Washington State

# LTAP News

Local Technical Assistance Program

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Last Printed Issue
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Perpetual Pavements Last Decades Without Major Reconstruction . . . . . page 10



Washington State Department of Transportation

Issue 96, Winter 2007-2008

# Washington State LTAP Center

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*Cover photo: Mountain snow and ice control.*

Washington State
Department of Transportation

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# Small Highway Project Yields Big Results – For Fish and Drivers

## Crews Replace Culvert and Improve Road on State Route 548 Near Birch Bay

*By Katie J. Skipper, WSDOT Communications*

At first glance, work this summer on State Route 548 appears to be just a little culvert replacement project. But what started as a concern from a local environmental nonprofit group has yielded benefits beyond the work zone. It resulted in improved habitat, structure and safety, and served as a classroom and field training opportunity for a young engineer.

SR 548, or Blaine Road, is a rural highway tucked up in the northwest corner of Washington near Birch Bay in Whatcom County. On average, about 2,000 vehicles a day travel the highway over Terrell Creek.

About 45 feet below the asphalt, a rusted steel pipe was intended to convey Terrell Creek from one side of the highway to the other, providing a passageway for fish moving upstream. Puget Sound steelhead, recently listed as threatened under the federal Endangered Species Act, are among the fish that depend on the stream for habitat.

*WSDOT took the opportunity to flatten a dip in State Route 548 in Whatcom County while they were replacing a culvert.*

*The broken ends of an old steel culvert flipped up when water was running high, blocking passage for fish trying to swim upstream. The broken culvert also was an indication that water could be seeping in around the pipe, jeopardizing the road above.*

*The old culvert sat high above the stream bed.*

## Problems Emerge

Nooksack Salmon Enhancement Association, a Whatcom County-based environmental nonprofit group, alerted WSDOT that the culvert was failing and creating a barrier to fish. Part of the group's focus is lowland streams such as Terrell Creek, where habitat is degraded by past land uses such as farming.

Salmon Association members noticed the Terrell Creek culvert, a corrugated pipe about 110 feet long and 12 feet in diameter, was hanging about a foot above the surface of the creek, creating a difficult jump for fish. During high water, sections of the decaying pipe would flip up at the upstream end and close off the pipe completely.

Kristin Fredericks, a WSDOT wetland and fisheries biologist, said the constricted space was shooting water through with too much force, leaving no place for fish to rest.

"It's like a fire hose," Fredericks said before the improvement project began. "It's too small, and the water flows too fast."

Engineers knew that if the culvert was falling apart, damage could extend beyond fish passage. A crack in the metal beneath the road could allow water to pool and wash out pockets of soil around the pipe, potentially creating a dangerous sinkhole.

"The culvert was going to have to be replaced eventually because of rust, but it wasn't a high priority," said Marco Foster, a WSDOT engineering manager. "Coupled with the fact that it is a high priority for fish – that's what got the project funded."

Since the work was going to involve tearing out a section of road to replace the culvert, WSDOT took the opportunity to improve driver safety, too. Cars were obscured from other drivers' view when they traveled through a significant dip in the road. From crest to crest, the hills were 600 feet apart, with a dip that dropped 9 feet in the middle.

WSDOT secured $2.2 million in federal funding for the highway preservation project. Ferndale-based Callen Construction Co. was awarded the $1.3 million construction contract.

## Learning Experience

About two years ago, 28-year-old transportation engineer Brian Charleston was assigned the lead design role for the project. Charleston was still cutting his teeth with WSDOT. He had been with the department for a year, straight out of the University of Illinois.

After designs were complete, project engineer Chris Damitio put Charleston on the project as lead inspector so he could see the process from beginning to end.

*The culvert was 25 to 30 feet below the road, making it difficult to get to.*

*WSDOT project engineer Chris Damitio, left, and lead inspector Brian Charleston, discuss details of the culvert replacement project at Terrell Creek.*

*King sized bucket brigade: Crews worked in tight spaces and on steep slopes to conserve space and limit adverse effects to the surrounding area.*

"It's not uncommon, and it is instructive," Damitio said. "When we get the opportunity, we try to match the designer with the construction project, especially a beginning engineer."

The culvert replacement was perfect for Charleston because it was a smaller, shorter-term project.

"To be able to do that, you learn a lot," Charleston said. "I know how stuff is built now and what the material looks like."

And he knows where he can improve his designs for next time. For example, he underestimated how much material it would take to fill the road in over the culvert, and he didn't intervene when he noted the contractor was overbuilding side slopes.

As a result, the project required 11,000 tons more fill material and nearly $100,000 more than Charleston had estimated in his design. But overall, the project finished on time and on budget.

Damitio pointed out that errors are made on every project, and contingencies are built into all plans.

"He did a wonderful job," Damitio said. "As long as he learned from his mistakes, those challenges become successes."

## Moving Dirt

Starting June 11, Callen crews spent three weeks clearing trees so the phone company could move overhead lines.

Water from the stream had to be pumped out and diverted through the work zone to an area downstream.

Fredericks, the WSDOT biologist, removed all the fish from a large scour hole downstream of the culvert so they wouldn't be harmed during construction.

Once the fish were removed, crews were ready to start digging. Crews would need to close the highway for 43 days because they were cutting out a section of roadway and rebuilding it. But traffic control was a breeze because of the relatively small amount of regular traffic, and because alternate routes were available on county roads, adding about a mile to a drive through the area.

It took about a week for crews to dig down 45 feet to the culvert in a section about 100 feet long, and chip out the old culvert. About 4,000 cubic yards of material – filling more than 250 dump trucks – were hauled off and stockpiled nearby to be used later for fill. All but the clay layer was saved to be put back. Charleston estimated that about 75 percent of the excavated material was used as fill.

In the interest of disrupting as little soil as possible, they built a steep service road down to the culvert base. With a 30 percent grade, the trucks could make it down the hill, but a bulldozer had to pull them back out.

"The crane driver was worried the brakes weren't going to work," Charleston said.

*A crane lowers one of the first sections of the culvert into place.*

*The new culvert measures 145 feet long, 18 feet wide, and 10 feet tall.*

*Replacing the culvert required cutting out a section of the highway.*

## New Culvert, New Design

The rusty old steel culvert was replaced with a concrete box culvert. The advantage of the box culvert design was that the flat bottom could create a seamless transition to the adjacent streambed, both in terms of the level and the gravel material.

An 80-ton crane lifted 30 base slab pieces and 30 top pieces of the culvert into place. Each 40,000 pound concrete section took about a half hour to put in place. Crews lined the edges of each piece with a fine cement grout to seal the joints. Assembling the culvert took about a week. The new culvert is 145 feet long, 18 feet wide and 10 feet tall.

Once the pieces were in, it was time to start refilling the hole and lining the culvert with streambed gravel. Backfilling took about two weeks, and putting in stream gravel took about two days.

With the new culvert in place and the road base built over it, all that was left to do was wait for the pore pressure in the clay layer to dissipate before crews put down the final layer of embankment and pavement.

Charleston expected to open the road temporarily and let cars drive over it for a week or two. But the soils quickly settled into place and the pressure remained stable, indicating that the embankment was stable enough to place the last layers of material.

"We just went ahead and finished building the last layers," Charleston said. "Then we just paved, striped, placed guardrail and planted."

Nearly 300 trees and shrubs of 12 different types were planted, including cedar, Indian plum, elderberry, salmonberry, Douglas fir and broadleaf maple.

Through an agreement with WSDOT, the Nooksack Salmon Enhancement Association planted and is maintaining a stream buffer downstream as mitigation for the environmental effect of construction.

"That saves us time and money," Charleston said. "We didn't have to purchase any property because they're planting on a conservation easement owned by BP (the nearby refinery)."

The road opened Sept. 14 and planting at the project site was finished in early October.

The final product was a dramatically improved section of highway that provides a smooth path for both fish, and the drivers above.

*Crews laid streambed gravel across the base of the new culvert creating a seamless transition with the natural streambed.*

"This was a great first project because I got exposure to several different aspects of design and construction on a small scale," Charleston said. "It was challenging, but I learned a lot."

*Katie J. Skipper works for the WSDOT communications team in Burlington, covering highway projects in Whatcom, Island and Skagit counties.*

*Water starts flowing through the new culvert.*

# Fog Seal to Protect New Pavements, Rejuvenate Old Ones

*By Richard Kronick, Minnesota LTAP Freelance Writer, University of Minnesota*

In his presentation on fog seals at the February 15, 2007, Minnesota Pavement Conference, chemist and pavement consultant Gayle King said "I've been working with civil engineers all my life, and never do I remember 95 percent of them agreeing on anything. So when I tell you that 20 of 21 civil engineers surveyed thought fog seals were cost-effective, that's amazing!" Nonetheless, King also pointed out that fog seals are banned in many states due to deadly accidents apparently caused by fog seals that reduced tire-to-pavement friction.

King showed that the root cause for much of the raveling and cracking of pavements is asphalt oxidation. He used results of shear rheometry on an Arizona highway to explain the problem. A core, illustrated in Figure 1, was taken from a four-year-old pavement.

The bottom section of the core—about ½-inch thick—was found to have about the same performance grade (PG) as the original asphalt; in other words, virtually no aging had occurred. But the top ½ inch of the core had aged 3.5 PG grades. "We found that the asphalt binder at the top wasn't just getting harder," King said. "It was also getting more brittle—so brittle that it couldn't flow at lower pavement temperatures to relieve stresses." In other words, its m-value—its ability to flow in response to stress—had been reduced. "That changes the way we need to think about protecting asphalt," King said. He recommended that we target oxidation as the enemy. Preventing oxidation in a new pavement will prolong its life. Reversing oxidation in an old pavement—i.e., increasing its m-value—will rejuvenate it.

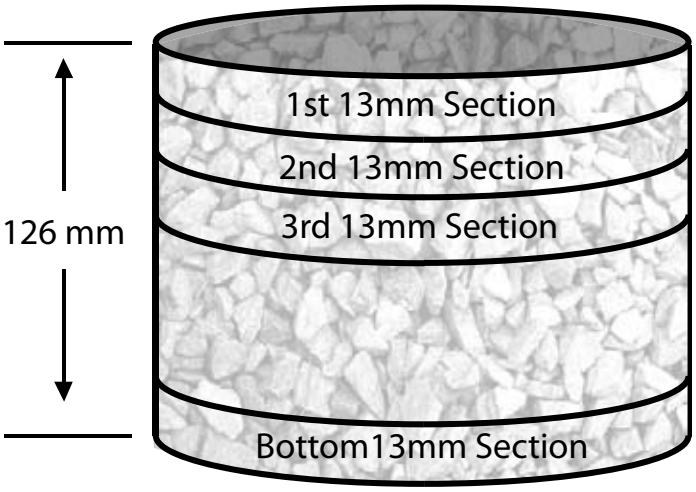


*Figure 1: A core taken from a four-year-old pavement.*

King said fog seals can perform these important tasks, but he cautioned that we need to develop a more sophisticated approach to using fog seals. "A fog seal is not a fog seal is not a fog seal!" King has been researching a variety of fog sealing applications and products in a five-year study that was scheduled for conclusion in August of 2007.

## Fog Seal to Prevent Oxidation Right After Chip Seal

King strongly recommended fog seals on several types of new pavement surface—especially chip seals. He showed a chip-sealed pavement that had been fog-sealed only on one lane. The lane with the fog seal had no measurable chip loss, but the lane without fog seal showed a great deal of raveling and plow damage. "If you're not losing chips to raveling or plows and your customers aren't complaining about wind shield damage," King said, "you don't necessarily need to fog seal. But you can take a little bit of the emulsion out of the chip seal application and put it down on top as a fog seal instead, so it doesn't cost much more, and it may save you a lot in terms of the length of time your chip seal lasts before you have to come back and fix it." The blacker color of the fogged surface also looks more like hot-mix and can offer safety advantages as well, particularly when applied to shoulders.

King enthusiastically recommended one particular product for fog seal over chip seals: "the Minnesota special: CRS-2P," as he nicknamed it. CRS-2P is a polymer-modified emulsion developed by Mn/DOT's Tom Wood. King explained that diluting CRS with water doesn't work: "That will break it, and it won't come out of the distributor, and you've got a mess." But if CRS is diluted with the soap from which it was made, King said "it dilutes very well, it applies very well, and it only costs 13 cents per square yard so you can afford to fog seal all your chip seals." He compared that with some of the "high-priced spreads"—specialty emulsions that cost as much as $1.60 per square yard. He concluded that "fog seals can be very cost-effective if you know what you're doing."

King especially recommended fog seal over chip seal on shoulders, pointing out that, because shoulders receive little traffic, they don't become as highly densified as travel lanes. This means shoulders absorb more oxygen, which eventually leads to raveling. He recommended applying the fog seal heavily on a shoulder so that it is very black. That helps drivers at night to easily see the edge of the travel lane. But he expressed caution at the idea of fog sealing the travel lanes themselves because of potential friction loss. King recommended experimentation on a small section before proceeding with a large project.

## Fog Seal Over Open-grade Friction Courses (OGFC)

King also recommended fog seals over Superpave coarse mixes and open-grade friction courses (OGFCs). In both of these pavement types, because there is more exposed surface and greater permeability, the pavement is more susceptible to oxidation and ages faster than other types. "Aggregate raveling caused by oxidation probably starts in three years if it's a straight OGFC and in six years if it's polymer-modified," he said. "But a regularly scheduled fog seal program can eliminate the problem."

However, King said the fog seal on these more permeable surfaces must be different from the type used on a chip seal: "On an OGFC or a coarse-mix Superpave asphalt, you're not doing it to avoid oxidation; you're doing it either to rejuvenate the asphalt or re-stick the aggregate with a less brittle binder to avoid raveling. Because we're doing the fog seal for a different reason, the emulsion needs to be different." The same factor that makes Superpave coarse mixes and OGFCs susceptible to oxidation —their permeability—also makes them good candidates for fog sealing because the fog seal emulsion can more easily and more deeply penetrate into the pavement. This means the friction problems associated with chip seals are avoidable and that it is possible to restore m-values at greater depths in the pavement. For these pavement types, he recommended polymer-modified emulsions because the high polymer content helps to lock down the aggregate.

## Don't Fog Seal Over SMA Asphalts Containing Rubber

King recommended extreme caution when fog sealing stone-mix asphalt (SMA; also called gap-graded asphalt) and asphalts containing crumb-rubber. Because an SMA has very low permeability, a fog seal emulsion cannot penetrate into the pavement, thus producing a dangerously slippery surface. And he noted that some of the asphaltic materials in a fog seal can cause crumb-rubber to swell.

## Developing Fog Seal Testing Methods

King's research includes assessments of several test devices and methods, including:

- A pavement permeameter developed by the National Center for Asphalt Technology.
- A "ring test" for emulsion infiltration.
- A portable seismic pavement analyzer—essentially a mini-FWD.
- A bending beam rheometer test for thin mixture specimens, as developed by Professor Mihai Marasteanu of the University of Minnesota.
- A dynamic shear rheometer torsion bar test for mixtures.
- Several friction testing methods, from portable lab procedures to full-scale skid trailers.

He said friction values change as a fog seal ages. "When applying a fog seal to a dense HMA surface, friction may be 30 percent lower on the first day; by the second day you may have a 20 percent loss; a month later it may be only 10 percent; and nine months later, you're typically back to the original value." Sanding immediately after the emulsion application will significantly improve early friction.

Detailed evaluations of testing devices and all other aspects of King's research are on a Web site hosted by the National Center for Pavement Preservation at **www.pavementpreservation.org/fogseals**.

## Can Research Overcome Well-founded Fears?

It remains to be seen whether King's research will be enough to convince justifiably skittish officials to repeal their fog seal bans. But King's research shows that, with a greater understanding of how fog seals work and more care in matching products to conditions, fog seals offer great promise in the fight against pavement oxidation.

▲

*From the "Technology Exchange" quarterly newsletter of the Minnesota Local Technical Assistance Program (LTAP), Fall 2007.*

# Warm Mix Asphalt Reduces Production Temperatures

*Reprinted from Nevada Milepost, Fall 2007, Nevada Technology Transfer Center.*

New warm mix asphalt technologies allow asphalt mixtures to be produced and placed at significantly lower temperatures. The temperatures can be reduced by as much as 30 percent while still allowing the asphalt binder to adequately coat the aggregate during mixing at the plant and achieve the desired workability at the paving site. This is accomplished by reducing the viscosity and increasing the workability of a given asphalt binder at a given temperature.

## Potential Benefits

Warm mix asphalt's most often mentioned benefits during mix production are:

1. Decreasing the energy and fuel consumed to make hot mix asphalt.
2. Reducing possible emissions and odors from plants.
3. Improving the working conditions at the plant and paving site.

Reducing emissions is especially critical around large cities that have tight air quality restrictions.

Some road agencies are starting to explore the use of WMA to extend the paving season. With WMA, mixes can remain workable at cooler temperatures, increasing the time available for compaction. This may make WMA a feasible option for those end-of-season projects that must be completed before winter.

Another potential benefit relates to the mix not being exposed to the elevated production and placement temperatures typical of HMA. Less oxidative hardening of the binder takes place with WMA, possibly reducing a mixture's susceptibility to aging and cracking.

Of course, with less hardening comes the potential for greater susceptibility to early rutting until the pavement has oxidized somewhat in service. Strategies need to be developed for determining when it is appropriate to select a higher performance grade to address the issue.

## Technical Working Group

The Federal Highway Administration and the National Asphalt Pavement Association formed a national WMA Technical Working Group in 2006. Members of the group include representatives from several highway agencies, state asphalt paving associations, HMA contractors and other industry groups such as the Asphalt Institute, National Center for Asphalt Technologies, American Association of State Highway and Transportation Officials, etc. The mission of the technical working group is to implement proactive WMA guidance, policies and procedures to evaluate and implement WMA technologies that contribute to high quality and cost-effective pavements. Specific guidelines include:

- Technology transfer and implementation
- Research needs
- Procedures for product and material approval
- Testing and performance management protocols
- Guidelines for mix design and construction

### Source for Pavement Preservation Solutions

Help is now just a phone call away. The new Transportation System Preservation Technical Services Program offers a Help Desk that state transportation departments can call or visit online for information and resources on pavement preservation.

The new TSP$^2$ Web site (**www.tsp2.org**) features a System Preservation Technical Library, Bulletin Board Service with a range of preservation-related topic discussion areas, e-mail listservs where members can post or respond to questions and comments, preservation news archive, event calendar and Help Desk assistance request system.

Assistance available through the Help Desk covers a wide range of preservation issues, including treatment technologies, asset management, best practices, certification and network planning strategies. To contact the Help Desk, call 517/432-8220 or email ncpp@egr.msu.edu.

### NCHRP Project 9-43

The National Cooperative Highway Research Program has just recently awarded Project 9-43, Mix Design Practices for Warm Mix Asphalt Technologies. The objective of this $500,000, 36-month research project is to develop a performancebased mix design procedure for WMA in the form of a draft AASHTO recommended practice.

The method will be based on Superpave, include a suite of performance tests and be applicable to any of the WMA technologies.

### Awaiting Answers

Although the various WMA technologies seem to offer promising benefits, many questions need to be answered regarding mix design, performance and cost before their use becomes more concentrated in the field.

Because of the variety of products and processes involved, this is no small challenge. National initiatives such as the WMA Technical Working Group and NCHRP 9-43 should provide many of the answers.

### Asphalt Definitions

- **Asphalt Tack Coat:** A light application of asphalt, usually asphalt emulsion diluted with water. It is used to ensure a bond between two bituminous pavement layers.
- **Modified Asphalt Chip Seal:** A variation on conventional chip seals in which the asphalt binder is modified with a blend of ground tire or latex rubber or polymer modifiers to enhance the elasticity and adhesion characteristics of the binder.
- **Rubberized Asphalt Sealant:** A sealant, usually hot applied, that is composed of asphalt cement, various types of rubber of polymer modifiers and other compounding ingredients used for pavement crack and joint sealing. Many grades and ranges of properties are available.

Reduce Collisions on Roadways

# Join Us for the Corridor Safety Showcase

## *April 24, 2008 in Portland, Oregon*

You are invited to participate in the National Showcase of the Corridor Safety Program on Thursday, April 24, 2008 in Portland, Oregon. This one day event will feature presentations and Q&A with Washington State Corridor Safety Program leaders and local project participants from the City of Vancouver, WA and from Skamania County, WA. The Washington State Corridor Safety Program works to reduce collisions on roadways using low-cost, near-term solutions through the use of partnerships with engineering, enforcement, education, and emergency services. The program is locally coordinated in each community and involves partnerships with local agency governments, interested citizens, businesses, schools, and any other agencies with a vested interest in the safety of their roadways.

This showcase will provide an opportunity for information to be shared about how a project is coordinated and completed from the perspectives of engineering, enforcement, and public awareness. In addition, field visits will be conducted to both urban and rural project locations to see improvements that were made and to talk with project participants.

This Showcase will run in conjunction with the National Association of County Engineers (NACE) Conference, however registration is an additional $50 per person (includes a box lunch and showcase transportation) and you must register separately to attend. Registration forms and information is available online at www.utahltap.org.

Hotel reservations are on your own and can be made at the Conference hotel by calling the Double Tree Lloyd Center Hotel at (503) 281-6111. For further information please call (435) 797-2931 or e-mail utahltap@cc.usu.edu. Information regarding the Annual NACE Conference can be found at countyengineers.org.

# Perpetual Pavements Last Decades Without Major Reconstruction

*Reprinted from Nevada Milepost, Fall 2007, Nevada Technology Transfer Center.*

The structural features of perpetual pavements have been the most discussed issues over the past few years. It has been acknowledged that beginning with a solid foundation for construction and long-term stability, the pavement structure needs to consist of a thick cross section of hot mix asphalt with the layers engineered to resist specific types of distresses.

## Preventing Fatigue Cracking

Fatigue cracking, which can be the most devastating form of failure, can be handled by first considering the level of traffic.

In high-volume facilities such as Interstate and primary highways, fatigue is best countered using a total HMA thickness that keeps the bending strain under the vast majority of heavy traffic loads below a threshold of about 70 microstrain. This will ensure that cracks do not originate at the bottom of the structure and propagate up to the surface. Thus, the need for full-depth patching or complete reconstruction of the HMA can be avoided.

For medium-volume roads, this may mean a minimum HMA thickness of about 11 inches, and for heavier trafficked roads, it could mean structures of 15 inches to 16 inches at the thickest. Of course, the thickness in a given situation depends upon the traffic, soil, foundation and climate.

In low-volume roads, heavy loads may be very infrequent. So it would not be cost effective to consider the same 70 microstrain criterion to resist fatigue. Instead, it would be better to consider the accumulation of damage and minimize the accumulation over a long period of time. Depending upon climate, support conditions and the particular traffic, this leads to low-volume road HMA thickness of 6 inches to 8 inches.

### Glossary of Pavement Coating Technology

The following basic terms give a good grasp of pavement coating technology.

***Alligator Cracking***

A series of interconnecting cracks in an asphalt pavement surface forming a pattern that resembles an alligator's hide or chicken wire. In its early stages, alligator cracking may be characterized by a single longitudinal crack in the wheel path. The cracks indicate fatigue failure of the surface layer often caused by repeated traffic loadings. Hence, the term fatigue cracking is also used.

***Bond Breaker***

Any material used to prevent bonding or to separate adjacent pavement layers. Thin bituminous layers are often used as bond breaker layers between a concrete pavement and an unbounded concrete overlay.

***Break***

The process in the curing of an asphalt emulsion by which globules of asphalt become separated from the water. The color of the emulsion will change from brown to black during the break process.

***Cape Seal***

A surface treatment that involves the application of slurry seal to a newly constructed surface treatment or chip seal. Cape seals are used to provide a dense, waterproof surface with improved skid resistance and ride quality.

### Rut Resistance

In addition to designing against bottom-up fatigue cracking, it is also important to consider the possibility of deep rutting within the pavement structure.

This is controlled in design by the vertical compressive strain at the top of the subgrade. If this strain is high, more than 200 microstrain, it indicates that the pavement structure is weak and incapable of resisting permanent deformation deep within itself.

The rut resistance must start at the top with a high quality surface mix, followed by a binder and base courses that allow the aggregate structure to transmit the load to the pavement foundation. It may be a granular layer or a stabilized subgrade with sufficient thickness to minimize the effects of seasonal weakening.

Per Road (version 3.0) can be used to design perpetual pavements for low to high traffic volumes. It is available for free download from the Asphalt Pavement Alliance at www.asphaltalliance.com.

### Life-cycle Costs

Not completely divorced from the pavement design is the issue of economy.

If one compares a typical rural interstate highway pavement design using the 1993 AASHTO Pavement Design Guide for a 25,000 ADT 4-lane facility, a conventional design might be 8 inches of HMA over 10 inches of granular base material versus a perpetual pavement consisting of 14 inches of HMA over 6 inches of granular base.

Assuming a typical surface for the conventional design and a high-quality SMA for the perpetual pavement, with the initial overlay intervals of 15 years and 18 years respectively, the conventional HMA section might need to be replaced in 35 years whereas the perpetual section would only need periodic resurfacing.

The perpetual pavement would require 25 percent less aggregate and 20 percent less liquid asphalt. This is a significant savings of resources that can be used elsewhere.

# WSDOT Winter Operations

### Photographs from the WSDOT Maintenance Office

WASHINGTON STATE
DEPARTMENT OF TRANSPORTATION
MATERIALS LABORATORY

TECH NOTES
APRIL 2004

# ELIMINATION OF TEMPERATURE AND DENSITY DIFFERENTIALS: THE CYCLIC DENSITY SPECIFICATION

Since 1995, WSDOT has performed research on temperature and density differentials in Hot-Mix Asphalt (HMA) pavements. Temperature differentials are formed during transport of the HMA to the paving project. As the mix is transported, a crust develops on the HMA surface, which, if not remixed with the hotter, underlying mass of HMA prior to placement, becomes concentrated in relatively small areas in the mat (Figure 1). These areas are near cessation temperature and tend to resist adequate compaction.

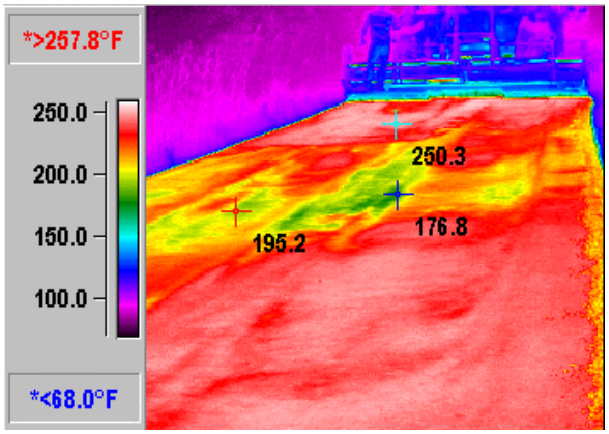


Figure 1. Temperature differential in HMA mat.

The result is a mat with a cyclic pattern of small low-density, open-textured areas that tend to deteriorate more quickly than the rest of the pavement (Figure 2). Although these areas can be small, they can significantly shorten the life of the pavement.

This research has led to the implementation of a cyclic density specification that has been in use on specified WSDOT projects since 2002. This specification purposely targets temperature differentials in a cyclic pattern in an attempt to identify their occurrence and eliminate them during construction.

The testing program uses temperature differentials as an initial indicator of potential low-density areas and proceeds in three basic steps:

- An infrared camera or infrared temperature gun is used to locate temperature differentials.
- If the temperature differential between a particular location and the surrounding mat is 25°F or greater, nuclear density testing is performed at the cool spot's location.
- If densities are verified as unacceptably low and there is a minimum of four locations per density lot, a penalty of 15 percent of the HMA unit price is assessed.

Figure 2. Cyclic pattern of low-density, permeable areas.

On projects where this specification has been used, the occurrence of temperature differentials and their resulting density differentials has been dramatically reduced. For instance, the specification was used on 13 projects in 2003. Of these projects, 12 utilized a material transfer vehicle (MTV) from the start of the project and had temperature differentials in the 8 to 15°F range. The one project that did not utilize a MTV at the start of the project failed the cyclic density specification during the first two days of paving. A MTV was placed in the paving train and temperature differentials and visible segregation were drastically reduced.

The goal is to implement the specification statewide.

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# Research Notes

## Performance Analysis and Forecasting for WSDOT Highway Projects

*By the WSDOT Office of Research and Library Services*

### Developing Standard Overall Performance Measures for Highway Projects

WSDOT evaluates contractors' work during construction through progress measurement; in other words, directly comparing the completed work to the planned work. As part of this evaluation, units of work are measured and paid for as the work progresses.

Our proposed performance evaluation goes beyond simple progress measures by relating the amount of progress to the time it took to achieve the work. This gives us a feel for the overall progress and scheduled completion of the contract work as it relates to total payment and overall time. Construction managers are responsible for completing projects on time and on budget. Contractors may experience overruns due to uncontrollable situations such as weather conditions, equipment breakdown, and cost escalation during construction. By monitoring and realizing in a timely manner that a contractor is experiencing such overruns, our construction managers may be able to mitigate the impacts by modifying cash flow, quality control and time impacts.

To do an evaluation, we require a benchmark, or a standard of measurement, against which the overall performance is compared. Due to overruns, projects of similar sizes and conditions experience different time and cost estimates during the actual construction. The problem for us becomes how to account for these differences when monitoring or predicting the time and cost of new projects of similar sizes. This research used historical project data to develop statistically valid boundaries that can be used as a reasonable benchmark for construction management.

### Examining Historical Data to Develop New Prediction Tools

WSDOT has built thousands of projects throughout Washington State. For this research, historical project data between 1990 to early 2006 was analyzed and tools were developed to support the evaluation of contractor's performance and in the prediction of the time and costs of projects.

Data used in developing the tools included:

- Cost data, such as contract value and progress estimates (payments).
- Time data including project duration and number of working days for each progress estimate.
- Quantity data for hot mix asphalt, grading, and surfacing, for example.

Benchmark average and minimum performance profiles (curves) were developed for all projects as one group and for categories of small, medium, and large pavement projects.

Based on the historical projects' time, cost, and quantity data, prediction models were developed. The models use between one to five parameters to predict the time and cost of new projects. The models are intended as an indicator to be used as a supplement to the existing WSDOT prediction tools. This is data that can readily be incorporated as a general indicator of the progress of projects statewide.

The following tables describe how a project was determined to be small, medium or large. Projects were categorized independently by miles, days, value or HMA (hot mix asphalt).

## Using performance Models to Better Manage Projects

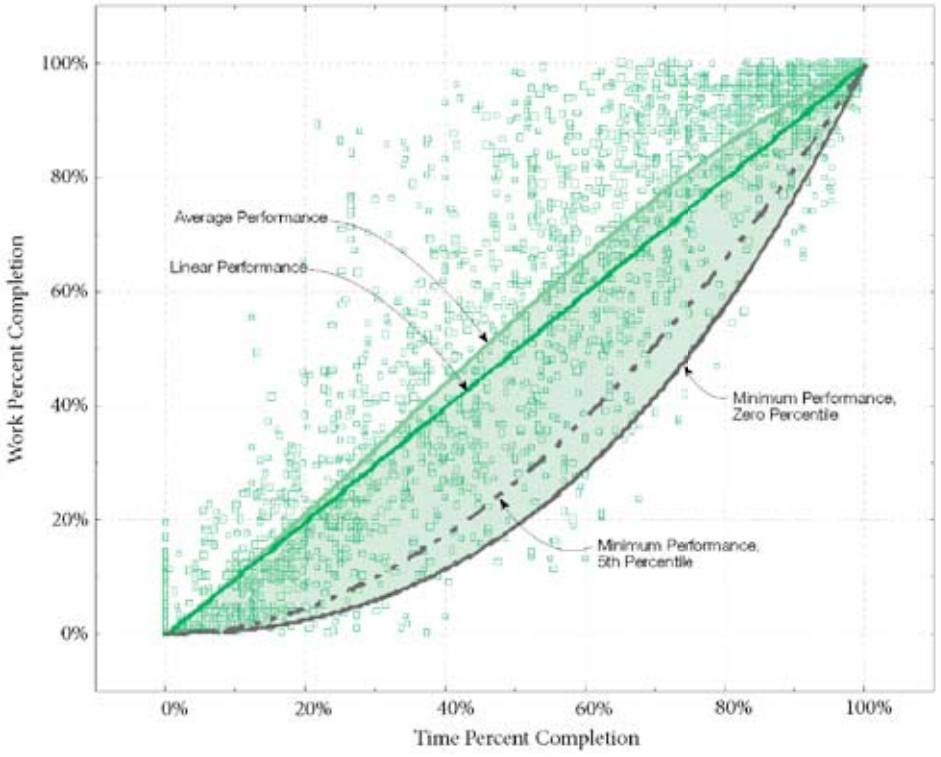
This research gives us the ability to use past data to evaluate future project performance and to predict the time and cost of projects. A project that plots below the line labeled "minimum performance" on the graph indicates that the progress of the project is not consistently performing with what history has determined to be a successful project. By using performance models that indicate when the actual performance approaches the minimum performance, we can react and therefore better manage the project by helping the contractor get back on track. If the actual performance crosses the minimum performance, we would consider imposing a performance penalty. Per agency practice doing so should be a last resort because it may exacerbate the situation.

| Small Projects | No. of Projects | Min Value | Max Value | Mean | Standard Deviation | Variance |
|---|---|---|---|---|---|---|
| Miles | 326 | 0.01 | 6.27999973 | 2.380509 | 1.737348 | 3.018379 |
| Days | 331 | 3 | 64 | 39.81873 | 13.75843 | 189.2943 |
| Value | 348 | $105,018.58 | $2,321,238.82 | $1,073,383 | $600,158 | $3.602E+11 |
| HMA | 342 | 0.00 | 16,753,74 | 4,978.590 | 4,986.134 | 24,861,530 |

| Medium Projects | No. of Projects | Min Value | Max Value | Mean | Standard Deviation | Variance |
|---|---|---|---|---|---|---|
| Miles | 145 | 6.4 | 18.9500008 | 10.37874 | 3.238595 | 10.48849 |
| Days | 143 | 65 | 146.5 | 89.01748 | 20.44104 | 417.8360 |
| Value | 128 | $2,357,167.46 | $6,495,159.59 | $3,612,667 | $1,031,118 | $1.063E+12 |
| HMA | 129 | 16,927.26 | 48,767.96 | 28,764.12 | 8,153,351 | 6,647,7130 |

| Large Projects | No. of Projects | Min Value | Max Value | Mean | Standard Deviation | Variance |
|---|---|---|---|---|---|---|
| Miles | 26 | 20.113 | 52,1700011 | 28.10381 | 7.845677 | 61.55465 |
| Days | 23 | 154 | 615.5 | 212.0217 | 96.55574 | 9323.011 |
| Value | 19 | $6,638,740.47 | $18,715,549.56 | $9,484,181 | $3,368,837 | $1.135E+13 |
| HMA | 26 | 51,338.70 | 99,426.20 | 69,997.30 | 16,447.71 | 270,527,300 |

*Provided your project's progress tracks within the bounds in the graph, this tool tells you that historically and statistically the cash flow/work progress over time indicates a healthy project and has a likelihood of being successful.*



### Summary of Implementation

WSDOT builds hundreds of transportation projects every year. We rely on time and cost predictions for these projects to make monitoring, planning and budgeting decisions. WSDOT maintains a wealth of data from past and present construction projects, which provides us with, among other things, feedback for future project cost and time estimating.

It is important to create and use as many administration oversight tools as possible. As a result of this research, we now have benchmark performance profiles as a tool for evaluating project progress and estimating cost and time. The products of the research are the graphs which define a performance envelope pertaining to different project criteria. This enables construction administration managers to flag projects that fall outside of expected performances thereby warranting special attention. It also provides executive management a quick, high-level view of whether the projects are progressing consistent with what has been determined to be successful.

### *Report Title and Number*

Performance Analysis and Forecasting for WSDOT Highway Projects WARD 675.1

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*For more information, contact Kathy Lindquist, Research Manager, Office of Research and Library Services at (360) 705-7976 or www.wsdot.wa.gov/Research*

# "Know the Signs" Poster

The LTAP Center has "Know the Signs" posters available for free.

This bright orange poster features examples of temporary traffic control devices such as signs, arrow panels, message signs, and channelizing devices that might be present in any road construction zone. They provide information to help drivers navigate a construction zone safely. The poster measures 15 inches by 15 inches.

The poster was prepared by The National Work Zone Safety Information Clearinghouse, the Federal Highway Administration, and American Road & Transportation Builders Association (ARTBA) Transportation Development Foundation.

The Clearinghouse website is **www.workzonesafety.org**

To order your free poster, see page 21.

The *Gray Notebook* is published quarterly by the Washington State Department of Transportation to track a variety of performance and accountability measures for review by the Transportation Commission and others.

The following is a sampling from this document. For an on-line version of this or previous editions of the *Gray Notebook,* visit **www.wsdot.wa.gov/accountability/**

**Washington State Department of Transportation**

# Measures, Markers and Mileposts

The Gray Notebook for the quarter ending September 30, 2007

WSDOT's quarterly report to the Governor, the Legislature, and the Washington State Transportation Commission on transportation programs and department management

**Paula J. Hammond, P.E.**
Secretary of Transportation

# Measuring Delay and Congestion: Annual Update

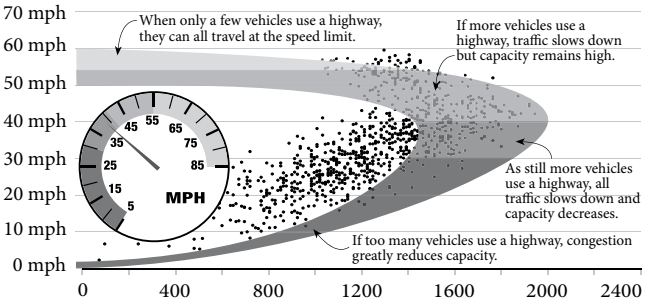
## Maximum Throughput as a Basis for Congestion Measurement

Travelers perceive delay when they are unable to travel at expected speed, which is typically believed to be the posted speed limit. Many travelers define delay as the difference in the amount of time it should take to get to a destination during off-peak hours and the actual amount of time it takes to get to their destination. Traditionally, delay and other congestion measures have been calculated based on the difference between actual travel times and the travel time that would have been if the traffic was free flowing or moving at the speed limit.

### The Highway System Operates at Peak Efficiency When Vehicles Travel at 70-85% of the Posted Speed Limit

From the perspective of operating the highway system as efficiently as possible, speeds at which the most vehicles can move through a highway segment (maximum throughput) is the most meaningful basis of measurement for WSDOT's management needs. It is logical for WSDOT to aim towards providing and maintaining a system that yields the most productivity (or efficiency) versus providing a free flowing system where not as many vehicles are passing through a segment during peak travel periods. Maximum throughput is achieved when vehicles slow to a range between 70-85% of the posted speed, which results in less space between vehicles than what is observed at posted speeds. When vehicle speeds have slowed down into the range where maximum throughput occurs, the segment of highway is operating at peak efficiency because more vehicles are passing through the segment than there would be at posted speeds. This phenomenon is illustrated in the chart to the right. Maximum throughput speeds vary from one highway segment to the next depending on prevailing roadway and traffic conditions, such as lane width, slope, shoulder width, pavement conditions, traffic compositions, conflict traffic movements, presence or lack of median barrier, etc. It should also be noted that maximum throughput speed is not static and can change over time. Currently, maximum throughput speed on a typical freeway segment in the Central Puget Sound region is about 70% to 85% of the posted speed limits. For surface arterials, maximum throughput speeds are difficult to predict due to the fact that they are heavily influenced by conflicting traffic movements at intersections. Ideally, maximum throughput speeds for each highway segment should be determined through comprehensive traffic studies and validated based on field surveys.

**An Adaptation of the Speed/Volume Curve: Relating Speed and Volume**
**I-405 Northbound at 24th NE, 6-11 AM Weekdays in May 2001**
*Hourly Volume/Lane*




Because operating at peak efficiency moves more vehicles through a segment than at any other range of speed, a number of the measures in the annual congestion report are reported in two ways: relative to posted speed limit and relative to maximum throughput speed.

In this 2007 Annual Congestion Update, WSDOT uses maximum throughput as a basis of measurement for the following measures:

- Travel Time Index (Maximum Throughput Travel Time-MT$^3$I)
- Duration of Congestion (measures the length of time when the highway operates at less than 70% of the posted speed)
- Delay (both statewide and for individual corridors)

**WSDOT Congestion Thresholds***

| | | |
|---|---|---|
| Posted speed | 52 mph or above (85% of posted speed or higher) | Vehicles are moving through a highway segment at approximately the posted speed. However since there are fewer vehicles on the highway, the highway segment is not reaching its maximum productivity under these conditions. |
| Maximum throughput | 42 - 51 mph (70%-85% of posted speed) | Vehicles are moving slower than the posted speed and the number of vehicles moving through the highway segment is higher. These speed conditions enable the segment to reach its maximum productivity in terms of vehicle volume and throughput. |
| Congestion | 35 - 41 mph (60-70% of posted speed) | Average vehicle speeds are below 70% of the posted speed (~42 MPH) causing drivers to have less than optimal spacing between them, and reducing the number of vehicles that can move through a highway segment. The highway begins to operate less efficiently because fewer vehicles are moving through a highway segment under these conditions than they would at maximum throughput. |
| Severe congestion | 35 mph or below (Less than 60% of posted speeds) | Speeds and spacing between vehicles continue to decline in a highway segment and the highway operates well below maximum productivity. |

*Based on a posted speed limit of 60 MPH.

## Motorcycle Fatalities

### 2006 Motorcycle Fatalities

Trends in motorcycle registrations indicates more Washington State residents are riding motorcycles now than in any time in the state's history. Since 1997 motorcycle registrations increased from 94,081 to 175,000. In 2006, there were 82 motorcycle fatalities. Motorcycle fatalities in 2006 accounted for 13% of all traffic fatalities on Washington State highways. Last year, a motorcycle task force recommended a combination of education and enforcement strategies to address the rise in fatalities.

### Traffic Safety Report to Governor Indicates Reduction in 2007 Motorcycle Fatalities

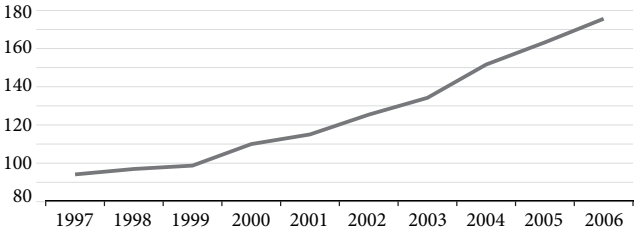
On October 9, 2007 the Washington State Patrol, Department of Licensing, and Washington Traffic Safety Commission provided Governor Gregoire with a comprehensive Government Management, Accountability, & Performance (GMAP) report on traffic safety. The report stated motorcycle fatalities totaled 57 for the first three quarters of the 2007 calendar year. This is down from 70 fatalities recorded during the same period in 2006.

Some key strategies reported by the agencies that appear to have impacted the reduction are:

- increased motorcyclist training opportunities and public awareness campaigns
- enforcement actions, consistent with legislation passed in the 2007 Legislative session;
- 53 motorcycles have been impounded (through August) since the Motorcycle Impound Law started in July 2007;
- speed arrests for motorcyclists are up 49% year-to-date compared to 2006, with 1,903 arrests.

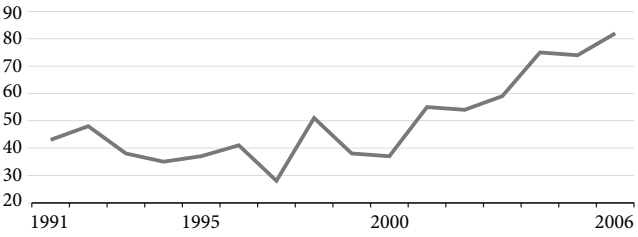
For the comprehensive GMAP report on traffic safety which includes action plans and the progress of the 2006 Motorcycle Task Force recommendations go to www.accountability.wa.gov/reports/safety/default.asp.

**Washington State Motorcycle Registrations**
**1997-2006**
*Number in Thousands*



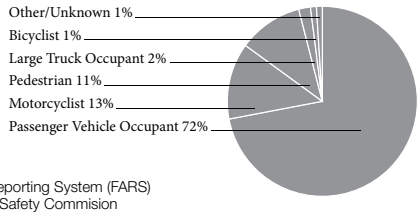

Data Source: Washington State Department of Licensing

**Washington State Motorcycle Fatalities by Year**
**1991-2006**




Note: Helmet Law was reinstated in 1990
Data Source: Motorcycle Rider Safety Task Force

**2006 Washington Statewide Traffic Fatalities by Mode**
**All Roads**




Data Source: Fatality Analysis Reporting System (FARS)
Provided by: Washington Traffic Safety Commision

## The At Risk Driver

Everyday the potential exists for an unexpected traffic collision to occur that may result in a fatal or serious injury. In an average year throughout 2002 –2006, 623 people died on Washington roadways while another 2,946 people encountered serious injuries. As part of the state's continued effort to focus on reducing collisions and keeping roadways safe, this report will take a closer look at driver behavior and characteristics.

Demographic analysis indicates that a specific driver age group may exhibit a consistent trend of driver behavior. As shown in the first two graphs, young drivers under the age of 25 account for approximately 15% of the licensed driver population, yet account for 28% of the collisions that result in fatalities and other serious injuries. In fact, the same age group of drivers are also involved in 43% of speed-related fatal and serious injury collisions, as well as approximately 30% of all alcohol or drug impairment as a contributing circumstance. Another growing concern is drivers over the age of 71 who fail to yield to others on the roadway (see graph below). This concern is expected to increase through 2030 as the number of baby boomers enter into this age group.

### At Risk Driver Taskforce

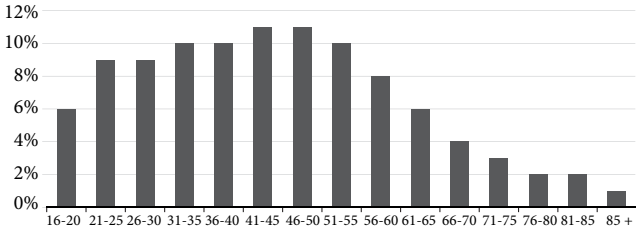
In response to a Government Management, Accountability and Performance (GMAP) forum in March 2007, the Governor's Public Safety Team consisting of the Washington State Traffic Safety Commission, Department of Licensing and the Washington State Patrol requested a taskforce to be established in order to help tackle the issues associated with drivers determined to be at risk to themselves and others while using Washington's public roadways. The taskforce defined a at risk driver as: "Drivers whose behavior, physical, or cognitive capabilities, or other traits present substantial risk to either themselves or others."

Based on the evidence reviewed by the taskforce three "at risk" groups identified are:

- Young and aggressive drivers
- Elderly and medically impaired drivers
- Drug impaired drivers

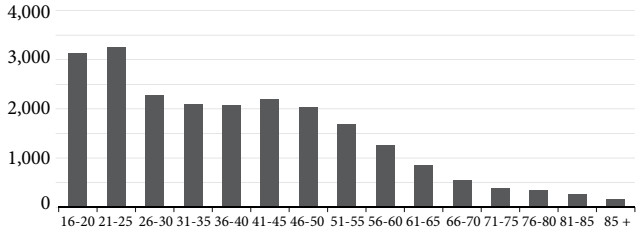
As a result of the available data and the concentration on the above three focus groups, the taskforce in September 2007 established recommendations that were submitted to the Department of Licensing to consider and develop strategies and report later to the Governor.

**Washington State Licensed Drivers**
**Percentage by Age Group**
**2002-2006**




Data Source: Washington State Department of Licensing
Provided by WSDOT Transportation Data Office

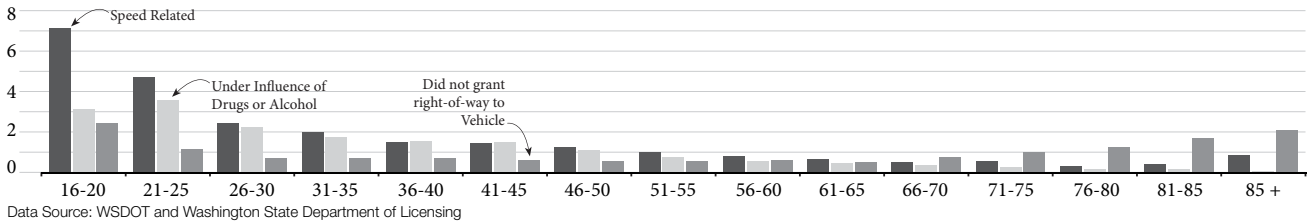
**Washington State Fatal and Serious Injury Collisions**
**All Roads**
**2002-2006**




Data Source: Washington State Departmen of Licensing
Provided by: WSDOT Transportation Data Office

**Washington State Contributing Circumstances to Fatal and Disabling Crashes**
**Rate by Driver Age**

**2002-2006**
*Rate per 10,000 Licensed Drivers*




Data Source: WSDOT and Washington State Department of Licensing
Provided by WSDOT Transportation Data Office

# LTAP Center Resources

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### Free Hard Copy Publications

- ❑ Asphalt Seal Coats, WSDOT, 2003
- ❑ Asset Management Primer, FHWA, 1999
- ❑ Basic Traffic Control for Utility Operations, ATSSA, 2002
- ❑ Bicycle Commute Guide
- ❑ BIKESAFE: Bicycle Countermeasure Selection System, FHWA, 2006 (includes CD)
- ❑ Building Projects that Build Communities, WSDOT, 2003
- ❑ Data Integration Primer, FHWA, 2001
- ❑ Distress Identification Guide, LTAP, 2005
- ❑ Dust Control on Low Volume Roads, FHWA, 2001
- ❑ Emergency Resource Guide, WA Military Department and WA DOH, 2007
- ❑ Entering the Quiet Zone, FHWA, 2002
- ❑ Family Emergency Preparedness Plan, 1999
- ❑ General Field Reference Guide (Pocket Size), 2006
- ❑ Gravel Roads Maintenance and Design Manual, South Dakota LTAP, 2000
- ❑ Guidelines and Recommendations to Accommodate Older Drivers and Pedestrians, FHWA, 2001
- ❑ Guidelines for Temporary Traffic Control, FHWA, 2005
- ❑ Highway Design Handbook for Older Drivers and Pedestrians, FHWA, 2001
- ❑ Improving Conditions for Bicycling and Walking, FHWA, 1998
- ❑ Incident Command System for Transportation Professionals, FHWA, 2006
- ❑ Increasing Physical Activity Through Community Design, 2002
- ❑ Materials and Procedures for Rapid Repairs of Partial-Depth Spalls in Concrete Pavements, FHWA, 2001
- ❑ Materials and Procedures for Repair of Potholes in Asphalt-Surfaced Pavements, FHWA, 2001
- ❑ Pavement Preservation Checklists, FHWA, 2001-2005, pocket guides:
  1. Crack Seal Application
  2. Chip Seal Application
  3. Thin Hot-Mix Asphalt Overlay
  4. Fog Seal Application
  5. Microsurfacing Application
  6. Joint Sealing Portland Cement Concrete Pavements
  7. Diamond Grinding of Portland Cement Concrete Pavements
  8. Dowel-Bar Retrofit for Portland Cement Concrete Pavements
  9. Partial-Depth Repair of Portland Cement Concrete Pavements
  10. Full-Depth Repair of Portland Cement Concrete Pavements
  11. Hot In-Place Asphalt Recycling Application
  12. Cold In-Place Asphalt Recycling Application
  13. Slurry Seal Application
- ❑ Pavement Surface Condition Field Rating Manual for Asphalt Pavement, NWPMA and WSDOT, 1999
- ❑ Prefabricated Bridges 2004: Good Business-Best Practice, AASHTO TIG/FHWA
- ❑ Priority Market-Ready Technologies and Innovations – 2006 List, FHWA
- ❑ PCC Pavement Smoothness, FHWA, 2002
- ❑ Reflective Sheeting Identification Guide, FHWA, 2005
- ❑ Road Symbol Signs, FHWA, 2002
- ❑ Roadway Safety Tools for Local Agencies, NCHRP, Synthesis 321, TRB, 2003
- ❑ Roundabouts: An Informational Guide, FHWA, 2000
- ❑ Scenic Byways Map of Washington State, 2006
- ❑ School Administrator's Guide to School Walk Routes and Pedestrian Safety, WTSC, 2003
- ❑ Signage Sourcebook, US SBA, 2003
- ❑ Signalized Intersections, FHWA, 2004
- ❑ Stepping Out – Mature Adults: Be Healthy, Walk Safely, NHTSA, 2003
- ❑ Trail Construction and Maintenance Notebook, USDA Forest Service, 2004
- ❑ A Walkable Community is More Than Just Sidewalks Brochure, FHWA, 2000
- ❑ Washington Bicycle Map, WSDOT, 2007
- ❑ Washington State Highway Map, WSDOT, 2006

## Free Videotapes

- ❑ Driving Modern Roundabouts, City of Lacey, City of Olympia and WSDOT, 2002

## Free CD ROMs

- ❑ H&LP CD Library, 8th Edition, Winter 2006-2007
- ❑ Bicycle Safer Journey, FHWA, 2003
- ❑ BIKESAFE: Bicycle Countermeasure Selection System, FHWA, 2005
- ❑ Context Sensitive Solutions Documents: Building Projects that Build Communities; Understanding Flexibility in Transportation Design, WSDOT, 2006
- ❑ Driving Modern Roundabouts, City of Lacey, City of Olympia and WSDOT, 2002
- ❑ Endangered Species Act – Build Smart, 2 CD set, FHWA, 2004
- ❑ Gravel Road Maintenance: Meeting the Challenge, Minnesota LTAP, 2005
- ❑ Guidelines for the Selection of W-Beam Barrier Terminals, FHWA, 2006
- ❑ High Performance Concrete Structural Designers' Guide, FHWA, 2005
- ❑ Introduction to Geosynthetics in Transportation, GMA, 2007
- ❑ Managing Pavement Edge Drop-offs, FHWA, 2006
- ❑ Roundabouts: An Informational Guide, FHWA, 2000
- ❑ School Administrator's Guide to School Walk Routes and Student Pedestrian Safety, WTSC, 2004
- ❑ Work Zone Safety for Roadway Maintenance Operations, Interactive Training Course, Advanced Technology Concepts With Rutgers University

## Free DVDs

- ❑ Danger Signs, WSDOT, FHWA, 2004
- ❑ Dangerous Travelers: Controlling Invasive Plants Among America's Roadways, USFS, 2006
- ❑ Driver Education Work Zone Awareness Program, ATSSA
- ❑ Driving Modern Roundabouts, City of Lacey, City of Olympia and WSDOT, 2002
- ❑ Lightly on the Land, FHWA, 2004
- ❑ Pedestrian Safety, City of Olympia and Washington Traffic Safety Commission, 2004
- ❑ Snow & Ice Control, WSDOT

## WSDOT Self-Study Guides

These non-credit WSDOT self-study guides may be obtained from the LTAP Center. An invoice will be sent with the books.

- ❑ Basic Surveying, $20
- ❑ Advanced Surveying (metric), $20
- ❑ Contract Plans Reading, $25
- ❑ Technical Mathematics l, $20
- ❑ Technical Mathematics ll, $20

## Free Workbooks from LTAP Workshops

- ❑ Implementing HMA (Superpave) in Local Agencies, WSDOT and FHWA, 2005

## Free Poster

- ❑ Know the Signs (see page 15 for description)

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### New Videos Available to Borrow

- **651 Backing, Parking, and Intersections**, WUMBUS Corporation, 17:00 minutes, tape.
- **652 The Safe Operation of Commercial Lawn Mowers**, WUMBUS Corporation, 12:00 minutes, tape.
- **653 Tribal School Zone Safety: Video & Toolkit**, FHWA, DVD and Safe Tips Resources, 2007.
- **654 Introduction to Geosynthetics in Transportation**, Geosynthetic Materials Association, CD, 2007.
- **655 Application of Ground Anchors and Soil Nails in Roadway Construction**, FHWA Western Federal Lands Highway Division, Technology Deployment Program, CD, 2007.
- **656 Road Engineering and Construction Practices for Cold Regions**, FHWA Western Federal Lands Technology Deployment, CD, 2007.
- **657 Enforcing the Underground Facility Damage Prevention and Safety Act** (State of Florida) (includes a Quiz), Florida Sunshine State One-Call, Inc., Tape, 20.27 minutes.
- **658 Water/Road Interaction Toolkit (CD)**, USDA Forest Service & USDOT, 2003.
- **659 What's Wrong With Your Underdrain?,** Oklahoma DOT, Tape, 1994.

# On-line Resources

## Bridge

- WSDOT Highways & Local Programs Bridge Section
  www.wsdot.wa.gov/TA/Operations/BRIDGE/BRIDGEHP.HTM

## Environmental

- WSDOT Highways & Local Programs Environmental
  www.wsdot.wa.gov/TA/Operations/Environmental/Enviroupdates.html
- *Environmental Procedures Manual* (M31-11)
  www.wsdot.wa.gov/fasc/EngineeringPublications/Manuals/EPM/EPM.htm
- Regional Road Maintenance Endangered Species Act Program Guidelines
  www.metrokc.gov/kcdot/roads/esa/index.cfm
- National Marine Fisheries Service Species Listings and Info
  www.nwr.noaa.gov/
- U.S. Fish and Wildlife Service Endangered Species Listings and Info
  www.fws.gov/endangered/
- Washington State DNR's Natural Heritage Program Home Page
  www.dnr.wa.gov/nhp
- FHWA's Environmental Home Page
  www.fhwa.dot.gov/environment/index.htm

## WSDOT Highways & Local Programs Listservs

For the following listservs:

- Pavement Technology
- LTAP News
- LTAP Training
- Traffic Technology and Safety

Use the following address to sign up:

www.wsdot.wa.gov/TA/T2Center/T2hp.htm

## WSDOT State Materials Lab

- www.wsdot.wa.gov/biz/mats

## WSDOT Engineering Publications On-line Orders

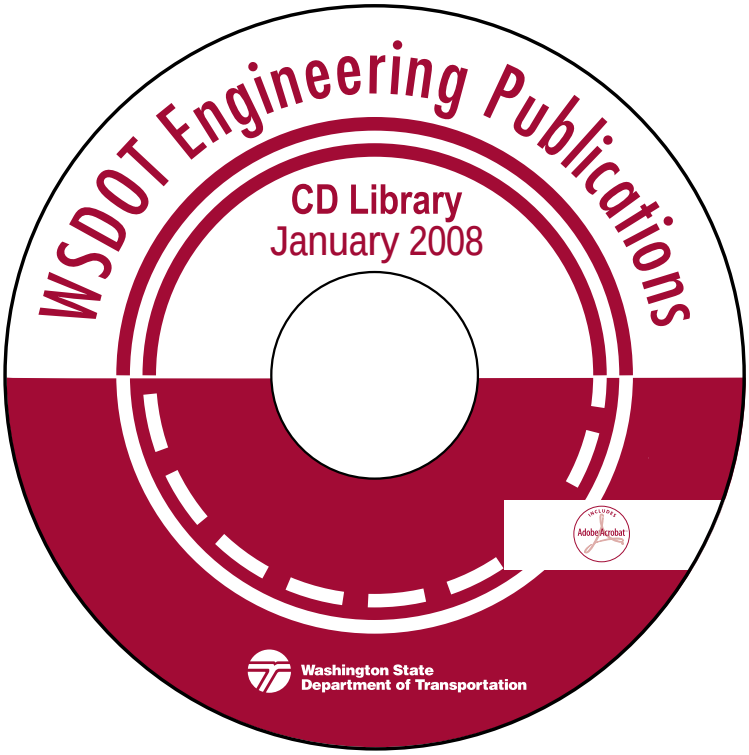
- www.wsdot.wa.gov/fasc/EngineeringPublications/order.htm

### The WSDOT Engineering Publications CD Library is available to order!

The CD Library will be updated with the most current manual revisions three times per year, in January, May, and September. Each CD costs $10.00.

WSDOT manuals that have not been revised since January 2004 will not be on the new CDs. They are on past CD Libraries, and are also available on the Engineering Publications' On-Line Library.

**www.wsdot.wa.gov/fasc/EngineeringPublications/order.htm**



## WSDOT Technical Manual On-line Library

- www.wsdot.wa.gov/fasc/EngineeringPublications/library.htm

## Legal Search

- Search Bills, RCWs, and WACs
  www.leg.wa.gov/help/infoavailable.htm

## Local Agency Guidelines (LAG) Manual

- www.wsdot.wa.gov/TA/Operations/LAG/LAGHP.htm

## Pavement Management

- Pavement Publications and NWPMA Links
  www.wsdot.wa.gov/TA/T2Center/Mgt.Systems/PavementTechnology/
- NWPMA – North West Pavement Management Association
  www.wsdot.wa.gov/TA/T2Center/Mgt.Systems/PavementTechnology/nwpma.html
- Asphalt Institute
  www.asphaltinstitute.org/
- National Asphalt Pavement Association
  www.hotmix.org/
- FHWA Pavement Resource Site
  www.fhwa.dot.gov/pavement/

## Project Development

- Federal Aid Progress Billing Form
  www.wsdot.wa.gov/TA/ProgMgt/Projectinfo/BILLFORM.XLS
- State-Funded Progress Billing Form
  www.wsdot.wa.gov/TA/ProgMgt/Projectinfo/BILLFORMSTATE.xls
- STIP (State Transportation Improvement Program)
  www.wsdot.wa.gov/TA/ProgMgt/STIP/STIPHP.htm
- TIP (Local Agency 6-Year Transportation Improvement Program)
  www.wsdot.wa.gov/TA/ProgMgt/STIP/TIP.html

## Research

- WSDOT Research Office
  www.wsdot.wa.gov/research
- TRIS Online
  Transportation Research Board National Transportation Library
  http://ntlsearch.bts.gov/tris/index.do
- Transportation Research Board
  http://gulliver.trb.org
- Municipal Research and Services Center of Washington (MRSC)
  www.mrsc.org

## Traffic and Safety

- WSDOT Transportation Data Office
  www.wsdot.wa.gov/mapsdata/tdo/
- Washington State Patrol
  www.wsp.wa.gov
- Washington Traffic Safety Commission
  www.wtsc.wa.gov
- National Highway Traffic Safety Administration
  www.nhtsa.dot.gov
- American Traffic Safety Services Association
  www.atssa.com

## Training

- Washington State LTAP Current Class List
  www.wsdot.wa.gov/TA/T2Center/Training/
- Washington State LTAP Class Registration
  http://fmapps.wsdot.wa.gov/tbase_registration/
- Washington State County Road Administration Board
  www.crab.wa.gov/
- American Public Works Association
  www.apwa.net/education
- University of Washington Engineering Professional Programs
  www.engr.washington.edu/epp

## WSDOT Local Programs Engineers

- Eastern Region (Spokane)
  Keith Martin, (509) 324-6080,
  martink@wsdot.wa.gov
- Northwest Region (Seattle)
  Ed Conyers, (206) 440-4734,
  conyere@wsdot.wa.gov
- Olympic Region (Olympia)
  Neal Campbell, (360) 357-2666,
  campben@wsdot.wa.gov
- North Central Region (Wenatchee)
  Paul Mahre, (509) 667-3090 or 667-2900,
  mahrep@wsdot.wa.gov
- South Central Region (Yakima)
  Roger Arms, (509) 577-1780,
  armsr@wsdot.wa.gov
- Southwest Region (Vancouver)
  Leon Winger, (360) 905-2215
  wingerl@wsdot.wa.gov

## Miscellaneous Washington State On-line Resources

- Community Design Assistance
  www.wsdot.wa.gov/TA/Operations/LocalPlanning/
- Bicycling in Washington State
  www.wsdot.wa.gov/bike/
- Walking in Washington State
  www.wsdot.wa.gov/walk/
- Washington Scenic Byways
  www.wsdot.wa.gov/TA/progmgt/byways/
- Retired Professionals Program
  www.wsdot.wa.gov/TA/T2Center/Retired.htm
- Governor's Office of Indian Affairs
  www.goia.wa.gov
- Association of Washington Cities
  www.awcnet.org/

## Other On-line Resources

- Pacific Northwest Interagency Cooperative – Grounds Equipment Maintenance (GEM)
  www.gematwork.org
- National LTAP and TTAP (Local and Tribal Technical Assistance Program)
  www.ltapt2.org
- Institute of Transportation Engineers
  www.ite.org
- Mineta Transportation Institute
  www.transweb.sjsu.edu

# Training Opportunities

## LTAP Center

Contact: Laurel Gray (360) 705-7355
www.wsdot.wa.gov/TA/T2Center/Training

The class fees shown apply to both public and private sector students. The most up-to-date information on these courses, and a link to on-line registration, can be found on the Web site listed above.

### Access Management and Its Benefits

March 11, 2008, Lakewood; March 25, 2008, Shoreline; April 8, 2008, Vancouver; April 22, 2008, Spokane; April 23, 2008, Moses Lake; April 24, 2008, Yakima. Instructors: LeRoy Patterson and Becky Hawkins, WSDOT. **Free.** This course will discuss access management in Washington State. It will discuss limited access and managed access programs, rules, and requirements. The course will provide an overview of the types of access control and how they relate to WSDOT and local agency functions.

### Appraisal Review for Federal-Aid Highway Programs

May 6, 2008, Tumwater; May 8, 2008, Spokane. **$200.** This is a National Highway Institute (NHI) class. The Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 as amended (Uniform Act) ensures that persons whose real property is acquired or who are displaced as a result of a Federal or Federally-assisted project are treated fairly and consistently. This course focuses on the application of appraisal review principles and how they fit within the Uniform Act and 49 CFR Part 24 as it relates to transportation project development. Focusing on larger parcel, uneconomic remnants, cost to cure, and severance damages, the course discusses the qualifications, roles, and responsibilities of the review appraiser from pre- to post-appraisal activities.

### Biological Assessment Preparation for Transportation Projects

(See page 26 for the Biological Assessment Re-Qualification classes.)

October 6-7, 2008. Exam on October 8. **$50.** WSDOT has implemented requirements for on-call environmental consultants who prepare Biological Assessments. WSDOT's on-call consultants will be required to complete this course and exam in order to qualify to write BAs for WSDOT projects. This new requirement is not mandatory but recommended for local agencies that either prepare BAs or hire consultants to prepare BAs for FHWA funded projects. The intent of these requirements is to achieve greater consistency with the presentation of analysis, formatting, and determining project effects to listed species and designated habitat. Improved consistency has the potential to significantly reduce the number of reviews and comments received during both the Department's review of a local agency BA and the Services' reviews. A reduction in review times yields a significant savings in cost and avoidance in delay to your schedules. This seminar is intended only for individuals who actually write BA documents.

### Bridge Condition Inspection Fundamentals (BCIF)

February 13-15, 2008, Olympia. **Free** to Washington State local agencies and consultants. **All others $150.** Instructor: Grant Griffin, WSDOT Local Agency Bridge Engineer. This course is designed to provide basic knowledge of bridge condition inspection, construction materials, material properties, bridge components and nomenclatures, loadings, stresses and strains, and deterioration of bridge materials and members. This course is preparatory for Bridge Condition Inspection Training. Graduate engineers or engineering technicians with bridge experience need not attend.

### Bridge Condition Inspection Update (BCIU)

February 6-7, 2008, Moses Lake; February 20-21, 2008, Olympia. **Free.** Instructor: Grant Griffin, WSDOT Local Agency Bridge Engineer. This year's classes will be three days instead of the usual two days. The goal of this training is to load *BridgeWorks* onto agency owned computers and ensure it is functioning properly. Attendees will become familiar with the layout and function of the software and will learn to create inspection reports, attach related inspection files such as photos, and transmit inspection data to the inventory database. Students will learn how to manipulate their bridge data for use in managing their bridge inventory.

### Bridge Condition Inspection Training (BCIT)

March 10-21, 2008, Olympia. **Free** to Washington State local agencies and consultants. **All others $700.** This course is two full weeks; attendance both weeks is required. Instruction by WSDOT Bridge, Highways & Local Programs, Hydraulics Section, and FHWA. This course is based on the FHWA "Bridge Inspector's Reference Manual" and will provide extensive training on the condition inspection of in-service bridges. Two comprehensive examinations will be administered: a field exam covering inspection and inventory coding, and a multiple choice classroom exam. Satisfactory completion of this course will fulfill the training requirements of the National Bridge Inspection Standards (NBIS) for a "comprehensive training course" based on the reference manual. This training is for new bridge inspectors or those who desire a refresher. Non-engineers and people with little or no bridge condition inspection experience are strongly advised to attend the Bridge Condition Inspection Fundamentals (BCIF) class prior to BCIT. Twenty hours in the field.

### Bridge Inventory Coding

January 15-17, 2008, Lacey. **Free** to Washington State local agencies and consultants. **All others $150.** Instructors: Grant Griffin, WSDOT Local Agency Bridge Engineer, and Larry Veden, WSDOT Bridge Database Manager. This training is intended for bridge program personnel charged with maintaining correct and current National Bridge Inventory (NBI) coding for the bridges owned by their agency. The course is preparatory for Bridge Condition Inspection Training (BCIT) and it is strongly recommended that this class be taken as a prerequisite to the BCIT.

### Contract Specification Writing

February 27, 2008, Shoreline; March 25, 2008, Yakima. **$75.** Instructor: Steve Boesel. This class will provide guidance and methods for writing consistently clear, concise, complete and well formatted contract special provisions. It will provide a thought process that can be used when writing or reviewing contract specifications to ensure the greatest possibility for a successful bid and a successful construction project.

### Context Sensitive Solutions

March 18-19, 2008, Olympia; March 26-27, 2008, Shoreline; April 1-2, Central WA. **Free.** Instructors: John Heinley and Robert Kutrich, WSDOT. This course will provide the knowledge and skills to collaboratively develop transportation projects addressing the needs of a broad range of users and interested parties. Participants will learn to identify critical issues, involve stakeholders, evaluate alternatives and minimize tort liability when developing solutions to transportation issues that are specific to individual sites.

### Cultural Resources Training

April 29-May 2, 2008; September 30-October 3, 2008. The Dalles, Oregon. **$375.** Three and a half days of training. This training will introduce participants to the value and significance of Washington's irreplaceable cultural resources. The class provides an exceptional opportunity for local agencies to work with the northwest's most qualified instructors, visiting some of the area's finest examples of cultural resources and attending the only statewide training session of this caliber. For any individual who wants to become knowledgeable about cultural resources and possess the necessary skills to address basic resource management problems associated with cultural resources. Call the LTAP office to have your name placed on a wait list for the next class; this course is not available for on-line registration.

### Highway Program Financing

April 15-16, 2008, Tumwater. **$300.** This course provides an overview of the Federal-Aid Highway Program, focusing on various aspects of highway program financing unique to the Federal Highway Administration (FHWA). Topics include: the operation of the Highway Trust Fund and its significance to the funding level of the Federal-Aid Highway Program; the content and policy implication of authorizing and appropriating legislation; the FHWA apportionment process; discussion of obligation limitation, allocations, deductions, earmarking, and transferability; and the effect of policy and budget considerations on the use of Federal-Aid funds. Participants will learn to:

- Describe the flow of Federal financing from authorization to reimbursement,
- Explain authorization, appropriation, apportionment, allocation, and obligation limitation,
- Discuss the impact contract authority and obligation limitation have on the use of Federal funds,
- Explain how the Federal budgetary process applies to the Federal-Aid Highway Program,
- Describe the significance of the Highway Trust Fund to the funding levels for the Federal-Aid Highway Program.

### Introduction to Subsurface Utility Engineering

February 28, 2008, Shoreline; March 5, 2008, Tumwater; March 19, 2008, Moses Lake; April 10, 2008, Vancouver. **Free.** This is an introduction to the concepts and issues involved with subsurface utility engineering (SUE). Discussion will include:

- Issues with utilities.
- Engineer's legal obligations to the public.
- Review the American Society of Civil Engineers ASCE *Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data*.
- Explain SUE – definition, process and strategy for civil projects.
- Detail inherent aspects with One-Call Locate services.
- Detail SUE pitfalls.
- Discussion of case studies.
- Review examples of project submittals, including cross sections, utility database and 3D enhancements for MicroStation users.

### LAG Training Conference

January 9-10, 2008, Tukwila; January 15-16, 2008, Olympia; January 30, 2008, Spokane (a one-day class); February 13-14, 2008, Mount Vernon. **Free.** The following courses will be presented in one hour and 45 minute sessions. The courses were selected based on information gathered during WSDOT/FHWA statewide reviews throughout 2006 and 2007. The specific sessions target subjects that require clarification or more training. The intent of this training is to improve understanding of the individual subjects offered. Instructors are from the Office of Equal Opportunity, Consultant Liaison Office, and Highways and Local Programs Division.

- DBE/Training/EEO: Interviews, Commercially Useful Functions, Training Plan, Reporting, Good Faith Effort, Administrative Reconsideration.
- Title VI: Title VI Plan, Reporting ADA issues.
- Managing Consultant Contracts: Supplements, negotiations, costs.
- Your Files and Project Reviews: File Set-up, Project Management Review, Project Closure, Backup Documents for billing, what should be in a Change Order File, what a consultant file should contain, Force Account, and Materials files.
- Materials Test Reports and Your Project: How to evaluate test reports, what to use them for and how to manage failing material.
- Materials Acceptance and Approval: Record of Materials, Specifications, Product Evaluation, Quality Analysis.
- Pay Notes and Billing Reviews: What will be checked during a billing review and how to build a proper documentation package for each type of payment (per C.Y., Per L.F., Per Acre, Lump Sum, etc.)

### Modern Chip Seal Techniques

April 15, 2008, Port Orchard; April 17, 2008, Mount Vernon. **$50.** Instructor: Phil Barto, P.E., retired Spokane County Operations Engineer. This course will cover asphalt chemistry, the purpose of chip sealing, asphalt and aggregates for chip sealing, design, supervising the chip seal crews, equipment preparation, calibration and maintenance, constructing a chip seal, weather conditions, and cost management.

### Pavement Condition Training

May 20-21, 2008, Ellensburg; May 28-29, 2008, Tacoma. **Free.** Participants will be provided a practical working knowledge of how to rate the condition of roadway pavements in accordance with the standards of the Northwest Pavement Management Association using the *Pavement Surface Condition Field Rating Manual for Asphalt Pavement*.

### Purchasing, Bidding and Contract Management

January 17, 2008, Renton. **$75.** Instructors: John Carpita, Municipal Research and Services Center (MRSC), and Michael Purdy, UW Capital Projects Office. Topics:

- Purchasing and bidding overview – statutes that affect local agencies in purchasing goods, materials and services.
- Public works contracting – procedures, checklists, files; contract documents; bidding and contract award issues; contract administration and closeout; retainage and bonding; sales and use tax issues; exemptions; small works projects; emergency contracts; prevailing wage issues; contractor licensing, bond and insurance requirements; change orders.
- Consultant selection – types of consultants; quality-based selection vs. bids; selection process; contract negotiations.

### Safe Routes to School: Planning and Partnerships

January 30, 2008, Valley; February 20, 2008, Gig Harbor. **Free.** This course will provide information about the Safe Routes to School Program and will help to develop an understanding of how communities can work together to plan for a Safe Routes to School project that will improve safety and health of students, and increase walking and biking to school. To schedule a session, contact Charlotte Claybrooke at claybrc@wsdot.wa.gov or call (360) 705-7302.

### WSDOT Biological Assessment Author Re-Qualification Seminar

March 24-25, 2008, Lacey; April 21-22, 2008, Lacey. **$50.** Instructors: Marion Carey, Erin Britton, Sharon Rainsberry, Julie Hampden. This two-day Re-qualification Seminar will complement information presented in the initial *Biological Assessment Preparation for Transportation Projects Seminar*. The seminar will present new and up-to-date guidance for preparing biological assessments (BAs) for WSDOT projects, as well as cover the most common mistakes made in BAs submitted to WSDOT and what constitutes an insufficient BA. Topics covered include:

- The difference in format and content of a No Effect Letter/assessments versus a BA.
- Using the Analytical Framework - What is it and when is it required.
- Noise and stormwater assessment updates.
- Indirect effects.
- Making effect determinations.
- Essential Fish Habitat updates.
- How to address de-listed bald eagles.

## Professional Trainings for Project Teams

Three courses are offered in this series sponsored by the Association of Washington Cities (AWC) and the Washington LTAP Center. Instruction is by Wynnlee Crisp. Registration is through AWC at www.awcnet.org/training. Scholarships are available for small cities. Lunch is provided. The first class in the series, Project Leadership, was held in November 2007. The others to be presented are: Managing Project Risk and Project Estimating and Budgeting.

### Managing Project Risk

March 26, 2008, Bellevue area, cost TBD. Course Topics:

- Why risk and opportunity management are important to project success.
- The inherent risks imposed by project triple constraints.
- Risk management by project stage and why a project's risk profile changes over its duration.
- How to prepare a risk and opportunity management plan scaled to fit the project.
- Collecting usable schedule, budget, and performance risk data.
- Identifying risks and opportunities using a Risk Breakdown Structure.
- Understanding probability of risks and degree of impact on time, cost and scope or quality objectives.
- Estimating the percent chance of meeting the budget or schedule.
- Monitoring, statusing, and reporting project risks and opportunities.
- Quantitative analysis of cost and schedule risk.
- Keys to successfully reducing risk.

### Project Estimating and Budgeting

November 6, 2008, Bellevue area, cost TBD. Participants are taught the relationship of scope to budget, bottom-up estimating, verification and disaggregation of top-down budgeting, application of escalation and efficiency factors, the effect of schedule on cost, contributors to budget risk, and calculation of adequate contingency.

## WSDOT Construction and Design Courses

**Free.** WSDOT courses are available for public agencies and consultants acting on their behalf. Attendance is limited. Classes are offered in Seattle, Olympia, Vancouver, Yakima, Wenatchee, and Spokane. All classes are posted on the LTAP training Web site as they become available and registrations are accepted online. You will find more information on our Web site along with descriptions for these courses. The Design courses run from September to March; Construction classes are scheduled for January through May. The courses offered are:

### Design

- Roadside Safety (B74)
- WSDOT Interchange Design (CFU)
- Intersection and Pedestrian Design (CBD)
- Roadway Geometric Design (BWE)

### Construction

- Excavation and Embankments Inspection (AC3)
- Nuclear Gauge Safety and Operation (ALG)
- Nuclear Gauge, Embankment/Surfacing/Pavement Applications (ANQ)
- Electrical-Illumination and Signals (API)
- Drainage Inspection (ACF)
- Hot Mix Asphalt Placement (ACB)
- Bridge Structures Inspection (ACM)
- Bridge Structures Overview (CZ3)
- Bituminous Surface Treatment Inspection (ACC)
- HMA Mix Design Review for Supervisors (CVQ)

## TRANSPEED
## University of Washington

Contact: Julie Smith
(206) 543-5539, toll free 1-866-791-1275
fax (206) 543-2352
jchant@u.washington.edu
www.engr.washington.edu/epp

The prices in this section are for local agency/non-local agency.

Introduction to Managing the WSDOT Consulting Process
January 29, 2008, Shoreline. $365/$545

Construction Inspection of Public Works Projects
March 3-4, 2008, Bellevue; May 28-29, 2008, Lacey. $390/$595

**Fundamentals of Traffic Engineering**
March 18-20, 2008, Seattle. $420/$600

Administering Consultant Contracts
April 8, 2008, Seattle. $280/$440

Retaining Wall Type Selection and Layout
April 22, 2008, Lacey. $250/$315

Legal Liability for Transportation Professionals
April 29-30, 2008, Seattle. $305/$475

Roadway Culvert Hydraulic Design
May 7-8, 2008, Seattle. $300/$475

Technical Communication for Transportation Professionals
May 20-21, 2008, Lacey. $315/$525

**Manual on Uniform Traffic Control Devices**
June 3-5, 2008, Lacey. $370/$570

Lighting and Illumination (New Course)
June 4-5, 2008, Bellevue. $395/$595

Managing Consultants
June 10, 2008, Seattle. $485/$675

Roadway Geometric Design 1
June 24-25/2008, Lacey. $315/$525

BMP Field Training for Construction Inspectors
Date TBA, Monroe. $295/$450

Public Works Construction Project Management
Date TBA, Lacey. $390/$595

## Regional Road Maintenance Endangered Species Act Training Program
## University of Washington

Contact: Julie Smith
(206) 543-5539, toll free 1-866-791-1275
fax (206) 543-2352
jchant@u.washington.edu
www.engr.washington.edu/epp/esa/index.html

The Regional Road Maintenance ESA Training Program courses offered by the University of Washington include the following. Check their Web site for descriptions of courses, and dates and locations of class sessions.

**Track 1: Briefing for Regional Decision Makers**

This is a stand-alone training class and not part of the required training program. It provides an overview of the ESA program for regional level management and administration. It is presented by members of the Regional Road Maintenance Program's Regional Forum.

Track 2: Introduction, Design and BMPs, Monitoring, and Environmental Roles for Engineering, Technical and **Scientific Staff**

Track 3: Classroom Introduction to ESA and Outcome-based Road Maintenance for Field Crews

Track 3B: Field Training for Bridge Maintenance

Track 3F : Road Maintenance Crew Training in the Field Environment: Applying Maintenance BMPs

Track 3W: BMPs for in-Water Work

Track 4: Train-the Trainer for The Regional Road Maintenance Program

### Retired Professionals Web Site

The Retired Professionals program provides a listing of retired public works individuals interested in part-time or full-time employment with agencies needing experienced professional employees.

www.wsdot.wa.gov/TA/T2Center/Retired.htm

# Other Training Programs

### Engineering Professional Programs (EPP)

University of Washington, Seattle
Civil and environmental professional development, engineering review courses in preparation for PE exams. (206) 543-5539
www.engr.washington.edu/epp

### Washington Environmental Training Center

Green River Community College, Auburn
Water, wastewater, and other courses of interest to public works departments. 1-800-562-0858
www.greenriver.edu/wetrc

### Washington State Emergency Management Division

Professional Development Series courses, Advanced Professional Series Courses, and courses that prepare individuals for disasters ranging from floods, fires, weather storms, earthquakes, and other natural or technological hazards. (253) 512-7048 or (253) 512-7000
http://emd.wa.gov/

### Homeland Security Institute

National Incident Management System classes, classroom and online. (360) 586-8169
www.hsi.wa.gov/

### Washington State Department of Personnel (DOP)

Human Resource Development Services. Local agencies are invited to attend all DOP training classes. Courses on health and safety, information technology, leadership, meeting facilitation, oral and written communication, personal development, customer service, sexual harassment awareness. (360) 664-1921
http://hr.dop.wa.gov/training

### Evergreen Safety Council

Traffic control supervisor, traffic control flagger certification, flagger instructor, first aid/CPR, forklift instructor, safety and health training. (206) 382-4090 or 1-800-521-0778
www.esc.org

### Washington State Department of Labor and Industries

Online safety courses, employee training kits, video library, videos online, workshops. (360) 902-5800, 1-800-547-8367
www.lni.wa.gov/Safety/TrainTools/default.asp

### Click, Listen and Learn
### American Public Works Association

APWA's series of interactive Internet educational programs. Hear it through your speaker phone; see it on your PC. Each program is led by top experts in the field who convey new ideas, new methods, and new technologies in a two-hour time frame. Over 50 past programs can be purchased. (816) 472-6100
www.apwa.net/education/cll/

***Now Scheduled:***

- **January 10, 2008:** Trenchless Technology
- **January 17, 2008:** The BEST from the San Antonio Congress: "Aging Infrastructure" Litigation: How to Prevent it, How to Defeat it!
- **January 31, 2008:** TARGET Emergency Preparedness #2: DURING the Disaster – Resource Management
- **February 21, 2008:** Water – A Precious Resource in Diminished Supply
- **March 6, 2008:** Mastering the Media – Telling the Public Works Story Your Way!
- **March 20, 2008:** TARGET Emergency Preparedness #3: AFTER the Disaster – Reimbursement
- **April 17, 2008:** Innovative Funding – Getting to the End of the Rainbow
- **May 15, 2008:** Delta Force Readiness! Developing Tomorrow's Elite Corps of Public Works Leaders
- **May 29, 2008:** Green Buildings – LEED the Way

# Conferences and Events

For more information:
www.wsdot.wa.gov/TA/T2Center/Conf.htm

### American Public Works Association (APWA) Conferences

***Spring:*** April 1-4, 2008, Ocean Shores Convention Center, Ocean Shores
***Fall:*** October 14-17, 2008, Whitman Hotel Conference Center, Walla Walla
Contact Mike Terrell at (206) 684-3078 or michael.terrell@seattle.gov for 2008 conferences, www.apwa-wa.org

### Road Builders' Clinic

March 4-6, 2008, Coeur d'Alene, Idaho. Sponsored by Washington State University. Contact wsuconf@wsu.edu or 509-335-3530, capps.wsu.edu/calendar

### Pacific Northwest Snowfighters Winter Maintenance Conference

May 20-22, 2008, Kennewick.
capps.wsu.edu/conferences/pns

### Pacific Northwest Bridge Maintenance Conference

October 7-8, 2008, Seaside, Oregon. capps.wsu.edu/bridge

LTAP News

Washington State LTAP Center
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Washington State Department of Transportation
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