

- Larger signs, especially street name signs, might be needed.
- Check the adequacy of existing traffic signals. Larger lens and/or backing plates can be added at minimal cost. Re-timing signals according to formulae in the *ITE Traffic Engineering Handbook* may improve intersection safety (see "Optimizing traffic signal phases for safety," *Technology News*, July–August 2003).
- Determine if any non-crashworthy obstacles such as utility poles or light bases in the clear zone should be removed, relocated, or modified with breakaway supports.
- Install durable pavement markings when possible to provide a longer period of desired visibility.

For more information
Contact Tom McDonald, 515-294-6384, tmcdonal@iastate.edu. •

CTRE helps plan Mississippi River Trail

TRANSPORTATION PLANNERS at CTRE have helped map out a section of one of longest north-south bicycle routes in the country. The Mississippi River Trail (MRT) is a bicycle trail that follows the Mississippi River from its headwaters in Minnesota to its mouth in the Gulf of Mexico.



The planned trail hugs the Mississippi River.

The trail is part of the Millennium Trails program, a federal program devoted to trail development to recognize America's history and future. The MRT includes urban and rural trails over varied terrain. It also includes off-road bicycle trails and on-road bicycle lanes on highway shoulders. Planners have designed the trail to maximize bicycle use along the river while keeping cyclists as safe as possible.

Because funding is not available to complete an entirely off-road MRT project in Iowa, planners looked at the possibility of using lower cost bicycle lanes on existing highways or other low cost bicycle trails to get the project started. Planners used geographic information systems (GIS) to compile various road information data for analysis. The data included

- number of lanes,
- lane width,
- paved shoulder width (where the bicycle lane would be placed),
- annual average daily traffic counts,
- percentage of heavy vehicles, and
- speed limit.

Planners used the bicycle level of service (BLOS) algorithm to calculate which highway shoulders would be suitable and safe for a bicycle lane either now or with shoulder paving and widening. GIS showed the BLOS results graphically on a map (see figure). Based on these results, planners recommended safe MRT bicycle lanes and off-road trails and verified their recommendations with the public.

The planners also recommended that appropriate off-road bicycle trails be built to replace the bicycle lanes as funding becomes available.

For more information
Contact David Plazak, director, Midwest Transportation Consortium, 515-296-0814, dplazak@iastate.edu; or Jamie Luedtke, CTRE research assistant, 515-294-7188, jtunnell@iastate.edu.

This study was requested by the Iowa Legislature and funded by the Iowa DOT. •

Signs like this are posted along the Missisippi River Trail.

The trail passes through historic Iowa cities like Dubuque.

Cyclists will see scienic views of the Mississippi River along the trail.

GASB Statement 34: Iowa's small and midsize communities respond

Tom Stout, principal transportation engineer, Stanley Consultants, Inc.

Omar Smadi, research engineer, CTRE

Editor's note: An article in the March–April 2003 issue of Technology News *described how nine large Midwestern cities (annual revenue $100 million or more) conducted their first financial reporting under the new Governmental Accounting Standards Board Statement 34 (GASB 34) requirements. This article discusses 12 small (annual revenue less than $10 million) and midsize (annual revenue $10 million to less than $100 million) Iowa communities' approaches to complying with GASB 34.*

Generally, GASB 34 requires state and local governments to begin reporting the value of their infrastructure assets, including roads and bridges. For background information on GASB 34, see "What's GASB 34—and why should you care?" in the January–February 2000 issue of Technology News. *It is online, www.ctre.iastate.edu/pubs/Tech_News/.*

TWELVE SMALL and midsize Iowa communities were recently interviewed regarding their plans for complying with GASB 34. The five midsize cities interviewed are just working on their first GASB 34–compliant reports for fiscal year ending June 2003. The seven small cities interviewed are preparing for their first GASB 34–compliant reporting, required for fiscal year ending June 2004.

Starting points

In all communities interviewed, the city clerk or finance manager is responsible for implementing GASB 34. In this early reporting stage, none of the financial officers has experienced any problems with the requirements other than extra time needed to prepare compliant reports.

Four communities operating on a cash basis, as opposed to an accrual basis, believe they are not required to determine an overall value for assets. Four other communities have systems for reporting the value of fixed assets, but no community interviewed has a system for reporting infrastructure assets.

Implementation plans

In their first reporting year, agencies are required to report only the value of newly acquired infrastructure assets. With the exception of one cash-basis city that is not planning to list the value of existing facilities (it will report only infrastructure assets tied to debt, adding new assets as debt is incurred and removing them as debt is retired), the communities interviewed are taking various approaches to determining the value of infrastructure assets. None of the communities interviewed plans to use the modified approach allowed in GASB 34.

One midsize city plans to implement an asset management system, and two small cities are considering it.

One city will use "actual" costs, one will use replacement cost, another will determine values based on its records, another is using Street Guard software. The public works department in one cash-basis community will determine infrastructure values. In another community, the engineering department is determining values.

Most communities interviewed don't yet know how they will depreciate their infrastructure assets, but two midsize cities are using straight-line depreciation.

Impact of GASB 34

When interviewed, none of the communities had adopted an asset management system as a result of GASB 34. One cash-basis city believes an asset management system isn't necessary, and one interviewee noted that the city council is not interested in spending money to initiate an asset management system in the current budgetary climate. One midsize city, however, plans to implement such a system, and two small cities are considering it.

Some cities expect that the information in the new reports may result in favorable audit opinions.

While there are still many unknowns regarding the implementation of GASB 34, one thing is certain: GASB 34–compliant financial reports should make it easier for creditors and the public to understand agencies' fiscal performance and creditworthiness.

For more information

Contact Omar Smadi, 515-294-7110, smadi@iastate.edu. •

Highway safety improvements proven to save lives

EVERY $100 MILLION invested in highway safety improvements saves approximately 145 lives over a 10-year period, according to the Road Information Program (TRIP) website sponsored by FHWA and the National Highway Traffic Safety Administration.

At right is a list of key road and bridge improvements evaluated over a 20-year period by FHWA, along with related percent reduction in fatality rates.

For more information, see the TRIP website, www.tripnet.org/hsfact sheet.htm. •

Improvements at Intersections	Reduction in Fatality Rate (in %)
Turning lanes and traffic channelization	47
Sight distance improvements	56
New traffic signals	53
Bridge Improvements	
Widening a bridge	49
New bridge	86
Upgrade bridge rail	75
Roadway Improvements	
Construct median for traffic separation	73
Widen or improve shoulder	22
Realign roadway	66
Groove pavement for skid treatment	33
Roadside Improvements	
Upgrade median barrier	66
New median barrier	63

SAVER enhances crash data analysis

THE IOWA DOT has developed new software that can help improve safety and save lives.

In Iowa, there are approximately 65,000–70,000 motor vehicle crashes annually. Agencies collect crash-related data like location, date and time, driver and vehicle characteristics, and injury details. State and local agencies can analyze the data and then, based on the analyses, make safety improvements and/or target law enforcement at certain locations.

The Iowa DOT Office of Traffic and Safety (TAS) has a long history of providing tools, like accident location and analysis systems (ALAS), to help local agencies analyze crash data. The latest version of ALAS is the Safety Analysis, Visualization, and Exploration Resource (SAVER), renamed due to an expanded focus beyond crash data.

SAVER allows users to analyze a variety of safety-related data, including enforcement-related data.

Michael Pawlovich, traffic safety and crash analysis engineer, developed SAVER to provide a single resource (data and user interface) that automates various safety data analyses to the extent possible.

“SAVER allows users to view highway safety data in context,” Pawlovich says.

SAVER can integrate safety data from the Iowa DOT Motor Vehicle Division (MVD) crash database and local law enforcement agencies. SAVER data include the following:

- Iowa DOT road and corporate limit maps
- Iowa DOT mapped crash data
- Iowa DNR hydrology maps
- Enforcement data (e.g., citations and criminal incidents) collected using the Traffic and Criminal System (TraCS) software.

SAVER is available to state, city, and county agencies and consultants that analyze safety data.

To use SAVER, organizations currently must have ArcView GIS 3.2/3.3 software. The SAVER GUI system runs within that software.

However, Pawlovich plans to revamp SAVER using Visual Basic and GeoMedia Objects, the components used to develop GeoMedia GIS software. The revamped SAVER will be both more compatible with internal Iowa DOT systems and less costly for users. (The SAVER GUI system is free, but ArcView can cost up to $1,200. The new version will cost $100 or less and will not require any GIS.)

Organizations can also use the data analysis services of the Iowa Traffic Safety Data Service (ITSDS) at CTRE. ITSDS is currently making the transition to SAVER as its primary data analysis tool.

For more information
Contact Michael Pawlovich, 515-239-1428, michael.pawlovich@dot. state.ia.us, or visit www.dot.state.ia.us/crashanalysis.

For more information about ITSDS, call 515-294-2329, or visit www.ctre.iastate.edu/ITSDS/. •

Understanding today's cements for concrete mixtures

Quality control at the plant is critical to using admixtures and blended cements successfully in concrete mixtures for pavements.

Hydraulic Cement Seminar
November 18, 2003
Scheman Building
Ames, Iowa

IOWA STATE UNIVERSITY is hosting this first-in-the-nation seminar developed by the FHWA.

The seminar is designed for city, county, and state engineers, consultants, contractors, and concrete producers. It will be particularly useful for technical and quality control personnel who specify or approve the use of cementitious materials in mix designs for concrete.

For centuries portland cement was the primary hydraulic cement in concrete mixtures for pavements. Today's admixtures and blended cements significantly complicate the chemistry and technology of cements and concrete.

This workshop will help participants understand the

- terminology of hydraulic cements,
- chemical reactions during cement manufacturing and concrete mix hydration that affect concrete pavement performance,
- potential benefits and drawbacks associated with various cements,
- quality control data, including mill test reports, and
- energy and environment issues affecting the production of hydraulic cements.

For more information contact Harold Smith, 515-294-4218, hsmith7@iastate.edu.

Enrollment is limited. To register, contact Lori Wildeman, 515-294-1866, lwild@iastate.edu. A registration brochure is online, www.ctre.iastate.edu/calendar/. •

Learning the latest about signing

Tom McDonald, Safety Circuit Rider

IN AUGUST 2003, more than 140 engineers, technicians, and other professionals from state and local agencies and the private sector attended CTRE's biennial signing conference in Ames.

The program featured expert presentations. For example, Pete Rusch, a safety engineer with the FHWA, discussed current and potential changes in the MUTCD and explained specific concerns of older drivers. Dr. Paul Carlson, from the Texas Transportation Institute, presented timely information about retroreflectivity requirements for signs and possible effects of future national standards on transportation agencies.

A highlight of the conference was concurrent sessions presented by experienced practitioners on topics ranging from characteristics of sign supports and sheeting types to fabrication practices and crash testing traffic control devices.

For more information, contact Tom McDonald, 515-294-6384, tmcdonal@iastate.edu. •

Conference attendees saw signing vendors' latest and greatest products.

New staff and new responsibilities at CTRE

Jim Grove

Jim Grove has joined the CTRE staff after nearly 17 years at the Iowa DOT. He is leading the 16-state, pool-funded project to research methods and tests for optimizing and coordinating mixture design, materials, and construction practices in concrete pavements. At the Iowa DOT, Grove held various positions, including bridge design engineer, portland cement concrete engineer, and portland cement concrete paving field engineer. He received his master's degree in transportation engineering from ISU.

Neal Hawkins

Neal Hawkins, former senior project manager at Howard R. Green Company, is now the associate director for traffic operations at CTRE. He plans to develop the program by assisting industry and public agencies with planning, designing, and managing surface transportation systems. He will focus on developing new tools, techniques, and partnerships to improve rural and urban transportation, freeway management and operations, emergency management, public safety, and work zones. Hawkins received his master's degree in transportation engineering from ISU.

Tom Maze

Former CTRE director Tom Maze has returned to CTRE after three years with Howard R. Green Company (HRG). At HRG, Maze was director and vice president of transportation services and implemented companywide strategic plans and actions for services, marketing, and geographic expansion. At CTRE, Maze will continue to assist agencies with transportation asset management and related issues, incorporating insights from his professional experience at HRG. He received his Ph.D. in civil engineering from Michigan State University and is also a professor of civil engineering at ISU.

Lori Wildeman

Lori Wildeman is CTRE's new program coordinator. She coordinates logistical arrangements for LTAP workshops like the recent signing conference and the Iowa Maintenance Training Expo. She replaces Sharon Prochnow, who is CTRE's new coordinator of project contracts. Wildeman also manages workshop committee activities, oversees office operations, and supervises clerical support staff. Previously, she worked as the program coordinator for ISU's Center for Portland Cement Concrete Pavement Technology. She received her master's degree in human development and family studies at ISU.