HIGHWAYS Seize Environmental INITIATIVE

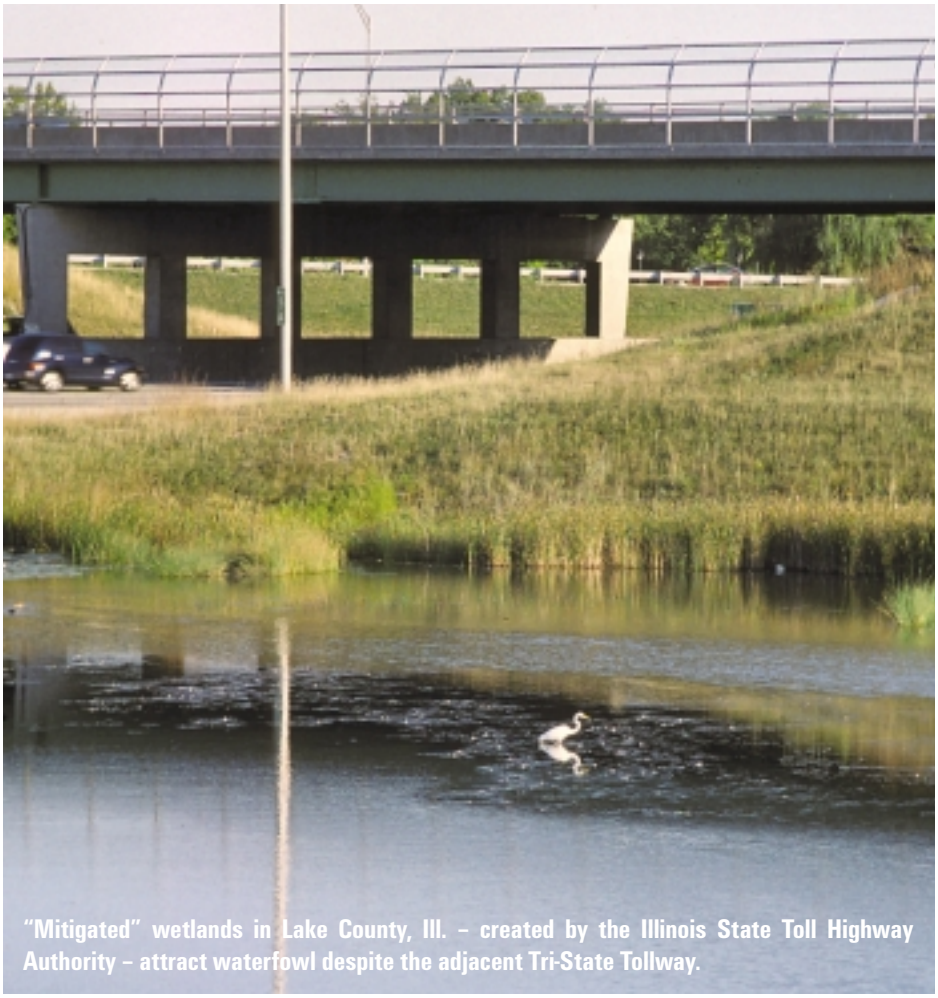
By Tom Kuennen

All factors indicate improvement in environment as traffic loads increase; highways are now No. 1 user of recycled materials

For years, the Dwight D. Eisenhower National System of Interstate and Defense Highways – and the American highway system itself – have been condemned as a despoiler of the environment and destroyer of cities. But nothing could be further from the truth.

Instead, the impartial observer will learn that today's road construction and highways are environmentally sustainable, and can actually reduce pollution when traffic can move unfettered. The nation's air gets cleaner every year, even as traffic and trips increase, according to the Federal Highway Administration's publication, *Transportation Air Quality: Selected Facts and Figures* (2002), and updated by U.S. EPA, U.S. DOT, and U.S. Department of Labor statistics into 2004. And we know more now about how to construct highways with minimal environmental impact, so the highways and bridges of today are designed with environmental and aesthetic needs as foremost considerations, long before work starts.

Today, on federal-aid projects, the highway industry is creating more than double the area of wetlands that are taken in construction, far exceeding the government mandate of 1.5 acres for every one taken.



"Mitigated" wetlands in Lake County, Ill. – created by the Illinois State Toll Highway Authority – attract waterfowl despite the adjacent Tri-State Tollway.

PHOTO COURTESY OF TOM KUENNEN

Only one-quarter of U.S. greenhouse gas emissions are transportation-related. And all transportation-related air emissions – greenhouse gases included – may be reduced by boosting funding for road construction, thus improving mobility and reducing congestion.

State departments of transportation (DOTs) are taking a proactive role in preservation and proliferation of rare native plant species – and in accommodating local wildlife – in both new and existing construction.

High-reflectance (high-albedo) portland cement concrete (PCC) pavements are reducing energy costs by reflecting heat and light away from urban areas, therefore reducing cooling costs, and have the ability to reduce lighting costs at night in the same fashion.

New designs for hot mix asphalt (HMA) pavements are substantially reducing pavement noise by trapping it in pores of an open-graded friction course (OGFC). These same pavements reduce tire spray, making them safer. Research continues on making both asphalt and concrete pavements quieter, and on the best design of noise walls and landscaping to reduce noise emissions.

And the highway industry leads the nation in recycling of materials. Reclaimed asphalt pavement (RAP) is the No. 1 most recycled material, according to the Environmental Protection Agency. Crushed portland cement concrete also is recycled extensively, and new research is showing new venues for its reuse. And, in addition to those reused construction materials, reclaimed post-consumer and post-industrial materials are going into engineered pavements, enhancing their performance as well as reducing pressure on landfills.

The results have been spectacular. Today, transportation is considered the No. 1 financier of historic preservation and archaeology. Transportation funding for bicycle and pedestrian projects has risen 80-fold since 1988, $2.6 billion in the 12 years ending 2003. It's part of the nearly 15,000 enhancement projects executed since 1992, providing billions of dollars for historic preservation, bicycle and pedestrian trails, landscaping, and community improvements. Recently, some 5 percent to 20 percent of a highway project cost has been invested in environmental elements, according to the Federal Highway Administration's (FHWA's) "Transportation Air Quality: Selected Facts and Figures" (2002).

Unfortunately, when it comes to recognition of their environmental benefits, it could be said that "highways get no respect." Little is said about the multitude of environmental and societal benefits that result from transportation.

In response, in 2001, the American Association of State Highway and Transportation Officials (AASHTO) created the AASHTO Center for Environmental Excellence for the purpose of promoting environmental stewardship, along with encouraging innovative ways to streamline the transportation delivery process. AASHTO recognizes that the American public demands projects that not only provide mobility, but also contribute to one's overall quality of life.

"Across the nation, programs to construct and rehabilitate U.S. roads and highways are revitalizing communities, enhancing the environment, and improving quality of life," said AASHTO Executive Director John Horsley in "Taking the High Road: The Environmental and Social Contributions of America's Highway Programs" [2003], a product of the center. "From preservation of historic covered bridges, to recovery of the delicate and endangered Karner blue butterfly, highway programs are balancing mobility goals with a responsibility to protect and enhance the nation's natural and cultural resources."

Rubber Pavements Association photo

Asphalt-rubber modified OGFC is placed in the Phoenix area as part of a major resurfacing of all freeway pavements. The asphalt contains recycled rubber and results in quieter pavements with less tire spray in rain.

A Legal and an Ethical Obligation

America's highway agencies have both a legal and an ethical obligation to enhance the environment as they pursue their mission of providing and maintaining transportation infrastructure.

"The Bush administration, [U.S. DOT] Secretary [Norman] Mineta and all of us at Federal Highways believe we can and must deliver the transportation improvements on which our economy and quality of life depend, and at the same time protect and enhance our natural environment," said FHWA acting administrator Rick Capka at FHWA's Environmental Excellence Awards in April 2005. "The dedicated people we honor today show we can have a high-quality transportation system and a healthy environment. They delivered excellent projects that keep our economy moving, while they protected what we cherish so much: clean air, clean water, and a healthy environment."

One goal of FHWA's National Strategic Plan is to protect and enhance the natural environment and communities affected by highway transportation.

Air quality monitoring data through 2000 shows that 76 out of 78 carbon monoxide nonattainment areas no longer show air pollution levels that exceed the National Ambient Air Quality Standards. From 1970 through 1999, total CO emissions fell 25 percent, and on-road vehicular CO emissions plunged 43 percent, despite huge increases in vehicles and travel.

"A strategic objective ... is to improve the quality of the natural environment by reducing highway-related pollution and by protecting and enhancing ecosystems," said James M. Shrouds, director, FHWA Office of Natural and Human Environment. To this end, FHWA measures performance through air quality and wetland mitigation indicators.

Performance of the air quality indicators is measured against reducing of on-road mobile source emissions by 20 percent in 10 years, and the country each year having more EPA-designated air pollution "nonattainment" and "maintenance" metropolitan areas that are meeting their on-road mobile source emission reduction plans.

Performance of the wetland mitigation indicator is measured against the goal of providing 1.5 acres of mitigation for each acre of wetland unavoidably affected on federal-aid highway projects, program-wide.

The most recent firm data are EPA estimates through 2003, which show on-road mobile source emissions are down nearly 25 percent from 1996 to 2003.

Furthermore, at time of writing, a high percentage of urban areas were meeting their emission goals in FY 2004, with over 96 percent of ozone areas, over 95 percent of carbon monoxide (CO) areas, and over 97 percent of particulate matter (PM) areas designated as nonattainment or maintenance had met their on-road mobile source emissions budgets.

Cleaner Air, More Drivers and Mileage

It's inescapable that the air has gotten healthier and cleaner, while the U.S. economy has grown and the number of drivers and miles driven has increased. The most recent firm U.S. EPA, DOT, and Department of Labor statistics (into 2004) available – as compiled for the Foundation for Clean Air Progress – indicate that from 1970 through 2004, nitrogen oxide (NOx) emissions have declined by 17 percent, sulfur dioxide (SO_2) emissions have declined by 49 percent, lead (Pb) emissions have declined by 98 percent, carbon monoxide (CO) emissions have declined by 41 percent, volatile organic compounds (VOCs, precursors to ozone) have declined by 48 percent, and particulate emissions from combustion declined by 82 percent.

This was against a backdrop in which the U.S. population grew by 42 percent, to 291 million, overall energy consumption grew by 43 percent, to 97.351 trillion btus, total U.S. employment grew by 95 percent, to 138 million, the number of registered vehicles grew by 111 percent, to 235 million, the annual vehicle miles traveled (VMT) grew by 151 percent, to 2.8 trillion miles, and "real" gross domestic product (GDP) grew by 175 percent, to $10.381 trillion.

That such environmental improvements have taken place in the face of the growth of economic factors that popularly are associated with the spread of pollution just shows how far the nation has come since 1970, and the transportation sector has played an enormous role in all this.

Wetland 'Mitigation' Way Ahead of Goals

Wetlands such as bogs, swamps, and marshes serve a number of valuable functions, such as controlling floods, improving water quality, and providing wildlife habitat, among other things.

In the early 1990s, FHWA established an agency policy of no-net-loss of wetland affected on a program-wide basis for federal-aid highway projects, meaning one acre of wetland "mitigated" (recreated) for every one taken. But seeing a high level of success possible, in 1996, the FHWA revised its no-net-loss policy upward to a "net gain goal," with a 1998 performance measure of 1.5 acres of compensation for every acre affected under the federal-aid highway program.

The goal was far exceeded. By 2002, the highway industry had surpassed FHWA's goal of 1.5 acres of mitigated wetlands for every acre affected, at a rate of 2.7 acres to 1. On a program-wide basis, the FY 2004 figures – the most recent available at writing – indicate that federal-aid highway projects provided 2.1 acres of

GOMACO CORP. PHOTO

Portland cement concrete is an environmentally sustainable paving medium.

Americans use cars more than any other form of ground transportation. Ninety-six percent of all passenger miles took place in personal vehicles (automobiles, motorcycles, and light-duty trucks) in 1998. Light-duty trucks, such as minivans, pickup trucks, and sport utility vehicles, make up an increasing portion of miles traveled.

compensatory wetland mitigation for each acre affected. While that's down slightly from previous years, it still continues to exceed the performance goal of 1.5 acres mitigation per acre of impact, with great benefit to wildlife and society.

Context-Sensitive Designs

Another way the highway community is making its projects more environmentally unobtrusive is through context-sensitive design.

"Context-sensitive solutions (CSS) consider the total context within which a transportation improvement project will exist," said the AASHTO Center for Environmental Excellence in its 2005 Best Practices in Context-Sensitive Solutions competition awards announcement. "CSS is a collaborative, interdisciplinary approach that involves all stakeholders to develop a transportation facility that fits its physical setting and preserves scenic, aesthetic, historic and environmental resources, while maintaining safety and mobility."

For this competition, AASHTO received 75 applications from 33 states. After careful review by a diverse expert review panel, three winners and seven notable practices were selected. "These winning transportation projects, programs, and initiatives demonstrate exemplary efforts in CSS that will serve as models for achieving transportation solutions that fit the natural and human environment while achieving mobility and safety goals and enhancing community," AASHTO said.

The winning project was the 47-mile Minnesota Trunk Highway 38 (TH 38). The Edge of the Wilderness National Scenic Byway Corridor weaves around lakes and wetlands, allowing travelers to experience Minnesota's northern woods.

Faced with the need to reconstruct the aging highway, the Minnesota Department of Transportation (Mn/DOT) developed partnership alliances with federal, state, and local stakeholders to guide the planning, scoping, and design process associated with the corridor. The resulting corridor reconstruction project exemplifies context-sensitive solutions, balancing safety, mobility, environmental, and community values.

The consensus solution focused on maintaining the two-lane roadway and existing alignment, incorporating spot upgrades where needed for safety improvements, and significantly reducing the amount of vegetation that needed to be cleared. The project incorporated 4-foot paved shoulders with a rumble strip and an additional two feet of reinforced soft shoulder to improve safety and accommodate bicyclists, while reducing the roadway impacts on the land.

Context-sensitive features and interpretive sites along the corridor were provided, including turnouts, rest areas, boat access sites, parallel trails, and sidewalk and streetscape enhancements. "The improvements have contributed to significantly reduced accidents, enhanced mobility, greatly reduced cost, and context-sensitive outcomes – all well ahead of schedule," AASHTO said.

Stewardship Plus Streamlining

Since the 1970s, the highway industry has worked assiduously to improve its environmental performance. At the same time, the environmental lobby succeeded in slowing down projects by using environmental impact legislation to enmire transportation projects. The results have been devastating, with major transportation projects mired for years of costly delays, new lawsuits filed, and studies ordered, even as existing issues were cleared.

The mechanism for this was the National Environmental Policy Act (NEPA) of 1969, which directs federal agencies – when planning projects or issuing permits – to conduct environmental reviews to consider the projects' potential impacts on the environment. After NEPA, in 1971, the average time to complete FHWA environmental impact statements was about 2.3 years; by 1980, it had risen to 4.3 years, and to five years in 1993. It hit a peak of about 6.5 years in 2002. Since then, the industry has worked hard to "streamline" this environmental review process while maintaining its overall fairness.

In 2002, President Bush issued an executive order – Environmental Stewardship and Transportation Infrastructure Review – that energized federal agencies involved in environmental streamlining for transportation projects. In mid-2004, the average FHWA environmental impact statement completion time had plunged back down to just over five years and continues to fall.

ASPHALT INSTITUTE PHOTO

A snow fence complements Interstate 80 near Elk Mountain in Wyoming.

The new Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy For Users (SAFETEA-LU, August 2005) contains elements that will help streamline environmental approvals, including a 180-day statute of limitations for lawsuits challenging federal agency approvals. This is longer than the 90-day period suggested by some opponents, but it's a step in the right direction.

"Delivering transportation projects better and faster requires a double commitment, to environmental stewardship and to expedited project review," AASHTO said in its pre-SAFETEA statements, indicating to all that the two must go hand-in-hand if infrastructure needs are to be met.

And the effort continues in other ways. For example, the new Mid-Atlantic Green Highways Initiative was created to promote innovative streamlining and market-based approaches toward sustainable transportation projects, and will create partnerships to promote watershed-driven storm water management, use of industrial byproducts and recycled materials in highway construction, and conservation and ecosystem management. The initiative is supported in part by a $500,000 pledge from FHWA, and it's thought that the initiative will provide a blueprint for similar initiatives elsewhere in the country.

PHOTO COURTESY OF TOM KUENNEN

Milled reclaimed asphalt pavement (RAP) is stockpiled at an Ohio asphalt plant for reuse as base or in hot mix asphalt pavement.

Highways Lead in Recycling

The road construction industry is the leader in waste material recycling. America's highway construction and reconstruction industry has by far become the No. 1 recycler of waste materials in terms of tonnage, saving tax money, and reducing demands on landfills and quarries and gravel pits, prolonging those resources.

Among the products recycled in road building and reconstruction are reclaimed asphalt pavement (RAP) as base material and as asphalt pavement, and reclaimed demolition portland cement concrete (PCC) as base material.

Post-industrial reclaimed materials also are added to concrete pavements, adding to their strength, performance, and resistance to damaging chloride penetration. These include fly ash from the combustion of coal for electric power, silica fume from the manufacture of glass, and ground granulated blast furnace slag (GGBF) from the manufacture of steel, all added to concrete.

Crumb rubber from old tires enhances asphalt pavements and surface treatments, and is reused as bases for temporary traffic signs, traffic cones, or in rubber railroad crossing pads. Crushed, rounded broken glass also is used as a mineral aggregate in asphalt, along with waste sand from metal-casting foundries and reclaimed asphalt roofing shingles. In California, even crushed toilets have been placed in road base.

But the largest application is for RAP. Special machines mill off aged, cracked asphalt pavement in varying depths and widths, and convey the RAP to dump trucks, which haul to stockpiles. From there, it's reused as inexpensive road base, added to virgin HMA as a tested material, used for driveways, bike paths, recreational trails, and much more.

Asphalt pavement is unquestionably the nation's most widely recycled product, reports the Asphalt Pavement Alliance, an industry coalition. Using EPA statistics from FHWA, APA says about 80.3 million of the 100 million tons of asphalt pavement that is removed each year during resurfacing and widening projects is reused as part of new roads, roadbeds, shoulders, and embankments. That's a recycling rate of 80 percent.

The 80.3-million-ton volume of recycled asphalt pavement is about one-third higher than the total volume of 60.7 million tons of post-consumer recycling. And it's double the volume of paper, glass, plastic, and aluminum combined, APA reports.

Use of RAP also saves valuable aggregate resources. While in America there are plenty of construction aggregates in place in the ground, there are fewer and fewer aggregate sites that are permitted for extraction. Existing quarries or gravel pits once outside of a city now are being overwhelmed by new suburbs and neighbors who don't like living near quarries and will fight any kind of expansion. But the RAP contains existing aggregates that have already been acquired, permitted, shot, loaded, crushed, screened, stockpiled, reloaded, and hauled, saving time, money, and resources.

COLORADO DOT

State DOTs mow less and grow wildflowers along roadsides, improving roadside aesthetics and providing cover for nongame wildlife.

Highways Getting Quieter

Also, new solutions are coming into play to control noise from America's Interstate highways, primary highways, and arterial streets. Road agencies are spending more on noise mitigation. On new or capacity improvement projects, sound walls that were once considered an extravagance now are standard procedure.

Engineers are finding that the best solution to highway noise is a combination of sound wall, appropriate vegetation, and a quieter pavement surface. Any combination of the three elements will help, because noise barriers can cost on the order of $1 million to $1.5 million per linear mile, with $1.25 million per mile being the rule of thumb.

Highway noise barriers can be of many varieties, including recycled plastic, wood, evergreens, gabion walls, and precast concrete panels. Trees – such as stands of thick evergreens – have the potential to replace noise barriers, and are aesthetically pleasing, but are effective only in deep stands, requiring additional strips of right-of-way, as much as 100 feet wide.

Efforts to limit highway noise have focused on barriers. But because most of the noise originates at the tire/pavement interface, use of "quiet pavements" to quell noise there makes sense.

Sophisticated asphalt pavement designs – like polymer-modified open graded friction courses (OGFCs) – offer greater tire/pavement noise reduction than conventional asphalt mixes. Also, their porous nature allows for fast drainage of water and eliminates the problems of tire spray, glare, and hydroplaning.

For PCC pavements, texture is added to improve friction and driver control, but done incorrectly it can add to pavement noise. Tine or groove depth, width, spacing, and orientation are all major factors affecting tire-pavement noise. Transverse tinings with uniformly spaced tines 0.5 inches or greater have been found to produce an objectionable tone, with pressure spikes at specific frequencies, that users interpret as a tire "whine." Randomly varying the transverse tine spacing can reduce the tonal quality problems.

Highways Accommodate Animals

If all this is not enough, new designs for highways and bridges now incorporate elements that enhance life for nearby wildlife and plants, whether endangered or not. This technology is shared among the state DOTs through the FHWA's Keeping it Simple Web site (www.fhwa.dot.gov/environment/wildlifeprotection/), administered by its Office of Planning, Environment, and Realty (HEP).

- For example, when the Missouri DOT completed improvements on two Meramec River bridges near St. Louis, they left the bottom foot of the work platform intact to benefit federally endangered pink mucket mussels and more than 25 other mussel species, which had been relocated to safer habitat upstream of the bridges. Scuba divers report that sand, small gravel, and other substrate materials have accumulated between the rock rubble, creating favorable mussel habitat, and that the pink muckets and other species are recolonizing this part of the river. Not removing all of the work platform also meant less disturbance to the river bottom and therefore less sediment to drift downstream.
- In Arizona, along a two-mile stretch of Arizona S.R. 86 on the Tohono O'odam Reservation, a simple fence has reduced the number of annual desert tortoise deaths by 75 percent. Arizona DOT maintenance crews installed the 24-inch welded-wire fencing onto the bottom of a right-of-way fence on both sides of the highway. Six inches of the new fence were buried below ground so migrating tortoises could not crawl under it, and the fence was secured to an existing culvert through which the tortoises could cross back and forth under the highway.
- In California, the threatened desert tortoise in San Bernardino County has been helped by Caltrans' briefing I-15 contractors to keep garbage cans tightly closed and empty trash regularly, because ravens – the major predator of desert tortoises – are attracted to garbage. They're also urged to avoid handling the tortoises (handling can cause the animals to dehydrate and die), frequently checking under vehicles and equipment, carefully checking potential excavation "traps," and prohibiting pets from the project sites.
- In many states, DOTs are no longer keeping roadways mowed to look like lawns, saving money, lessening injuries, and enhancing the environment with wildflowers and new wildlife habitat.

For example, the Arkansas Highway and Transportation Department recently established "transition zones" – areas mowed only once a year – along non-Interstate highways and on approximately 200 Interstate interchanges. These infrequently mowed zones next to high-maintenance areas immediately adjacent to the roadside have increased habitat for ground-nesting birds such as Eastern meadowlarks, mourning doves, and ovenbirds, and for rodents such as harvest mice, deer mice, and cotton rats, which provide food for predatory birds like the red-tailed hawk.

Visit HEP's Keeping it Simple Web site at http://www.fhwa.dot.gov/environment/wildlifeprotection/ for many more examples.

Don't Blame Sprawl on Highways

Another ecological bugaboo – suburban sprawl – is supposed to be encouraged by highway construction, and for years has been presumed to be draining central cities of their residents, destroying farmland, forcing new investments in suburban infrastructure while precipitating disinvestment in central city infrastructure, and even contributing to global warming.

While it's clear that highway construction and sprawl go hand-in-hand, it would be a mistake to assume that highways "cause" sprawl. Instead, in the United States, contemporary suburban sprawl was launched by the railroads in the late 19th century as a means of developing high-value real estate far from the furor of the cities. Up and down the urban East Coast, and in older Midwestern cities like Chicago and St. Louis, "old line" suburbs lie along former passenger (now commuter) rail lines. Ironically, today, the Green movement considers a beefed-up commuter rail system a way of forestalling sprawl.

In late 2005, a new tome investigated the causes of urban sprawl and found that it is inherent in the human condition. In *Sprawl: A Compact History,* Robert Bruegmann – a professor of art history and urban planning at the University of Illinois at Chicago – demonstrates that urban sprawl is a natural process as old as the world's oldest cities, in which large cities reach a point of maturity, and those with financial means escape the congestion and high prices of city life. Bruegmann says that what has changed is the fact that U.S. citizens are so prosperous that suburban life is no longer an exclusive luxury of the rich, and that has driven tremendous expansion of U.S. suburbs.

Sprawl is presumed to be self-perpetuating, attracting even more vehicles to overloaded streets and roads, which requires more widening, which attracts more vehicles, ad infinitum. This is a rephrasing of the "chicken-or-the-egg" question, in which planners are challenged to address the issue of what comes first: vehicles or highways. In truth, each are so intimately wound with each other that they cannot be separated.

If anything, the urban expressways of the Interstate system today make it easier for suburbanites to get to the inner city and spend money there, on shops, stores, sightseeing, restaurants, entertainment, and sporting events. The real question is: "How does unfettered mobility in America's free market economy contribute to economic growth and consumer choice?" And then, "How does road construction multiply economic growth?" In this context, congestion, economic development, and suburban sprawl are the kinds of "problems" that most undeveloped countries in the world might like to have.

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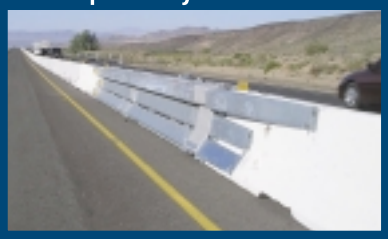

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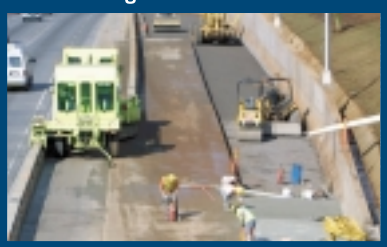

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Roads and the Environment Find Common Ground with Asphalt Recycling

By Stu Murray

When the federal government committed to funding state roads in 1916, many highways outside cities lacked hard pavements and were lucky to be of macadam or gravel surfaces. In 1916, only 295,000 miles of U.S. roads had any kind of surface, compared to over 4 million miles paved by this year. Back in 1916, auto and truck registrations totaled 3.6 million vehicles, but by 2005 they exceeded 231 million.

To keep up, America vigorously built roads, culminating in our Dwight D. Eisenhower National System of Interstate and Defense Highways. Always, the emphasis was on building new roads or providing new capacity. But we now are in the post-Interstate era, and state and federal attention has shifted to maintaining and preserving our roads, rather than expanding the system. Simultaneously, new demands of environmental stewardship have affected road building and maintenance to levels unimaginable a few decades ago.

Anticipating these new needs, Wirtgen America Inc. is proud to have led the market with unique, technologically advanced road maintenance and construction equipment that provides innovative mechanical – and environmentally sensitive – solutions to pavement maintenance and construction problems.

For example, in the past 20 years, America's highway industry has become by far the No. 1 recycler of waste materials, mostly reclaimed asphalt pavement (RAP). Use of RAP saves existing resources as well as huge sums of tax dollars. Asphalt recycling and cold milling technologies developed under Wirtgen help road agencies make scarce road funds go further, permit low-cost reconstruction of roads, and re-use in-place construction materials.

A new twist for today, though, is the abundance of environmental restrictions on how and where aggregate extraction and hot mix asphalt plants can be located, which drives up the cost of virgin aggregates and adds to delivery costs. In-place, high-volume foamed asphalt pavement reconstruction – as developed by Wirtgen Group – addresses the challenges of high petroleum costs, aggregate extraction costs, and high environmental standards with one process.

Instead of costly heavy equipment and endless dump trucks being used to dig out and remove failed roads – followed by an equally costly and disruptive reconstruction – failed pavements now can be ground to bits and then stabilized as road base with asphalt foam in just one pass by a single machine.

An environmentally sensitive project just completed last summer has proven that one-pass, 100 percent cold recycling of high-traffic, limited-access pavements is practical, economical, and environmentally beneficial.

The project – in-place foamed asphalt recycling of I-80 in the Sierra Nevada, a major Interstate highway linking San Francisco with Reno – was completed in summer 2005 and demonstrated that in-place foamed asphalt recycling of Interstate-type highways is a powerful alternative to conventional reconstruction, opening the door for similar projects in every state of the union.

Application of foamed asphalt for Interstate 80 in California provided more than a superior base course; it saved money, big-time. The contractor's early estimate is that the foamed asphalt process directly saved over $1 million for California taxpayers over the conventional reconstruction that Caltrans proposed.

But much more was saved. Because RAP already contains existing aggregates that have already been permitted for extraction and processed, tremendous savings in extraction and hauling costs were realized. This includes fuel to mine virgin aggregates, fuel to move the aggregates to a processing plant and then to an asphalt plant, fuel used to dry and coat the aggregates, fuel used to haul the asphalt to a paver, and fuel used by trucks to go back and get another load.

Fuel also was saved by motorists – and the air was cleaner – because the one-pass method created a lot less work zone-related traffic congestion. And, as the average virgin hot mix design will incorporate 5.5 percent to 6 percent liquid asphalt – and this recycle method used only 2.5 percent liquid asphalt – there was a huge savings in liquid asphalt alone, especially meaningful these days, when crude oil prices are so high.

As America's roads and Interstate highways enter their next era, Wirtgen is working to help highways and the environment find common ground.

Stuart W. Murray is president, Wirtgen America Inc., Nashville, Tenn.