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Since the LOCAL OPERA PROGRAM began in 2003, it has provided more than $513,000 in funding to 53 cities, counties, and townships for a total of 72 completed projects.
About OPERA

The Minnesota Local Road Research Board’s Local Operational Research Assistance Program, or the Local OPERA Program, helps to develop innovations in the construction and maintenance operations of local government transportation organizations.

The Local OPERA Program encourages maintenance employees from all cities and counties to get involved in operational or hands-on research. In particular, OPERA helps to develop your great ideas locally and share those ideas statewide.

The Local OPERA Program funds projects up to $10,000. OPERA project selections are made as projects are submitted. OPERA-funded projects also may receive support from other sources, including cities, counties, suppliers, or manufacturers. Projects are funded in two parts. The local agency is eligible for 80 percent of the total approved project cost when initial results are submitted. The remaining 20 percent will be paid upon submission of a final report.

Apply for OPERA funding

To apply for OPERA funding or to hear more about the Local OPERA Program, please contact Mindy Carlson or Jim Grothaus with Minnesota LTAP, or visit us online at mnltap.umn.edu/opera.

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2014 PROJECTS

Back-up Sensor Technology for Snowplows

Project Number 2013-04

Project Leader Chuck Weiman

Agency Stearns County Public Works
455 28th Avenue South
Waite Park, MN 56387

Phone 320-255-6180

Problem When Stearns County drivers have to back up large trucks, they are challenged by a large blind spot. It can be difficult for drivers to ensure that the path behind the truck is clear, but it is not practical for them to physically walk around and look behind the truck each time they need to back up.

Solution The county installed Precise View back-up systems on three tandem dump trucks in 2013. Stearns County then tested the systems to determine how effectively they alerted drivers to any obstacles while backing up the trucks in many different weather conditions and scenarios encountered during the year. The system works by alerting the driver with a beeping sound as a truck backs closer to an object. The closer the truck gets to the object, the louder and faster the receiver beeps.

Procedure County staff mounted the units in the center of each truck’s tailgate, which included constructing an angled bracket to point the units toward the ground. They then bolted a section of angle iron to the end gate to run the cable between the bracket and side post of the end gate. A hole was drilled in the side post of the end gate and the cable was routed through the side post, emerging through another hole drilled near the hinge. A loop of cable, including a cable splice to facilitate removal of the end gate when necessary, was run over the hinge for the end gate. The cable was then fed back down to a hole in the side post of the box and run to the cab of the truck where the receiver was mounted.

Results Driver comments were mostly positive. While there were some false alarms, mainly when the device had a fine coating of ice on it, the units seemed to work through any amount of snow and even through the film of silt left from melting snow and sand on the end gate.

Approximate Cost $4,150

OPERA Funding $3,800

Implementation Stearns County plans to add more units in the future. When it does so, the county plans to check with the unit manufacturer to see if each unit can be purchased with a 35-foot cable, making it possible to have only one splice at the end gate.

Status Complete
Versatile Spraying Unit

<table>
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<th>Project Number</th>
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<tr>
<td>Project Leader</td>
<td>Mike Suska</td>
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| Agency         | Nicollet County Public Works  
501 South Minnesota Avenue  
St. Peter, MN 56082 |
| Phone          | 507-934-7725 |
| Problem        | Nicollet County’s existing method of spraying noxious weeds and brush sites was slow, unsafe, and inefficient. Sites required multiple spraying applications and often required applying several different chemicals simultaneously. In addition, the county did not have a reliable method for precisely documenting spot application areas. |
| Solution       | The county designed and fabricated a versatile spraying unit. The unit consists of a mountable platform that contains tanks, hoses, and a pump, which can be easily installed on and removed from an existing flatbed one-ton county pickup truck. The unit can spray multiple chemicals at once while keeping the chemicals away from the applicator. It can also be tracked by GPS to assist in year-to-year documentation and in any crop damage claims. |
| Procedure      | The unit includes four tanks, a hose reel with a hand sprayer, and a 5 horsepower motor with a Hypro pump. The spraying head contains three nozzles: the first treats the area from zero to 10 feet from the unit, the second from zero to 20 feet, and the third can spot spray for brush as far out as 40 feet. If the second and third nozzles are used together, the unit can provide a continuous spray from zero to 40 feet. The arm and head both have independent electronic cylinders for spray application. |
| Results        | The unit is easy to operate and only requires a driver and operator. Visibility is excellent with the spray head on the front of the vehicle, and enough chemicals can be stored on the unit to last for a half day of spraying. The instructions are simple, the preparation work is fast, and everyone who has used the unit has been satisfied with the results. One of the biggest advantages is that the unit allowed the county to reduce its spraying crew from six people operating three units to just two crew members operating the versatile spraying unit. |
|                | The unit’s GPS device initially failed at locating the actual chemical application location. Instead, it identified the vehicle’s location. The county is continuing to refine this GPS device so it will better track the spraying location and time for the 2014 season. |
| Approximate Cost | $10,767 |
| OPERA Funding  | $10,000 |
| Implementation | The county plans on changing the 500-gallon main tank from a premix system to a direct injection system in the future. This will allow the county to have just water in the main tank when leaving the shop, with a separate smaller tank for the chemical. The direct injection system will then automatically mix the chemicals at the time of field application. |
| Status         | Complete |

View the complete project report online at www.mnltap.umn.edu/opera.
Evaluating Local Road Rehab Alternatives

Project Number 2013-06

Project Leader Wayne Stevens

Agency Brown County Highway Department
1901 N Jefferson Street
New Ulm, MN 56073

Phone 507-233-5700

Problem The use of cold in-place recycling (CIR) to completely recycle distressed asphalt pavements has been an efficient and cost-effective strategy for the county for several years. The CIR roads are typically surfaced with a 2-inch hot-mix asphalt (HMA) overlay. On low-volume roads, Brown County has tried chip seals as a less expensive, lightly surfaced alternative. Determining when and where to apply the lightly surfaced alternative and helping define expectations is highly desirable for Brown County and many other counties throughout the state.

Solution Brown County conducted pavement strength and performance analysis on thin HMA overlays and chip-seal surface treatments over recycled stabilized bases. The county also identified pertinent research to characterize the various stabilization treatments and how they might perform in relation to the overlay or chip seal.

Procedure The county conducted non-destructive pavement assessments along with coring for strength analysis to better define the differences between a lightly surfaced CIR pavement and one that is overlaid. Non-destructive testing included ground penetrating radar (GPR) and falling weight deflectometer (FWD) analysis. The GPR was used to look at pavement section thicknesses, and the FWD was used for strength determinations.

Results The analysis showed the overlay section had a 10.2-ton rating, while the seal-coat section had a 7.6-ton rating. Past projects using seal coats over CIR have shown between 9- and 10-ton ratings, with the difference being the subgrade R value. Since the road has an annual average daily traffic of 170, the 7.6-ton rating on the chip-seal section would normally be adequate. However, heavier loads from trucks and agricultural traffic could overstress the road, resulting in premature failure. This is especially true at the edge of the CIR pavement, which is typically weaker than the center of the road. Therefore, it may be desirable to use the lightly surfaced strategy with higher subgrade R values. Also, when using the chip-seal option, the CIR pavement should be widened a few feet to push the unconfined edge further into the shoulder, beyond where traffic runs on the pavement.

Approximate Cost More than $100,000

OPERA Funding $10,000

Implementation The county has shared its findings in a geotechnical report. This report also provides guidance for evaluating other recycling processes and materials and how they might perform under the same surfacing comparisons. This project is the first step toward a comprehensive method for determining rehab strategies using various materials, processes, and surfacing methods on low-volume roads.

Status Complete

View the complete project report online at www.mnltap.umn.edu/opera.
Vinyl Wrap for Paint Truck

Project Number 2013-07

Project Leader Dave Tucker

Agency Sherburne County Public Works
13880 Business Center Drive Northwest
Elk River, MN 55330

Phone 763-765-4303

Problem The Sherburne County paint crew is always given the worst truck of the fleet since it is likely to get paint on it during painting operations. The crew also spends a significant amount of time cleaning up the equipment at the end of the painting season.

Solution The county installed a vinyl wrap on the box and tailgate of a pickup truck. This allowed the paint crew to have access to a newer truck with better strobes and an extended cab. The goal of the wrap is to extend the life and value of the paint truck.

Procedure The paint truck was dropped off at Trent Signs & Graphics for the design and installation of the vinyl wrap. Prior to installation, the county approved a computer-generated picture of the truck with the vinyl wrap.

Results In this project, the county took a product that is readily available and used it in a different way. Wrapping the paint truck with a vinyl wrap helped keep the truck protected from permanent stains caused by accidental spills or drips during the painting season. At the end of the season, the county was able to remove the wrap and still have a functional, undamaged truck to use for other purposes.

Approximate Cost $900

OPERA Funding $900

Implementation The installation of the vinyl wrap on the paint truck spurred other implementation ideas for the county. For example, a similar wrap could be applied to parts of the crack-filling tar kettle to aid in clean up. The wrap could also be used to protect portions of other equipment or trucks that tend to get a lot of paint chips.

Status Complete

View the complete project report online at www.mnltap.umn.edu/opera.
Evaluation of Expanded Polypropylene Rings for Manhole Grade Adjustment

Project Number 2013-09

Project Leader Anthony Paron

Agency City of Eden Prairie
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Eden Prairie, MN 55344

Phone 952-949-8530

Problem The traditional method of adjusting the elevation of a manhole casting by using concrete rings has historically been prone to many problems. Concrete rings—along with the mortar used to install them—may crack and deteriorate. The casting subsequently settles, causing the road surface to become uneven. The deteriorated rings also allow stormwater to enter sanitary sewer manholes, increasing wastewater treatment costs. In recent years, the City of Eden Prairie began using hard plastic rings as a lighter, more versatile alternative. However, these rings may only be stacked vertically and cannot be offset.

Solution Eden Prairie installed new polypropylene (foam) plastic manhole rings in its town center. These rings are lighter and more durable than concrete and offer more versatility than hard plastic rings, since they can be easily stacked or staggered when necessary. Because the foam rings are between two and five times as expensive as the concrete rings, depending on thickness, the city wanted to evaluate their performance under high-traffic conditions.

Procedure The city began installing the foam rings in May 2014 on both sides of Prairie Center Drive, a four-lane street in one of Eden Prairie’s most heavily traveled areas. In total, foam ring installations were completed on more than 30 catch basins in need of major repair.

Results The foam rings were much easier for the construction crew to install; it took less effort and significantly less time to position the assembly and make changes to match the grade line. Also, since the foam rings are not hollow-cast like the hard plastic rings, the adhesive used to bond one ring to another could be applied more liberally and quickly, and the face-to-face bonding area created a much stronger seal with less opportunity for failure in the future. Additionally, the rings could be stacked in a fairly extreme offset. One procedural lesson learned included using lower-cost hard plastic rings to build vertically upward as much as possible after the foam rings were used to achieve the required offset. Had foam rings been used throughout, the project cost could have easily doubled.

Approximate Cost $16,545

OPERA Funding $9,850

Implementation The city will inspect the repaired structures annually to determine how normal Minnesota environmental conditions impact the life cycle of structures rehabilitated using foam rings.

Status Complete

View the complete project report online at www.mnltap.umn.edu/opera.
Roadway Shouldering Machine Modification

Project Number 2014-10
Project Leader Gerald Holo
Agency Otter Tail County Highway Department
505 S. Court Street, Suite 1
Fergus Falls, MN 56537
Phone 218-770-5890

Problem Otter Tail County’s Ulrich shouldering machine was mounted on the front of its motor grader. The machine required two people to operate, with one person sitting in a very unsafe position out on the shouldering machine while the other operated the grader from inside the cab. In addition, the machine’s power unit was old; when the gear box that ran the conveyor belt failed, there were no parts available to fix it. Replacing the machine was also not an option: the county’s budget did not support the purchase of a $65,000 machine that would only be used for three weeks each year.

Solution County staff rebuilt the existing machine to fit on a 624J John Deere loader, which has better capacity to handle the machine’s load. The rebuilt machine is also able to make use of hydraulic power from the loader, ultimately lowering operational costs and increasing efficiency. The redesign has also allowed the machine and the loader to be operated by a single individual seated safely inside the loader’s cab.

Procedure To rebuild the machine, county staff first removed the existing power unit (engine/clutch assembly and gear box). They then reinforced the back of the shouldering machine frame and installed an attachment that allowed the machine to fit on the loader’s quick attach mechanism. The machine’s existing wing assembly was replaced by a newer, lighter wing. Mekalson Hydraulics designed and installed the necessary hydraulic controls on the loader to operate the shouldering machine; it is now driven by an Eaton Controller and a hydraulically driven motor.

Results Otter Tail County achieved its safety goal by removing the operator platform from the shouldering machine and going to an in-loader operator control system. In addition, the county realized a productivity increase of at least 30 percent for roadway shouldering tasks. County staff also recognized a need for heavier shouldering machine ground wheels, which eliminated flex in the shouldering machine’s frame that had been allowing misalignment of the conveyor belt.

Approximate Cost $32,000
OPERA Funding $10,000
Implementation Otter Tail County is currently using the improved roadway shouldering machine to add aggregate to the shoulders of its more than 1,000 miles of bituminous roads.

Status Complete

View the complete project report online at www.mnltap.umn.edu/opera.
PAST OPERA PROJECTS

2013

In-Pavement LED Pedestrian Crossing Operations and Effectiveness
The City of St. Anthony Village installed a pedestrian-activated in-pavement lighting system designed to increase driver compliance in yielding the right-of-way to pedestrians at a potentially dangerous mid-block crossing. The system warns motorists as they are approaching the pedestrian crossing when it is occupied by pedestrians or about to be occupied by pedestrians.

Nonintrusive Road and Weather Information System
During night and weekend weather events, staff at the City of Eden Prairie had a difficult time determining when a full deployment of personnel was needed for snow and ice removal. To facilitate decision making, the city installed a Vaisala road and weather information station that provides real-time information on weather conditions and the current grip level of the roadway.

Traffic Control Response Trailer
The City of Lakeville Streets Division purchased a trailer and fabricated racks to store barricades and other traffic control devices. The trailer has helped the city to better store its traffic control devices, improve its response to traffic control and barricade placement needs, and save time and labor costs.

Sign Inventory Storage Cabinets
Olmsted County lacked the ability to efficiently store and maintain its sign inventory. The county developed a durable storage cabinet system that vertically stores the county’s multiple sizes and shapes of signs. The system allows for easy access and protects the sign sheeting from damage.

Chip Seal over Gravel Road
Silver Creek Township wanted a more affordable solution that could help reduce maintenance costs for gravel roads that have low traffic volumes and primarily serve residential homes and farms. The township applied a flexible chip-seal mat on four miles of gravel roads, which has made the roads smoother and less muddy and dusty.

2012

Evaluation of Deicing and Anti-Icing Technologies
The City of Grand Rapids assessed the operational efficiency of two alternative deicing technologies: tailgate spreaders and an Epoke bulk spreader. The city compared the performance of the spreaders on two equivalent routes.

Sustainable Pavement Rehabilitation Using Thin Bonded Overlay Constructed with High Taconite Mix
The City of Duluth constructed three roadway test sections to evaluate the performance of thin bonded overlay mixes containing taconite tailings, a locally available mining byproduct.

Snow and Ice Products for Bituminous Trails in Recreational and Critical Areas
To improve winter maintenance service delivery on segments of residential bituminous trails and sidewalks, the City of Waconia began treating these areas with anti-icing and deicing winter maintenance liquids. The project included the creation of an application unit as well as the use of a blending station for winter maintenance liquids.

Interim Report: Development of Aggregate Loss Factors for Rural Gravel Roads
Itasca County began collecting field data to measure gravel loss caused by traffic and winter maintenance activities.
After four years of data collection, the information will be used to develop aggregate loss factors that can be used to predict annual gravel needs for a variety of roadway characteristics.

**Greener Bituminous Pavements**
Lake County developed potential reclaimed asphalt pavement (RAP) mixes containing imported, high-quality aggregates that could be tested in a low-volume pavement project. These mixes allowed the county to reduce costs by using less new asphalt while also using surplus RAP material available from local surface renewal projects.

**Implementation of an Anti-Icing Calibration Unit**
The City of Golden Valley purchased an anti-icing calibration unit so its trucks could be calibrated for consistent salt and sand application. The goal of the project was to reduce the city’s material use, resulting in both a cost savings to the city and benefits to the watershed and surrounding environment.

**Skid Loader Bituminous Screed**
Murray County built a wide-screed skid loader attachment to improve the quality of its bituminous patching over large areas. The screed slides on hydraulically maneuverable skids that can be raised or lowered depending on the desired thickness of the patching material.

2011

**Implementation of a Scale-Tec Calibration Scale**
Olmsted County used a Scale-Tec Calibrator to correctly calibrate the amount of salt and sand being applied by its snowplows. By measuring the weight of the discharged material, the calibrator helped the county determine the appropriate settings for each spreader.

**Taconite-Enhanced Pothole Repair Using Portable Microwave Technology**
The University of Minnesota Duluth’s Natural Resources Research Institute partnered with Anoka County and St. Louis County to test the repair of potholes and damaged pavement with mobile microwave technology.

**Innovations in Microsurfacing Materials and Application Techniques**
To improve the properties of microsurfacing for better performance on county roadways, Wright County partnered with Road Science to test a new flexible microsurfacing product on portions of two county roads. The new material was designed to improve the crack resistance of pavement.

**Use of Laser Scanning Technology to Obtain As-Built Records of Historic Covered Bridges**
The City of Zumbrota used laser-scanning technology to complete three-dimensional scanning and data processing of the Zumbrota Covered Bridge. The information was used to assemble a complete digital representation of the bridge and to generate a 1/100-scale three-dimensional replica.

**CAD Drawing of a Simple Salter/Sander Chute**
Washington County fabricated a simple salter/sander chute to facilitate more accurate and precise salt and sand placement on roadways. Accompanying CAD drawings were created to allow other agencies to easily fabricate, install, and adjust the salter/sander chute.

**Rehabilitating/Upgrading Low-Volume Roads with Waste Shingles**
Blue Earth County completed a gravel road stabilization project on a section of County State Aid Highway 48 using a blend of recycled asphalt shingles and recycled asphalt pavement. The county plans to observe the performance of the shingle mix for one to two years.
Stormwater Pollutant Removal in Rain Gardens
As part of a street reconstruction project, the City of Grand Rapids constructed modified rain gardens that discharge to the city's storm sewer system. Although not as large as traditional rain gardens, the modified gardens have potential as a best management practice for reducing stormwater pollutant discharge.

Minnetonka “Winter Green” Initiative
The City of Minnetonka began a “Winter Green” initiative after being notified that it was exceeding its maximum chloride loading standards by the Nine Mile Creek Watershed District. The initiative included an aggressive and comprehensive training program as well as the purchase and installation of upgraded equipment.

Advanced Deicing Product Testing
The McLeod County Highway Department tested the use of IceSlicer™ granular deicing material. The material allowed for reduced usage—about half as much material was needed compared to traditional white salt—at a comparable cost.

Installation and Early Performance of Mastic Patches on City Streets
The City of Bloomington partnered with the City of Minnetonka to compare the performance of mastic products to that of traditional bituminous patching. The materials were used to successfully repair potholes and transverse cracks.

Catch Basin Maintenance/Repair Trailer
The City of Lakeville Streets Division modified an existing trailer for use in catch basin repairs and maintenance. All the necessary equipment and materials are readily available, including a service crane and cement mixer installed directly on the trailer.

Application of Replay® Agricultural Oil Seal and Preservation Agent
The City of Hutchinson used Replay®, an agricultural oil seal and preservation agent that contains no petroleum, to seal two sections of asphalt pavement. Unlike other sealants, the treatment did not become sticky in hot weather, making it ideal for areas experiencing high volumes of pedestrian traffic during the summer.

2010

Magnesium Chloride Dust Coating Evaluation
Magnesium chloride was applied to a county road to help decrease material and maintenance costs. The application eliminated the need to apply a biennial resurfacing aggregate layer and reduced the need for blading operations in areas of light traffic.

City of Eagan Automated Vehicle Location
The City of Eagan equipped its winter vehicle fleet with automated vehicle location technology, allowing managers to observe real-time snow removal operations from any computer terminal and adjust resources immediately via telephone and radio communications.

Cushion Release Push Frame and Weight Transfer Kits
One Cushion Release Push Frame and two Weight Transfer Kits were installed on snow blowing and lawn mowing equipment. The Push Frame assisted the tractor-mounted snow blower in continuously scraping the surface being cleared, and the Weight Transfer Kits permitted operators to increase traction by shifting weight to the drive wheels.

Brunswick Township Erosion Control Project
When a tire fill was used to repair an old corduroy road, a silt fence was required between the construction area and
a nearby swamp to prevent damage to the wetland. The stabilization fabric beneath the tire fill was extended to the construction limits and attached to stakes, forming a positive erosion control barrier.

**Evaluation of Grader Front-Mounted Retriever Hitch**
A front-mounted retriever was used on gravel roads and bituminous roads with gravel shoulders, allowing one motor grader to perform reclaiming and blading operations in a single pass.

**U.S. National Grid Field Marker Prototyping**
The City of St. Paul investigated the methodology and equipment necessary to inexpensively mark infrastructure in the field with U.S. National Grid location data. A smartphone-based system for generating portable markers in the field and a marker-reading application for end users was developed.

**GPS/AVL Tracking and Mapping**
A low-cost, flexible alternative to traditional automated vehicle location systems was developed using Nokia N900 cellular phones, off-the-shelf hardware, and open source tools. The system is designed to help medium and small communities track their mobile assets.

**Ultra Guard Cart Test**
The Ultra Guard Cart, a handheld device that can paint a 6-inch retro-reflective stripe on vertical surfaces, was used to paint guardrails on several types of curves. The cart was easy to use and adjust for different types of barriers, and paint stripes applied by the cart have shown less vulnerability to damage.

**2009**

**Hot-Applied Asphalt as an Adhesive on Cold Longitudinal Asphalt Joints**
An asphalt joint adhesive was used as a sealant on cold longitudinal asphalt joints and at the interface of asphalt pavement and concrete curb and gutter. The joint adhesive is pliable and will allow movement to occur without breaking, unlike the more rigid tack material formerly used to seal these areas.

**Asphalt Emulsion Full-Depth Reclamation and Granular-Base Stabilization on Urban Streets**
Several 7-ton streets scheduled for rehabilitation had their reclaimed road base stabilized with an asphalt emulsion to a depth of 4 inches. The emulsion provided added stiffness to the base section and allowed the depth of the new asphalt to be reduced from 3½ inches to 2 inches.

**Blind Lake Chloride Research Project**
High concentrations of chlorides were identified in the Blind Lake basin in part due to pre-treated road salt leeching into the lake. To lessen the impacts of the chloride, the city used a “liquids only” anti-icing/deicing program in the area.

**Blue Light Use for Traffic Enforcement**
Enforcement lights, which turn blue as traffic lights turn red, were installed at a number of intersections to help police officers observe violators more effectively and reduce right-angle intersection crashes caused by drivers running red lights.

**Crack Sealing on Cupped Joints on Bituminous Pavements**
Extensive cupping at transverse cracks in bituminous pavements allows water intrusion and accelerates pavement deterioration. By using Bergman Companies Inc. Flex-Patch material and a fine aggregate cover to seal cupped transverse cracks and improve ride, the serviceable pavement life was extended without the more expensive mill and overlay.
Culvert Sediment Elimination
Three culverts installed at the same elevation often became plugged during periods of low and normal water flow. The construction of a rock weir near the inlets of two of the culverts forced the water to pass through only one pipe during low- and normal-flow periods, minimizing the collection of sediment.

Road Reclamation With and Without Emulsion
Goodhue County split a 6-mile road project with poor surface conditions into two segments to determine if using an emulsion to build strength down into the existing structure was a viable alternative to the existing rehabilitation procedure.

Evaluation of Rear-Vision Systems for Snowplows
With a tandem snowplow, vision is very limited and several blind spots occur, particularly when the snowplow is backing up. Rear-vision cameras and LCD monitors were installed on snowplow trucks to determine if they would improve drivers’ ability to see directly behind the plows during snow or ice events.

2008

Evaluation of Paving Fabrics for Isolation of Bituminous Cracking
Existing bituminous pavements require major seasonal maintenance for both thermal and distress crack repairs. Spun-glass paving fabric was used to preserve existing bituminous pavements by isolating the effects of heavy crack sealants and reflective cracking.

Low-Cost Base Stabilization
To stretch limited road funds, county officials turned to full-depth reclamation to use the existing bituminous surface as additional base material. An insufficient amount of bituminous and base material, as well as limited road width for additional material, led to the use of a low-cost base stabilizer to strengthen the existing material.

Improvement of Water Quality in Storm Ponds
The Minnesota Pollution Control Agency requires public road authorities and others to construct storm-water ponds as part of its National Pollutant Discharge Elimination System. Two windmills were installed on a berm adjacent to the pond in order to use wind energy at no cost and a direct drive compressor to provide the airflow and oxygen necessary to aerate the pond.

Seal Coating of a Gravel Road Hill
The grade and curves on the Muhle Coulee Hill make it difficult to keep the surface smooth, so a seal coating was applied to the top half mile of the hill. Gravel was applied and then graded, and hot oil and chips were put down and rolled to a smooth surface.

QuickView Storm Sewer Camera
The implementation of the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit requires that owners of MS4 storm sewer systems inspect the systems for maintenance needs. The QuickView camera system allows a single person to view and examine the sewer system as well as record video and audio.

Road Material Recovery
A loss of gravel and crushed rock from road surfaces and shoulders required the installation of a wing-mount retriever on the township road grader, which created smoother transactions and a safer roadway.

Mini Paver
Longitudinal cracks along curb lines and centerline streams required crews to hand-patch certain areas in order to
preserve the integrity of the bituminous surface. Using the Mini Paver more than doubles the amount of patching that can be completed in a day, and roads will remain in better condition longer.

Evaluation of Hot Beam Wiper Blades
Windshield wipers become coated with ice during snowplow operations, causing poor visibility out of the windshield. Hot Beam wiper blades were installed on the front of snowplow trucks to keep ice from forming.

2007

Extending the Life of Bituminous Overlays
Fiberglass mat TruPave was used prior to overlaying with new bituminous in order to prevent reflective cracking and provide a moisture barrier. A June 2006 inspection found that roadway sealed with TruPave averaged 36 cracks per 100 feet, while the control section averaged 79 cracks per 100 feet.

Recycled Tear-off Shingles Road Construction Demonstration
The use of post-industrial recycled asphalt shingles (RAS) as a partial asphalt and aggregate supplement in hot-mix asphalt (HMA) has been specified by MnDOT, but more field experience was required to demonstrate the use of post-consumer RAS. Several HMA blends containing RAS scraps were tested near the town of Hassan.

Millings for Gravel Road Stabilization
Millings were added to Scott County roads that required expensive maintenance because of heavy traffic. The millings were a cheaper alternative that kept roadbeds sturdier as well as less dusty in dry weather and less slick in wet weather.

Pick Cutting Edges
Straight cutting edges on washboard roads disturb more gravel than necessary. Pick cutting edges were used to comb the road top instead. Picked blades also helped remove snow in the winter and helped evenly spread caught-up vegetation on the roadside.

Frost Boil Correction
Geo-Tec fabric was used to seal the road bed instead of rock or gravel in order to prevent frost boiling and other road defects. The material will be used in future road repairs.

2006

Windshield Wiper Deicer
A pneumatic system was installed to remove ice and snow on plow windshield wipers from inside the cab, keeping drivers safe and warm. The system has since been implemented by several agencies and counties.

Concrete Pipe Tie Bars
A tie-bar system on the exterior of concrete pipes allowed crews to positively tie sections of pipe together without having to go inside the pipes and also prevents debris from being snagged inside the pipes.

Increasing the Capacity of Slab-Span Timber Bridges
University of Minnesota research showed that increasing the number and size of spreader beams increased the capacity and performance of a slab-span timber bridge over Buffalo Creek to accommodate increased traffic and loads.

Pedestrian-Activated Solar Warning Flasher
Flashing lights activated by pedestrians drew attention to a crosswalk in St. Paul and initially reduced conflict
points at the intersection, but traffic behavior reverted after about three months, showing the devices have short-term effects on vehicle stopping actions.

**DuraTherm Pavement Markings**
Ramsey County tested DuraTherm pavement markings at a highway intersection for durability, ease of installation, retroreflectivity, and cost. Testing continues to determine if the markings outlast traditional epoxy treatments.

**2005**

**Improved Effectiveness of Salt Brine as an Anti-icing and Prewetting Agent**
Mankato found that liquid corn salt as an additive to the salt brine solution applied to winter roads resulted in longer-lasting road treatments and reduced need for salting trucks during snow events.

**Advanced Warning with Solar-Powered Flashers**
Kanabec County tested three different light-emitting diode flashers to alert drivers to controlled intersections down the road that they might otherwise not notice, especially at night or in inclement weather.

**Dust Reduction and Stabilization of Gravel Roads**
Gravel roads under heavy use in Kanabec County were treated with a soil stabilization product that increased load capacity and durability while reducing dust.

**Construction Project Process Automation**
Software and tablet personal computers used by Morrison County construction crews eliminated many duplications of information in the office and field, saving substantial time—in the case of engineering staff, reducing hours worked by almost half.

**Cameras for Striping Truck**
The cameras on a Washington County striping truck were inadequate for outdoor use. Operators couldn’t view monitors over the glare of sun and the system was susceptible to water leaks. Upgrading to cameras used on large agricultural equipment solved the problem, reducing operator strain and eliminating the retracing of lines.

**Blower Attachment to Remove Grass Clippings From Gravel Roads**
A blower mounted to the front end of a Marshall County motor grader cleared gravel roads of grass clippings, which not only maintained the safety of the roads but also reduced the cost of replacing gravel that previously would have been discarded.

**Rockville X-hesion Testing**
A dust-control product was used on Rockville roads to increase the load capacity and minimize dust, but failed to meet standards of success when tested on three roads.

**New Road Preparation Technology Prior to Overlay**
A flexible slurry system tested on a one-mile section of road in McLeod County improved smoothness, durability, and cost-effectiveness, though the procedure was more expensive than traditional methods.