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# Saving our Secondary Roads

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MARCH 2010 www.BetterRoads.com

By Tom Kuennen, Contributing Editor

# At a Crossroads

## The fate of our secondary roads may be in the balance.

Against the backdrop of stalled federal surface transportation reauthorization and threats from reduced state and local funding, secondary roads are at an intersection.

**Secondary roads** are the essential links to the primary highway system. They link farms to homes, farms to markets, and homes to homes. They move timber from forests to mills and processing plants, raw materials from mines, and provide public access to outdoor recreation and social infrastructure such as schools and hospitals.

The vast majority of the nation's centerline miles are secondary roads. According to Bureau of Transportation Statistics from 2006 — the most recent year for which firm data are available — some 25 percent of the nation's highways was owned by state and federal government, but 75 percent, or 2.9 million miles of America's roads, was owned by counties, cities and townships. The vast majority of these local roads is secondary in nature, as well as a large portion of the state-owned roads.

Battered by heavy agricultural and truckloads, most were not built to withstand long term, and by age and the elements, secondary roads serve essential areas of the nation that would not otherwise be accessible. But because they serve remote areas with rural populations they lie out of the public eye, and they suffer, perhaps not coincidentally, from chronic underfunding.

But while funding, maintenance and preservation for secondary roads may be endangered in lean times such as these, there are options for local agencies.

"Local roads matter," says the National Association of County Engineers (NACE), which has taken a special interest in promoting the needs of secondary systems in the ongoing SAFETEA-LU reauthorization. "Counties are responsible for 1.74 million miles of roads. This is about 43 percent of the total road mileage in the United States."

Complicating the understanding of secondary road needs is the lack of a standard definition of what a secondary road is. We have primary roads that constitute part of the National Highway System, thus by logic we also have secondary roads. But secondary roads can be county roads, municipal roads, local roads, timber roads, unpaved roads, and low-volume roads. Which is it?

"The cleanest definition of a secondary road is a non-numbered route," says Steve Varnedoe, P.E., associate director, National Center for Pavement Preservation at Michigan State University. "At the state level, primary routes carry either interstate, U.S. or state route designations, while the secondary system typically is assigned a unique county-wide numbering sysem."

But many states also have low-volume secondary roads in their system. In Missouri they aren't numbered, but named with letters. In Texas they can be Farm-to-Market Roads. "In North Carolina

| Functional Class | Total Miles In U.S. | # of Miles Reporting to Pavement Condition Report | % Reporting Miles that are Poor to Fair | # Reporting Miles that are Poor to Fair | % Share of Total Poor to Fair Miles |
|---|---|---|---|---|---|
| RURAL | | | | | |
| Interstate | 30,360 | 30,512 | 22.8 | 6,957 | 2.0 |
| Other Principal Arterial | 94,766 | 94,500 | 34.6 | 32,697 | 9.4 |
| Minor Arterials | 135,296 | 134,914 | 46.6 | 62,870 | 18.1 |
| Major Collectors | 419,437 | 378,753 | 64.9 | 245,811 | 70.5 |
| Minor Collectors | 262,899 | -- | -- | -- | -- |
| Local | 2,045,000 | -- | -- | -- | -- |
| Rural Total | 2,987,758 | 638,753 | 54.5 | 348,335 | 100.0 |
| | | | | | |
| URBAN | | | | | |
| Interstate | 16,132 | 15,899 | 39.8 | 6,328 | 3.2 |
| Other Expressways | 10,913 | 10,659 | 49.5 | 5,276 | 2.7 |
| Other Principal Arterials | 63,282 | 61,064 | 70.5 | 43,050 | 21.8 |
| Minor Arterials | 104,033 | 101,637 | 66.9 | 67,995 | 34.4 |
| Collectors | 109,555 | 106,843 | 70.0 | 74,790 | 37.9 |
| Local | 740,273 | -- | -- | -- | -- |
| Urban Total | 1,044,368 | 296,102 | 66.7 | 197,439 | 100.0 |
| Urban and Rural Total | 4,032,126 | | | | |

▲ ***Condition of U.S. Roadways by Functional System 2006****, from most current data available from Bureau of Transportation Statistics.*

*Photo courtesy of Bureau of Transportation Statistics via National Association of County Engineers*

[where Varnedoe worked as state maintenance engineer, and later, chief engineer, through 2008] they are called S.R. routes, which stands for 'secondary road' classification," Varnedoe tells *Better Roads*. "That's not uncommon because most states will have a few secondary roads which serve as arterials that will connect to the main state routes, or some that are strictly local or county-wide in function."

The No. 1 issue that owners of secondary roads are facing is that a lot of the secondary roads were not designed for robust use, Varnedoe says. "When they were designed and constructed, they were paved with a standard design of a thin pavement section over a stone base," he says. "That same design standard might be used throughout the system. They would not go into the level of subsurface investigation that would be used in building a state or primary highway, so the result many times is a hodgepodge of sections without a lot of construction history. The decisions on maintaining them then are based on visual conditions."

## Never enough funds

Paying for them is another major problem facing owners, Varnedoe points out. "Funding is a big challenge," he said, "but a lot of the secondary roads just haven't had the same level of planned maintenance and preservation that the higher-service roads have."

Fortunately, surface transportation reauthorization is giving the secondary roads community an opportunity to spotlight their needs.

"Most roads and bridges in the United States are under local jurisdiction, but national and state transportation funding policies starve them of the resources necessary to maintain a state of good repair and meet growing mobility needs," according to a recent NACE reauthorization advocacy publication. "The consequences of this shortsightedness range from an appalling highway safety record, to a pervasive negative impact on local and regional economies. A new and more enlightened federal, state and local partnership is needed to restore balance to highway investments and achieve important economic, environmental and safety goals."

Not only do local jurisdictions not have enough funds to maintain all their secondary roads, at least one state legislature considered dumping the secondary roads on its network on its counties.

In spring 2009, legislators introduced three bills into the North Carolina General Assembly that would force cities or counties to take responsibility for maintaining thousand of miles of roads now controlled by the North Carolina Department of Transportation.

Each bill targeted secondary roads. One bill would have affected about 64,000 miles of the roughly 79,000 miles of roads the DOT maintains, including in-city roads. Two others targeted in-city DOT-controlled roads only, but because of the way they defined roads eligible for state maintenance, in some cases would force the state to take over roads now belonging to cities, reported the *Durham Herald-Sun*. But the net effect would be to reduce DOT's maintenance burden.

"North Carolina is unique because in all but a few states, counties and townships tend to be responsible for secondary roads," Varnedoe says. "During the Great Depression, North Carolina took over maintenance responsibility for the county roads. Now North Carolina is facing fiscal challenges, like all other states, and they looked at the possibility of divesting themselves of part of the network, as now the state has some 80,000 centerline miles to maintain, far more than other states. That did not come about, but the discussion continues."

## Struggles of the states

The funding gap exists in every part of the nation. In 2009, California's 478 cities and 58 counties owned 81 percent of the state's roads, NACE's state affiliate reported. "A 2007-08 survey shows that California's local streets and roads are on the edge of a cliff," NACE reported. "On a scale of zero (failed) to 100 (excellent), the statewide average pavement condition index (PCI) is 68 ("at risk category"). If current funding remains the same, the statewide condition is projected to deteriorate to a PCI of 58 in 10 years, and further to 48 ("poor" category) by 2033."

In Indiana in 2009, county highway

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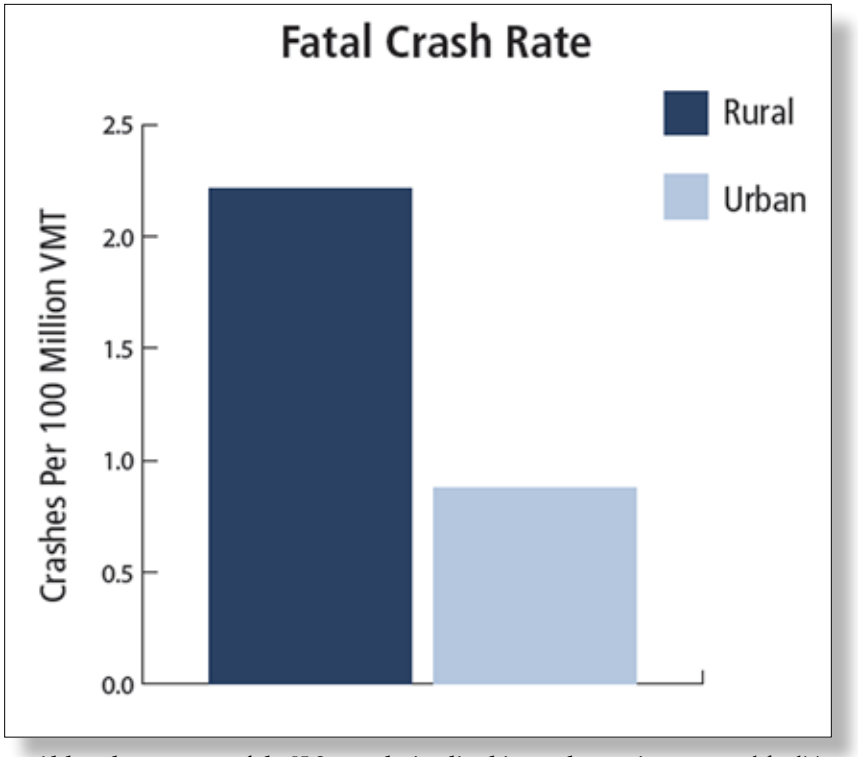
and city and town street departments maintained over 84,000 miles of roads and streets, accounting for nearly 90 percent of all of the public roads in Indiana. "Annual travel on county and municipal roads is estimated at 34 billion annual vehicle miles or 46 percent of the total miles traveled in Indiana," according to the Indiana LTAP Center at Purdue University. "The short-term funding shortfall for local agencies is estimated at $5.4 billion."

But progress is possible when tools such as NACE's *Local Roads Matter!* promotion are used. The New York State County Highway Superintendents Association faced ongoing challenges while fighting for state funding year after year, NACE reported. In response, in 2005, the association worked for a more visible presence with the state administration and legislature.

The campaign stuck to the slogan and theme, and highlighted the impact of local roads on the state and local economy. Then, in 2009 more than 500 county and town superintendents, commissioners and highway industry professionals rallied in Albany, the New York State capital, and spent two days meeting with state lawmakers to request the funding necessary to address the needs for local highway systems, which make up 87 percent of the state's roads.

The campaign worked. In an extremely difficult fiscal year, funding for local highway and bridge projects remained a high priority throughout the thorny budget negotiating process. "In addition to an infusion of transportation funds to New York from the federal American Recovery and Reinvestment Act, the state restored local highway funds originally proposed to be cut from the 2009-10 Executive Budget," NACE reported.

As a result of the enactment of the new budget, Consolidated Highway Improvement Program (CHIPS) funding stands at $363.1 million. Although the same level as the previous fiscal year, the allocation represents a $112 million increase over what was originally proposed for CHIPS in the executive budget. The new CHIPS funding level is $53.4 million more than provided in the Five-Year Capital Plan scheduled amount of $309.7 million.




***Although 23 percent of the U.S. population lived in rural areas in 2007**, rural fatalities accounted for 57 percent of all traffic fatalities that year.*

*Information courtesy of National Highway Traffic Safety Administration via National Association of County Engineers*

## Major safety concerns

Secondary roads bear a higher fatality rate than primary or Interstate routes, or urban routes. This appears to be a result of longer response times for emergency vehicles, in addition to less-forgiving or obsolete designs and alignments.

"There is a need for better and more readily available crash data, specifically on local roads, as it relates to improving rural road safety and in linking congestion problems to crashes," notes Sue Miller, P.E., county engineer of Freeborn County, Minn. "There is a need for a collective responsibility of both the state and local governments to resolve this deficiency."

In the meantime, many states have revenue sharing programs in which state funds are shared with local jurisdictions for road use. The more common template is for county roads to be owned by the county, and some states have programs in which some revenue is kicked back to the county to assist with maintenance and upkeep of county secondary roads. Every state has its own system. But in this recession, most states are strapped for funds and this is affecting their ability to allocate funds.

Complicating everything is the fact that counties and townships are "all over the place" in terms of their tax base and ability to spend money on highways or other public works. "Some counties are pretty progressive, while others won't have the revenue stream and will be less-inclined to have the pavement management system they need to program their funds wisely," Varnedoe says. "But not having a sophisticated system doesn't preclude them from managing their network or having a strategy, although having a system helps."

Just because they are off the primary system does not mean that secondary roads don't undergo crushing loads, at least at certain times of the year.

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***Charles E. Watts Inc.*** *broadcasts double chip seal bottom stone over Cherokee County, Ala., Route 29 near U.S. Route 411 intersection.*

*Photo courtesy of BASF Inc.*

Harvest time results in overloaded high-wall trailers full of produce placing terrific loads on secondary roads not meant to endure them. In addition, the dispersal of manufacturing from urban areas to rural areas during the last three decades has increased the exposure of secondary roads to conventional truck traffic.

"A lot of secondary roads were not designed for the heavy loads, and if you increase your load tolerance for agricultural or forest products, it doesn't take many loads to do damage, especially where you have a thin pavement," Varnedoe says. "And because the local agency doesn't necessarily know what's below the pavement, deci-

sions to permit heavier traffic loads on secondary roads can be very damaging."

In the Midwest, Varnedoe says, the profusion of new green motor fuel ethanol plants has led to reports of damage in surrounding secondary roads. "They have seen significant deterioration on secondary roads within a radius of the new ethanol plants," he says. "Industrialization has an impact."

## Preservation the key

Funding shortfalls and crushing loads notwithstanding, lower jurisdictions have the same "tool box" of pavement preservation practices available to them that larger government agencies have.

"Counties, for example, have the same range of treatments available to them that you would see states using," Varnedoe points out. "There is a lot of opportunity to do preservation on secondary roads. Chip seals are very common on the secondary system, and generally are well accepted by the public, while being a cost-effective way of preserving a pavement. In North Carolina, probably more than half the secondary system was originally constructed with chip seal over base as the original driving surface."

In 2009, a double-chip seal preservation treatment in Cherokee County, Ala., was made possible by use of a rapid setting asphalt emulsion that saved time between applications, and expedited the return of traffic to the county road.

Gadsen, Ala.-based paving contractor Charles E. Watts Inc., received permission from the county highway department to use CHFRS-2P, a cationic, high-float rapid-setting emulsion modified with latex, on its contract to double chip seal a section of County Route 29. This was the first-time use of the product in an Alabama county.

A double-chip seal treatment consists of spraying a pavement surface with asphalt emulsion, covering this with a layer of stone, and repeating the process but using the same emulsion at a different application rate, and smaller stone. Compaction by rollers forces the smaller stone to interlock with the larger.

Throughout the years, this process has proven to be the best surface maintenance treatment for their roads, according to county engineer Corey Chambers, who heads up the department's staff of 30 personnel. "We get more roads done for the dollar with double chip seal than we do with 1 1/2- to 2-inch hot-mix asphalt, about three times the length," Chambers said, adding the treatment adds 10 years or more of pavement life.

## New materials mean help for counties

Like the technique of double-chip seals, innovative new materials can help counties solve secondary road problems. For example, in 2009, a Minnesota county was using warm-mix asphalt to fight destructive asphalt thermal, or low-temperature, cracking caused by fierce winter weather.

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In bituminous pavements, thermal or low-temperature cracking is non-load associated and appears as transverse shrinkage cracks in the asphalt layer. As frigid ambient temperatures chill the surface, they contribute to tensile stresses in the pavement due to material shrinkage. If these stresses exceed the fracture strength of the asphalt pavement layer, transverse cracking develops.

To fight thermal cracking, the county hopes Evotherm warm-mix asphalt (WMA) additive from MWV Specialty Chemicals will get from a lower-cost PG 58-28 binder the same cold weather performance of the more expensive polymer modified PG 58-34 binder specified in Minnesota for newly constructed low-volume bituminous roadways.

But it also hopes to use the WMA additive to improve binder durability by reducing the premature or "artificial" aging to binder caused by exposure to the scorching heat of the asphalt plant burner.

Last summer, Crow Wing County, Minn., was in the second year of testing of warm-mix asphalt to ameliorate thermal cracking and improve binder durability. Following a test project in late 2008, testing in 2009 included placement of two layers of bituminous mix containing a warm-mix additive, and 30 percent reclaimed asphalt pavement, on County Road 2.

"One of the hoped-for benefits of warm-mix asphalt is greater durability over time," says Wayne Dosh, senior engineering technician, Crow Wing County Highway Department. "One of the issues we struggle with in Minnesota is thermal cracking, It's usually the biggest killer of our roads. One of the ways to get around it is by using 'softer' grades of binder. The performance-grade binders used are based on our ambient temperature extremes, and with that kind of spread, it usually implies polymer modified asphalt. By using a warm-mix additive we hope to be able to get the same performance with a non-modified oil as with a modified."

But premature aging of binder also is an issue that the county hopes to minimize with warm-mix asphalt. "One of the benefits of warm-mix over hot mix is that in the hot-mix plant, the heat contributes to premature or artificial aging of the binder, which breaks down the oils," Dosh says. "This gets even worse as the mix ages in-place over time. One of the benefits we're hoping from the warm-mix additive for is for us to be able to use cheaper binder – PG 58-28, that doesn't require a polymer modifier – with the added benefit of less premature aging in addition to less thermal cracking."

The county did extensive research into how premature aging develops, and anticipates that over the life cycle of

the pavement, the field tests will show the benefit of lower production temperatures.

"The initial rate of oxidation is less for WMA pavements than for HMA, which should slow down the binder aging process and extend the life of the pavement, so long as it's maintained properly," Dosh says. "Based on our analysis, the life cycle cost of a low-volume roadway like C.R. 2 constructed with warm-mix PG 58-28 will be lower than a similar road constructed with hot-mix PG 58-34, assuming the rate of aging is slower for WMA than HMA."

For the C.R. 2 project, initial cost of the WMA PG 58-28 was $3 per ton less than the HMA PG 58-34 binder, so the test already was ahead in initial cost, Dosh says. "More data and time are required for long-term performance answers, but the initial indicators are positive," he says.

Projections of life cycle costs for the preliminary project in 2008 yielded very favorable numbers. The life cycle analysis showed that WMA alternatives would cost less per mile than HMA, the main reason being the extended time to the first rehabilitative overlay. As Crow Wing County is responsible for 613 miles of roadway, the cost savings during the life of the roads using WMA would be some $1 million per year.

## Reclamation for secondary roads

For secondary roads past the point of preservation, full-depth reclamation (FDR) is an alternative for cash-strapped local governments. "Full-depth reclamation is easily done on a secondary road, because you can close the road down, remix and reconstruct it, and return with a chip seal or thin asphalt overlay," Varnedoe says. "The lower traffic gives you lower-cost options that might not be feasible for higher-volume roads."

For example, foamed asphalt was a good choice in Summer 2009 for reconstruction of Ashland County Trunk H secondary road on an island in Lake Superior off the Wisconsin coast.

On Madeline Island, Wis. – adjacent to the Apostle Islands National Lakeshore – road construction costs can be extremely high because all material (except sand) must be brought over by barge. But because only liquid asphalt for the foaming process needed to be barged over for this 100-percent in-place recycling project, the use of foamed asphalt resulted in significant savings for Ashland County, Wis., as it reconstructed a completely "green" road base with minimal carbon footprint in an ecologically sensitive area.

The project consisted of reclaiming and recycling 14.5 miles of County Trunk H on Madeline Island. As it takes a scenic loop through woods

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and along the Lake Superior shore, it serves as the only access to a large number of both vacation homes and year-around residents.

While traffic volumes are light, the road often carries heavy trucks hauling fuel oil or construction materials, and suffers badly during the freeze-thaw cycles of northern Wisconsin winters, springs and falls.

Foamed asphalt technology incorporates liquid "foamed" asphalt, or bitumen, in which hot performance-grade asphalt is foamed with water and air, and is injected into reclaimed materials and aggregate in a mixing chamber in a Wirtgen WR 2500, in this application.

Precise addition of water allows control of the rate and amount of asphalt foam expansion. The expanded asphalt has a resulting high surface area available for bonding throughout the materials, leading to a stable cold mix that can be overlaid with a thin wearing course. This cold mix is placed, graded and compacted, and can permit traffic — including heavy trucks — almost immediately.

Tremendous savings in materials extraction and hauling costs are realized because the recycled asphalt pavement (RAP) used in this technology contains aggregates that have already been acquired, permitted, shot, loaded, crushed, screened, stockpiled, reloaded and hauled.

"We decided to go with a cold-in-place recycle project, followed by a thin overlay," says Emmer Shields, P.E., Ashland County highway commissioner. "We decided foamed asphalt was the best option to go with, and we added an addendum to the project to require it," Shields said. The project is Ashland County's first foamed asphalt project.

While not specified, the contractor, Pitlik & Wick, Inc. of Eagle River, Wis., decided to pre-pulverize the base in advance of the foaming. The pulverized base generally was foamed to a depth of 4 in. "The pavement structure varies, and they were having to adjust things as they go through sections with thicker pavement depths," Shields says. "Our understanding of the base was derived from cores and previous plans."

## Pavement inventories and management

For America's road agencies of all sizes, eventually trade-offs will have to be made when balancing the needs of a primary system versus those of a secondary system.

"From a preservation standpoint, an agency can employ a preservation strategy on any network, primary or secondary," Varnedoe says. "When you get down to the finances of it, the level of service that you are trying to provide on an Interstate highway in good-to-excellent condition is much different from that of a secondary road system. I'm not saying that's not desirable on a secondary road system, but the level of service that's acceptable may be reduced while still keeping it in good condition and preservation."

The best way to manage a secondary road system is to revisit a system, then create a pavement inventory that can be the basis of a pavement management system.

"Ultimately, you need to know what you have in the network, which means you need an inventory," he says. "And you need to know the condition of the network, and have a means of analyzing that condition through a pavement management system. That system will help you determine what the conditions are, what the needs are, and be able to forecast what the needs will be in the future as you manage the network on a cost-effective basis."

Roads that are in good condition are excellent candidates for preservation. "You need to keep them at a good level," he says. "Don't put all your efforts into a 'worst-first' approach. Instead, manage your secondary roads as a network, not as individual roads." ❖