

T² Bulletin

A Newsletter of the Local Technical Assistance Program (LTAP)



Issue 65, Winter 2000

Pilot Tube Advances Save City Disruption and Dollars

By Mark Lester and Richard Vedder
 Reprint by permission of "Trenchless Technology"



▲ The small pilot tube microtunneling system enabled Cape Girardeau to install more than 40,000 lin. ft. with disturbance of only one tree.

(CSOs) threatened the local watershed, the city and its project team found an innovative technology to separate the sewers with minimal disruption and at a lower cost than open-cut construction.

Cape Girardeau, Missouri, located about 100 miles south of St. Louis, traces its history and growth to its location on the Mississippi River. Founded in 1793, the city thrived as a steamboat port and debarkation point for passengers wanting to go inland.

Today Cape Girardeau is the home of Southeast Missouri State University and has a population of about 40,000. When combined sewer overflows

Sewers in the older sections of town were originally constructed as combined sewers, handling both storm water and sanitary wastewater. During rain events, the combined flow of wastewater and storm water is more than the system can transport and treat. The excess combined sewer overflow discharges to the nearest receiving stream.

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Washington State Technology Transfer Center WSDOT

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The CSO from three of the watersheds flowed into a small creek running through a city park.

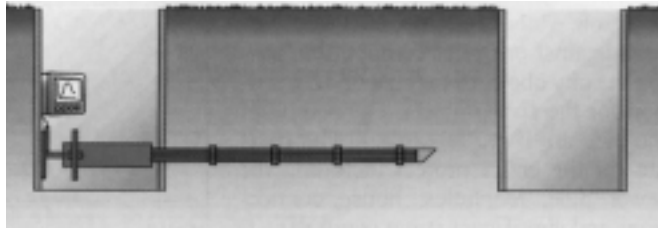
Concern about the health aspects of the creek discharge led the city to commission a study in 1990 to identify necessary sewer system improvements through 2010. The study showed that in Cape Girardeau it is significantly less expensive to separate the combined sewer into sanitary and storm sewers than to provide CSO treatment.

Finding Solutions

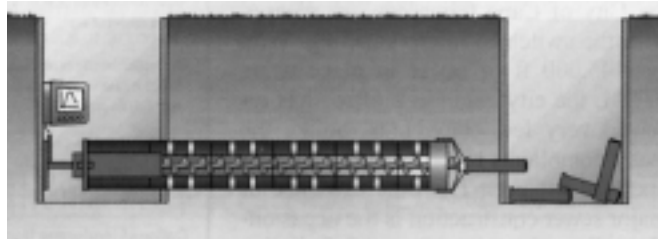
Twelve of the projects identified in the study became the Sanitary Sewer Improvement Program (SSIP). Constructing the six CSO separation projects posed several challenges. Because the projects are in the older, more congested parts of town, the city was concerned about the disruption to neighborhoods and businesses. With more than 8 miles of new sewers to install under paved city streets, utility disruption and street damage during construction were immediate concerns. Cape Girardeau’s unstable soils also made trenching difficult and potentially dangerous. Despite these concerns, the city decided it could not pay the anticipated extra cost if microtunneling was specified. The projects were designed as

open-cut requiring significant engineering to address all the construction issues.

the reduced impact on citizens and businesses, but only if the finished installation satisfied the original specifications at no greater cost. Additional discussions led to a change order allowing trenchless, if compliance with the original design requirements could be demonstrated during a detailed testing program. The change order reduced the contract price on the two projects by 7 percent.



Phase 1:A theodolite guides the pilot tube displacement.



Phase 2:A cutterhead with auger excavates for the clay carrier pipe.

Robinson Construction Co., with offices in Perryville, Mo., won the first two CSO projects.

They were typical unit price bids with cut-and-cover quantities. Early in the planning process, Robinson requested a meeting to discuss the possibility of doing much of the work using trenchless methods. Robinson had experience tunneling short segments on a previous project using an unguided wet-bored method and thought this might be cost-effective in Cape Girardeau.

The city and its consultant, Sverdrup Civil Inc., were willing to consider trenchless because of

New Technology

Tests showed that unguided wet bores of 30 or 40 ft could not meet the specified tolerance of 0.1 ft for line and grade. A method was devised for enlarging the tunnel, manually inserting the PVC pipe and grouting the void space, but this was determined to be too expensive. Andy Robinson from Jason Consultants (on site to assist the city and Sverdrup



▲ An 8-ft steel can is inserted into the auger-excavated shaft. When finished, flowable fill is poured and the can is pulled from the shaft.

in observing the test program) suggested that Robinson consider guided pilot tube technology used in Germany for 4 in. and 6 in. diameter sewers. Frank Robinson, president, and Dave Monier,

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project manager, of Robinson Construction Co. went to Germany to observe the technology and purchased a Soltau RVS 35 machine.

The guided pilot tube machine easily met line and grade requirements, but the wet-bore method was rather labor intensive. Streamlining construction methods could significantly reduce the cost. With the promise of additional savings, the city allowed additional development and testing which evolved into the current pilot tube system of microtunneling (PTSM)- a technology that addressed the construction challenges, reduced disruption, and created a 15 percent savings compared to open-cut.

The Process

Installation begins with the truck mounted auguring of the drive and receiving shafts. Much of the work is done in 6.5ft diameter shafts, but 8ft diameter shafts are used when a precast manhole is to be installed. Auger cuttings are placed in a container and hauled off site. The construction team inserts a reusable steel shaft, only slightly smaller in diameter than the auger, when the

auguring is complete. The steel shafts create a safe work environmental and keep the job site safe for local residents.

Once the shaft is in place, the construction team aligns the microtunneling machine using

the drive shaft where they are removed by a suction truck and transported off site. The auger is totally enclosed, so the carrier pipe remains clean. The tunnel is only an inch larger in diameter than the carrier pipe, minimizing void space. After the clay microtunneling pipe is installed, flowable fill or control low strength material (CLSM) is added as the temporary shaft liners are withdrawn. The CLSM fills the void spaces to prevent soil movement. CLSM hardens to about 100 psi and can be excavated in the future.

The successful demonstration of microtunneling techniques on the first two projects led the city to allow the method on the three

remaining CSO projects conducive to microtunneling. Specifications were changed to lump sum to allow the bidder to choose open-cut, microtunneling or a mix as the method of construction. Robinson won all three projects against open-cut competition, saving the city about 15 percent of \$2.1 million for the five projects. The results of the bids are listed in Table 1. The costs are for the entire project including the sewer pipe, manholes, house

Table 1
Cost Savings using Pilot Tube System of Microtunneling
Cape Girardeau, Missouri

Projects	2nd Low Bid (open-cut)	Engineer's Estimate	Micro-T Bid	\$ Savings	% Savings
Walnut Henderson (12/7/95) 4,000 ft sanitary (8-12 in.) 230 ft storm (12 in.)	\$ 598,648	\$ 837,992	\$ 556,832	\$ 41,814	7.0
College/Henderson South (1/18/96) 15,000 ft sanitary (8-15 in.) 800 ft storm (12-18 in.)	2,971,450	3,207,719	2,764,264	207,186	7.0
Fort D (6/17/97) 9,200 ft sanitary (8-15 in.) 2,100 ft storm (12-24 in.)	2,931,523	2,450,000	2,187,000	744,523	25.4
College/Henderson North (10/9/97) 15,900 ft sanitary (8-12 in.) 2,000 ft storm (12-18 in.)	none	5,000,000	4,698,000	302,200	6.0
Main CSO (8/11/98) (1) 1,800 ft sanitary (8-18 in.) 9,900 ft storm (12-42 in.)	4,725,000	3,870,800	3,890,000	835,000	21.6
	16,226,619	15,366,511	14,096,096		
	PTSM Savings over Open-Cut (all projects)			\$2,130,523	15.1

(1) About 50% anticipated to be tunneled

standard survey techniques. Robinson currently used RVS 35, RVS 35-60 and RVS 80 machines -all variations of the PTSM process- to install sewers from 6 in. to 18 in. ID. The machine pushes the 4 in. pilot tube by displacement to precisely set the line and grade. Tolerances well within the specified 0.1 ft vertical and horizontal are easily achieved. Because the pilot tube is rigid, the line and grade run true from start to finish with no high or low spots.

Cuttings are auger-conveyed back through the carrier pipe to

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connections and significant street overlays.

The citizens and administration of the city of Cape Girardeau are pleased with the switch to microtunneling. With over 45,000 ft. of sewer in place using PTSM, the city engineer's office has received very few complaints, unlike the many complaints received during similar open-cut projects. The only evidence of major sewer construction is the occasional small patch at the 6.5- and 8-ft. diameter shaft locations.

The Cape Girardeau, PTSM has yielded substantial benefits: a safer job site, minimal street cuts, simplified house connections and reduced settlement. The city gained the social cost savings of trenchless construction at a cost lower than open-cut.

Mark Lester is city engineer for Cape Girardeau, Mo. Richard Vedder is with Sverdrup Civil Inc. and is the program manager for the Cape Girardeau SSIP.



Walkable Communities: Designing for Pedestrians

Videotape of the class by Dan Burden. Four tapes, 5.5 hours. Available for purchase (\$75) or can be borrowed by local agencies.

Call T² Center for further information (360) 705-7386 or grayl@wsdot.wa.gov.



Transportation Partners Designate April 3-7 Work Zone Safety Week

Source: FHWA 79-99



To help reduce fatalities and injuries in highway construction areas, the Federal Highway Administration (FHWA), the American Traffic Safety Services Association (ATSSA), and the American Association of State Highway and Transportation Officials (AASHTO) today signed an agreement to designate April 3-7 as the National Work Zone Safety Awareness Week. FHWA Administrator Kenneth R. Wykle, ATSSA Executive Director Roger A. Wentz and AASHTO President Thomas R. Warne signed the document. In the past decade more than 8,000 fatalities were reported in work zones. Fatalities in 1998 rose to 772, reversing a three-year decline in work zones fatalities from 1995-1997. Approximately 37,000 people were injured in work zones in 1998.

"This agreement underscores our commitment to safety which is President Clinton's highest transportation priority," U.S. Secretary of Transportation Rodney E. Slater said. "This new safety partnership will help save lives and prevent injuries in work zones."

The signing of this agreement between the three organizations provides the framework for action in implementing the nationwide awareness week

which will seek to increase awareness of work zone safety among the driving public and construction workers and generate dialog among highway program managers in the public and private sectors.

"FHWA is committed to working with our safety partners to improve work zone safety and to reduce the number of crashes and fatalities on our nation's highways," Wykle said. "We have one of the safest highway systems in the world, but we must make it even safer for highway workers and motorists." The goals and objectives of today's memorandum of understanding are as follows:

- Increase public awareness of the need for greater caution and care while driving through work zones to reduce fatalities and injuries in work zones.
- Establish and promote a common set of "safety tips" for motorists.
- Increase public sector, industry, and worker awareness of the value of training and best practices regarding work zone safety.
- Establish a nationwide program for promoting work zone safety.
- Communicate to workers and contractors the effects of

motorists frustration with delays on their driving behavior, and suggest possible actions to alleviate that behavior.

- Engage as partners interested parties involved in work zone safety.

"Safety is a top concern to AASHTO's member departments, and far too many fatalities and injuries occur in work zones each year," Warne said. "AASHTO is dedicated to this effort to inform the public of the problem, and to educate drivers on how to get through work zones in order to ensure their safety and that of the highway workers." "Roadway work zones are a way of life in every community across America. Motorists need to be aware of them and the workers within them," Wentz said. "If drivers would simply slow to posted speed limits in work zones, disengage from distracting activities such as cellular phone usage, and be aware of the workers, countless lives would be saved."

For additional information, please contact : FHWA, Virginia Miller, 202-366-0660 ATSSA, James Baron, (800) 272-8772, ext. 113 AASHTO, Thomas Schulz, (202) 624-5838

Student Job Referral Program for Summer 2000

By: Laurel Gray, T2 Training Coordinator



Do you need summer temporary help for agency work such as inspection, engineering support, park maintenance, roadway inventory, mapping, GPS surveys, construction staking, roadway maintenance, record keeping, drafting, field surveying, or traffic counts?

This spring the T2 Center will be offering a summer job referral program to local agencies and civil engineering and technical students. This program will be designed to assist local agencies in hiring students enrolled in transportation related engineering and technical fields for summer employment.

The program can benefit both the local agency and the student. It will benefit the agency by providing motivated employees as well as provide the transportation student practical field experience. The student's education will provide the agency with a potential summer employee familiar with public works. At the same time, the student will gain valuable work experience in his or her chosen field of study.

It will also provide an opportunity for agencies to identify prospective future employees.

As your agency makes plans to hire summer help let the Technology Transfer Center help you match the job with a student.

Watch the T2 Educational Opportunities and the T2 Bulletin for more information as the program develops. We will also be providing updates by way of the Internet. The T2 Internet site can be found at:

<http://www.wsdot.wa.gov/TA/T2Center/T2hp.htm>.

We anticipate that this program will be up and running by the end of March. If you would like further information or would like to participate, contact Laurel Gray, T2 Training Coordinator, at (360) 705-7386 or grayl@wsdot.wa.gov.



NovaChip® Makes It's Way West

by Dan Sunde, WST2 Center

Last November three representatives from the state of Washington were able to attend a demonstration of the NovaChip® technology in San Jose, California. Vince Kiley, Pierce County; Jeff Uhlmeyer, WSDOT Materials Lab; and Dan Sunde, WST2 Center, along with over a hundred other transportation representatives from the Bay Area local agencies and CalTrans, spent a day learning about and watching the new paving process on a San Jose paving project.

The demonstration drew a large amount of interest. In all, 145 engineers and technology representing seven cities, five counties, two state DOTs and nine CalTrans districts attended the full day show and tell. There were also twenty contractors representing fourteen companies for a total of 163 observers.

NovaChip® is a paving process developed in France in the 80's and recently imported to the United States by Koch Pavement Solutions. Although used for some time on the east coast, NovaChip is just beginning to make it's way to the west coast.

It is an ultra-thin overlay designed to be placed over a structurally sound base to provide an open graded wearing course that is durable,

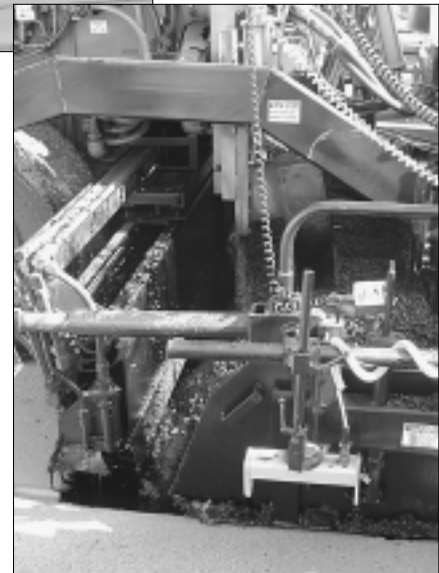
laid at a rate of about 55-60 lbs. per square yard.

NovaChip® system differs from other paving processes in several ways.



The paving machine is unique. It is comprised of a hotmix delivery system, a hotmix spreading system, an emulsion storage/application system, riding on an articulated chassis. The hot mix is

and provides drainage and friction resistance. It is not designed as a structural surface to replace a failed pavement system nor to cover existing pavement distresses. It is intended to be one more tool in your arsenal of preventive maintenance techniques along with chip seals and slurry seals. It can also be used as a final wearing course for resurfacing projects. It has an expected service life of up to ten years.



NovaChip® system places a thin 3/8" to 3/4" thick open-graded hotmix over a special asphalt membrane called Novabond in one pass with a single paving machine. A roller travels just behind the paver to compact fresh overlay. The membrane is sprayed at a rate of 2/10's gallon per yard and the mat is

loaded into the hopper at the front of the machine then transported longitudinally the length of the unit via four screw conveyors. It's then dumped into a rear hopper where it is spread laterally with a

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spreading auger and a hydraulically extendible screed. A 2800 gallon tank sits between the front hopper and the spreading unit which stores the emulsion. The emulsion is delivered to a variable width spraybar just a few inches in front of the spreading augers. All in all this makes for a paver larger than normal.

The application is very quick. Although the demonstration project was in an urban area and didn't allow for maximum paving speeds, speeds of over 100 feet per minute were cited.

The hotmix is applied simultaneously with the emulsion. The hot mix is placed only few inches behind the fresh emulsion. As a result the hotmix is placed on very fresh emulsion allowing for maximum penetration and bond. The emulsion also penetrates both the existing pavement and the new pavement providing a strong bond to ACP as well as PCC.

The overlay has a quick curing time. Due to the minimal thickness the hotmix cures very rapidly and can be driven on within a few minutes. We witnessed car traffic crossing the single lane with no damage to the overlay within fifteen minutes of being laid. Even more dramatic was a large front-end loader with cleated tires that drove down the center of the freshly laid overlay within fifteen minutes of being

laid with only dust tracks to show it had been there.

It has a very short active construction zone that travels along with the paving operation. As with normal paving



operations the space required for construction was fairly small about 320 feet from front of the paver to the end of the rollers operation. However, since the paving process is quick and the curing time is short the construction zone travels along very rapidly. This removes the need to close long sections of roads or blocks of streets and their driveways for hours. Traffic is only disrupted for a few minutes. This is very beneficial in urban areas and business districts.

The emulsion membrane provides a moisture barrier. The special polymer-modified emulsion used in the membrane is thicker than normal tack coats and fills low to medium severity cracks sealing the entire existing pavement surface from water intrusion.



Information on NovaChip® Available on the Web

Research Reports

National Center for Asphalt Technology (NCAT) research report on NovaChip® performance: "Construction and Performance of Ultrathin Asphalt Friction Course" by Prithvi S. Kandhal and Larry Lockett <http://www.eng.auburn.edu/center/ncat/reports/rep97-5.pdf>

Research Report from the Texas Transportation Institute: "Performance Evaluation of

NovaChip®: Ultrathin Friction Course, February 1997, Summary of Texas Department of Transportation Research Project 553"

Texas Center for Transportation Research Article: "Project 2957: Use of Pavement Surfaces To Attenuate Traffic Noise" <http://www.utexas.edu/research/ctr/aviprojects/2957.html>

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Articles on improving safety on Canadian highways using NovaChip®, "Looking for New Ways to Reduce Collisions" http://www.rmoc.on.ca/Public_Affairs/Public_Announcements/prnova.html

FHWA Policy Memorandums - Office of Engineering: "Surfacing Finishing of Portland Cement Concrete Pavements - Final Report FHWA-SA-96-068,

Tire Pavement Noise and Safety Performance," May 1996 http://www.fhwa.dot.gov/legsregs/directives/policy/sa_96_06.htm

More information on NovaChip® on the Web:
KOCH Pavement Solutions web site: www.kochpavement.com/Solutions/novachip.htm
NovaChip® in the southeast U.S., E.J. Breneman's site: <http://www.ejbreneman.com/nova.html>

[/www.ejbreneman.com/nova.html](http://www.ejbreneman.com/nova.html)

SIR-Societe Internationale Routiere, the originator of NovaChip®: http://www.si-routiere.com/pro_utl.htm

Boral Asphalt, the Australian NovaChip® Site: <http://www.boral.com.au/cmga/asphalt/i6.htm>



FIND YOUR WAY

at the

2000 TRAFFIC ROUNDABOUTS CONFERENCE

May 1-3, 2000
Doubletree Hotel Seattle Airport
Seattle, Washington

For Conference Information Contact
Darlene Sharar
Highways & Local Programs WSDOT
(360) 705-7383
sharard@wsdot.wa.gov

Registration Information Available
February 1, 2000

Great News From Heritage Corridors Program

December brought an announcement from FHWA, of \$734,936.00 in National Scenic Byway funding awarded to Washington's Scenic Byways. For the first time, the top seven rated grants out of eighteen were awarded to Washington State routes. They are:

of successful applicants are expected in the late spring.

In the post I-695 era, The Heritage Corridors Advisory Committee (HCAC) met on January 27th via five video conference locations, and one teleconference location in the regional offices. This was the

"The Grant Ranking Team," whose primary responsibilities will be to review, evaluate and rank Washington's submissions for National Scenic Byway funds.

"The Byway Designation Recommendation Panel." This panel will meet to set

thresholds for state byway designation qualifications, and to review nomination packages for routes applying for both Scenic Byway and Heritage Tour Route designation.

Committee members and schedules of meetings will be announced at a later date.

GRANT NAME	SR #	AMOUNT
Snoqualmie Point Scenic Viewsite Master Planning	I-90	\$100,000
Traveler Info & Interpretive Area	SR 112	48,156
Tipsoo Lake Restrooms & Picnic Area	SR 410	157,200
US Hwy 97 CMP	US 97	80,000
Developing Washinton's HCP	Statewide	156,800
Early Winter Community Trail Bridge	SR 20	123,900
Implementing CMP/Marketing Plan	SR 410	68,800
	TOTAL	\$ 734,936

Heritage Corridors Program also submitted two new nominations for National Scenic Byways: SR 31, North Pend Oreille in the northeastern corner of the state; and SR 112. The Strait of Juan de Fuca Byway in the Northwest corner of the state both submitted application packages in January for designation as National Scenic Byways. Forty-four routes nationwide submitted applications. Announcements

last meeting of HCAC as it has been structured for several years. The HCAC will now divide into three groups:

"The Byway Coordinators Working Group," whose purpose is to assist byway groups with completing Corridor Management Plans, and to increase communication between byways and related organizations.

For more information contact Judy Lorenzo at 360-705-7274.



Got a "Better Mouse Trap"? Come and share it with the rest of us!



The WSDOT, WST2 Center, and FHWA are co-sponsoring the first Pacific Northwest Transportation Technology Expo at the Grant County Fairgrounds in Moses Lake, Washington, September 12-14, 2000. The purpose of the Expo is to demonstrate the leading edge technologies currently available on the market, as well as innovative "home grown" ideas for roadway operations developed by Pacific Northwest state and local agency transportation operations staff.

A major part of the Expo will be set up for demonstrations and displays of practical tools, equipment modifications, and new techniques developed and used in the field by public agencies. No idea is too small. If it works and saves you time and money, we invite you to share it with the rest of the agencies in the Pacific Northwest. This will be one big three-day "show-and-tell" to share your ideas and see what others like you have done to be more efficient and effective.

Attendance, registration, and display space are free to public agencies. We have plenty of space. Just let us know what your innovation is and how much space you need. We'll make the arrangements to get you a site. If possible, we encourage the actual inventor to be at the display to field questions and show the functionality.

Please submit your ideas to either:

**Clay Wilcox, Maintenance Superintendent
WSDOT-FOSSC
PO Box 47358
Olympia, WA 98504-7358
(360) 705-7861
wilcoxc@wsdot.wa.gov**

**Dan Sunde, WST2 Center
WSDOT-H&LP
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Olympia, WA 98504-7390
(360) 705-7390
sunded@wsdot.wa.gov**

We look forward to hearing from you.

Transportation Researchers Find Unusual Source For Environmentally Friendly Snow and Ice Control

Source: FHWA 76-99 U.S. Department of Transportation Office of the Secretary ~ Office of Public Affairs, Washington, DC 20590

U.S. Transportation Secretary Rodney E. Slater today announced that researchers have discovered how cheap feedstocks, such as cheese whey, can be used to make inexpensive calcium magnesium acetate (CMA), an environmentally-friendly snow and ice control material used for roadway deicing and anti-icing.

Several states use CMA to maintain the safety and efficiency of highways and bridges during the winter months.

"President Clinton and Vice President Gore are committed to protecting the environment and improving safety, their highest transportation priority," Secretary Slater said. "The results of this research can help improve the quality of life in our communities and make it safer for motorists and pedestrians alike."

The Federal Highway Administration (FHWA), in partnership with the New York State Energy Research and Development Authority and several state highway agencies, funded the research which involves fermenting cheese whey to produce acetic acid which, in turn, reacts with lime to produce CMA. Researchers from Ohio State University's Department of Chemical

Engineering conducted the research on behalf of the agencies.

"Some of the largest strides in research come from a willingness to find significance in the seemingly insignificant," FHWA

Administrator Kenneth R. Wykle said about the use of the cheese by-product.

"This discovery is tremendously valuable because it illustrates the kind of ingenuity and resourcefulness that will enable us to meet the transportation challenges of the new millennium."

CMA is a mixture of calcium acetate and magnesium acetate and has a deicing ability comparable to salt. Although salt is less expensive, CMA has no significant health or environmental concerns. It is not corrosive to vehicles and not harmful to concrete, structural steel, vegetation, fish or other aquatic life.

Many states have expressed interest in the findings which show that production of acetate from waste liquid whey could provide approximately 1.7 billion

pounds per year of low cost CMA and potassium acetate for highway and airport runway deicing and anti-icing materials.

Deicing tests have shown that the whey-based product has an equal or slightly better ice penetration rate than that of commercial CMA. Cost analysis shows that CMA made from cheese whey can be produced at a cost of less than 30 percent of the current market



price for commercial CMA, helping to make environmentally-friendly winter highway maintenance operations more cost-effective. Researchers have also developed methods for producing CMA from sewage sludge with similar results.

The results of this study are documented in a report (FHWA-RD-98-174) titled Calcium Magnesium Acetate at Lower Production Cost: Production of CMA Deicer from Cheese Whey.

Visit the USDOT Public Affairs Web Site at:
<http://www.dot.gov/briefing.htm>

CRS - A Collision Record System for Local Agencies

By Ed Lagergren, P.E.

Managing traffic safety requires knowledge of where collisions occur on your street or road network. CRS Collision Record System is a public domain computer program that is available for use in cities to keep and analyze traffic collision data. CRS is the fourth generation collision record system designed and programmed by John Bean, Traffic Engineer for the City of Longview. John has incorporated many features that make the program easy to use, capable of generating reports that enable the user to analyze locations/corridors and develop cost effective corrective safety measures.

CRS contains three main elements: Data Entry, Reports and Graphs. A brief description of these elements is described below.

Data Entry

Data entry is accomplished by manual entry only at this time. The data entry screen is set up to simulate the WSP Collision Report Form. The fields automatically advance following data element entry. Street name data is selected from a pull down list. CRS data entry includes many internal data checks to help the user enter the data correctly. A collision record can easily be entered in less than a minute with some practice. As part of the data entry, CRS allows the user to scan the officer's

collision diagram sketch and attach it as a file to the collision report. These sketches can be referred to later during collision analysis.

Two other data elements that the user can enter increase the capability of CRS. Traffic volume data at specific locations on the roadway network allow the user to generate collision rates. Societal collision costs can be entered into CRS to determine the societal cost for collisions at a user defined location.



Reports

The reports section of CRS provide the user with eleven different canned reports. Reports can be customized for date, location and other features. Four of the reports are described in the following sentences. The Location Report for a specific intersection produces all of the collisions at the selected intersection. The High Collision Location Report provides a list of locations ordered by one of three different methods: number of

collisions, collision rate or collision cost. The Corridor Report provides a list of collisions in location order on a selected street between two selected intersections. The Collision Diagram Report provides the user with a collision diagram for a selected intersection. CRS also gives the user the option of designing their own reports.

Graphs

The Graphs section gives the user the capability to graph collision types, times, day of the week and other collision particulars at a selected location. These graphs are a powerful analysis tool to help the user determine possible collision causes and potential collision countermeasures. The graphs can also be sent to the clip board for inclusion into a written report or Powerpoint presentation.

John Bean wrote CRS for his own use at the City of Longview. For this reason earlier versions of the program, which have been in use by John and some agencies for almost two years, did not have any help screens or documentation. The Washington Traffic Safety Commission, Traffic Records Committee (TRC) evaluated the program for statewide use. Their evaluation determined that the program was suitable for use by agencies throughout

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the state. Funding was obtained from the TRC for John to enhance his program for statewide use. The enhancements included the addition of help screens and the writing of a users manual. Future plans for CRS, made possible by the TRC funding, include a one day training session taught by John Bean (tentatively scheduled for March 2000) and a module to provide the capability to download collision records from the WSP when the data becomes available.

CRS requires a 486 processor system or newer with Windows 95, 98 or NT.

If your agency is looking for a way to keep collision records, CRS should be considered. CRS can be obtained in two ways: downloaded from the internet at <http://www.wsdot.wa.gov/ta/T2Center/TRAFFIC/software.htm> or by contacting Ed Lagergren, WSDOT Traffic Services Engineer, at 360-705-7986.



Clark County and City of Vancouver Become Roommates to Save Time, Money

Source: Vancouver, WA - Doing what most people do to save money on housing costs, the city of Vancouver is moving in with Clark County.

A work crew from the city of Vancouver, and their equipment, will begin co-locating with Clark County at the county's English maintenance facility at NE 192nd Avenue and 9th Street.

City and county employees will share office space and office equipment, crew space, the rock stockpiles, various pieces of specialized equipment, and the storage yard. In addition, the city of Vancouver will utilize the county's fuel truck and have minor equipment maintenance repair work done by county mechanics.

"By locating our employees together, we can save on mobilization costs to get our crews out to our work sites," said Richard Hoffman, city of

Vancouver. "We are able to move our work crew out to the English facility with minimal capital outlay because the county is willing to share their facility. It's a win-win for both agencies, as well as the taxpayer."

"We are also hoping to get a price break on the rock that we order and stockpile out there," said Roy Brannam, Road Operations Supervisor for the Clark County Public Works Department. "Because we will be working together and using a larger volume, we should be able to save additional money." Currently, the city of Camas is also planning to purchase their rock for winter road maintenance at the English Facility.

All of the agencies are members of GEM, an acronym for Grounds Equipment and Maintenance, which is a Southwest Washington Interagency Cooperative. Their goal is to work together to promote efficiency, use existing resources, and look for economies of scale. They meet on a regular basis to exchange successes, concepts, and general information to promote efficiency in government.

Visit their web site at: <http://www.tntwebcraft.com/gem/>

From Roger's Technology Toolbox: Unraveling the mystery of GPS (Global Positioning System)



By Roger Chappell, T2 Technology Integration Specialist

Does one size fit all? What is the difference between the \$99 GPS unit in the sporting goods store and the one a surveyor uses? There seems to be a lot of confusion today about GPS units. And rightly so, with prices ranging from \$99 to over \$40,000. I am asked these questions a lot.

In this on-going series, I hope to answer these questions, and to help demystify this strange new technology. The military, surveyors and other select groups have been using this technology for a long time, but it has only been the last couple of years that the common person could afford to use it. It reminds me of the explosion in popularity of desktop PC's in the last 20 years. What was shrouded in mystery a mere 20 years ago is now a part of our lives, and in many of our homes. Except now in the case of GPS there are more players in the game than Apple and Big Blue.

Will the next 20 years find geospatial coordinates as common as e-mail is today? Probably not, but hopefully it will be as easy to use. Along with looking at GPS, we will look at various peripherals like laser range finders, voice command, digital cameras, dead reckoning systems, and how these tools function together. We will also look at software systems, databases

and how to use your data in a GIS (Geographic Information System) environment.

Before we can begin to answer the question "What type of unit is best for you?" Let's take a quick look at some of the different types of units available. I generally divide them into four types of systems:

1. "Navigation grade" receivers.
2. "Mapping grade" receivers.
3. "Survey grade" receivers.
4. "Specialty and Military grade" receivers.

Navigation grade receivers

These units are not typically DGPS (Differential Global Positioning System) capable. We will discuss things that affect positional accuracy later on but, in general, any unit that does not use DGPS can only pinpoint a location within a 100 meter circle.

Once you've selected a navigation receiver with a 100 meter accuracy, unit costs will vary depending on how many features are included with the unit. Navigation grade units are usually under \$1000 with most of them under \$500 depending on the features.

Some include things like maps, data points or line feature storage, and even satellite e-mail messaging.

Mapping grade receivers

These units should be DGPS capable, and should be capable of 5 meter to "sub-meter" (smaller than a 1 meter circle) positional accuracy. These systems range from \$1000 to as high as \$30,000, depending on the features, software, and peripherals included with the package. Most of these units come with a computer system and software that allows the user to input various types of data. Some systems include laser range finders, digital cameras, dead reckoning systems, voice command and every type of test probe and meter imaginable.

Survey grade receivers

These are DGPS capable, and should be capable of centimeter accuracy or better. These units range from \$5000 to \$40,000 per unit. Achievement of sub-centimeter accuracy requires skill and training, and is best left to the GPS guru types for now. For example, there are RTK (Real Time Kinematic) systems that require a base station to be set up over a survey marker of known coordinates. There are radio links that must be maintained and the data must be corrected and verified.

Please continue to next page ➡

As part of this series I plan to dedicate several of the articles to addressing some of the more complex issues involved with achieving this type of accuracy, and hopefully to some extent demystifying it as well.

Specialty and Military grade receivers

This is a general “catch all” category. The price and accuracy can vary dramatically. I throw this category in so we have a place to discuss things such as Specialty receivers used for Aerial photography, underwater positioning and the like.

Military P(Y) Code Receivers, that utilize the encrypted P code from the GPS satellite’s are only available to the military and some federal agencies. Receivers that aren’t Military Receivers are called C/A (Civilian Access or Course Acquisition) code receivers. These P coded receivers remove the effects of SA (Selective Availability), but may not compensate for ionospheric, atmospheric and other conditions. Even without SA, these receivers are only accurate to between 3-9 meters (without differential correction).

So what is SA (Selective Availability)? The greatly simplified version is: The DOD (Department of Defense) controls the GPS satellite system. Each satellite has a very accurate atomic clock, that broadcasts the current time, and your receiver also has a clock built into it. By comparing the time from the GPS satellites (when it left space), when it got to you (the

clock in your receiver), and knowing that the signal travels at a constant velocity at the speed of light, it is simple math for the computer in your receiver to figure out how far away that satellite is from you. I don’t know why they use the speed of light in stead of the speed of dark, I’m just glad I don’t have to do the math. Anyway, it takes the signal from three or more satellites to triangulate a position in space (3 satellites for an X,Y position, 4 or more to add Z). This is called trilateration. Everything about the process comes down to time and velocity.

Here’s where the mystery comes in. There are invisible forces acting on these signals that change the velocity (ionospheric and atmospheric) or time (clock errors or human intervention). If you had an atomic clock in the vacuum of space with no interference, in theory, the measurements could be perfect.

Even though the satellites are way up there (12,600 miles). You need pretty much “line of sight.” Unlike radio waves that you can pick up accurately inside a building; interference as minor as leaves on a tree can stop the signal from reaching you. I’ve had people demonstrate that their equipment can pick up satellites within a building. What they are seeing is known as “multi-path” or reflection. These multi-path signals have reflected off something. This means the signal had to take a longer distance to get to the receiver. Which in turn means it took a longer amount of time to get from the satellite to the receiver. This then distorts the positional

readings. Remember, time is related to distance, and at the speed of light, it doesn’t take much added time to really mess up your distance.

So back to SA. Since DOD controls this system, they also control its accuracy by controlling the time output from the satellites. This system was created and is operated by the DOD for military purposes. Besides wanting to know where in the world things are, it is used for military targeting, and it is not a good idea for everyone in the world to have that pin point targeting ability, so they play with the time element a little bit. This also makes it a lot harder for someone on the ground to target a satellite, especially if it is moving and dodging in a virtual hundred meter circle.

Where does that leave the C/A code receiver people? I say, “in great shape.” We didn’t have to install and maintain the system or pay rental on all these signals from space. We can use them for free, provided we have the right equipment. The DOD gives us free access to accuracy that is within a 100 meter circle (95 % of the time) and most of the time the circle is much smaller than 100 meters. That is good enough for most hikers, hunters, boaters and general purpose navigation. Even better news is that in March 1996, President Clinton approved the phasing out of SA over a 10 year period. In theory your cheap navigation receiver will get more accurate as time goes on. This will help the navigation people immensely.

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The bad news is that it still won't correct all possible inaccuracies. If you want sub-meter you'll still need DGPS.

The last question we will briefly cover in this issue is, what is DGPS, and how does the D (Differential) in DGPS help you.

In a nut shell, DGPS is achieved by using two receivers. The first receiver is the one you bought to do your field work with. The second receiver may be a base station, DGPS vendor, or even a unit that you set up yourself. Whatever the case is, the second GPS receiver is placed over a point with a known coordinate value (such as a survey marker). Now that the receiver is at a known coordinate value, you can compare the signals that it is receiving against the coordinates that it is at. The difference in distance between the receiver and the point projected by the GPS signal is your correction factor. From a very simplified view: if the signal coming into the GPS receiver determines that it's location is 50' to the west and 25' to the north of where my coordinates say the receiver should be, then I need to subtract that distance from my measurements made in the field. Then it is just a matter of comparing the position that you receive in the field with the corrected ones from the base station and doing a little math. Again, thank goodness for computers and software. This is provided that the receiver in the field is looking at the same satellites that the base station is

using. Some vendors use a network of base stations and adjust over long distances (baselines), then broadcast their corrections through a satellite to you.

There are two main ways that differential correction is accomplished, one is "post processing," the other is "real time."

Post Processing

In this scenario, the base station stores raw GPS position fixes and software is used to compare the raw positions to the coordinate value of the receiver. This data is then placed in a log file or database and distributed. If you are using someone else's base station, keep in mind that there are various formats and positional rates that are collected. You will need to determine if their data will meet your needs. Look for "meta data," the data about the site,

base station and data that you are wanting to use. Then you will need to get the files you need to use to do the differential correction. Some base station information can be accessed

directly over the Net, some you may have to contact the base station operator. Now that you have the base station files in hand, it is simply a matter of figuring out the software you bought that compares the two.

If you are new to GPS, it is a good practice to visit survey monuments as often as you can when collecting data in the field. This is a point with known

coordinate values. I like to verify my data against known points whenever possible.

Real time

Real time "Differential or correction," is not to be confused with "Survey Grade" Real Time Kinematic (RTK systems). Using real time differential correction is basically the same concepts as stated above. The big difference is that your receiver is in constant contact with a base station, through radio or satellite links, making the differential corrections on the fly in "real time." Some equipment even allows you to do both "real time" and "post processing" differential correction on the same data.

There are free broadcast corrections available in many locations, and there are companies that sell these services as well. It is up to you to find the system that works best for you.

I hope this gives you a starting point for answering the question "Which type of unit is best for me?" Any of the above systems will tell you where in the world you are and some will even tell others what you found when you got there. The cost of the equipment will vary depending on the accuracy of the equipment and the features included. Sometimes you may pay a heavy price to get the features you want. Some units do it with great accuracy and some with great complexity, but as with any technology, it is getting smaller and easier to use everyday.



Ultra-Thin Whitetopping

By Lisa Haakon Pogue, Director of Technology Transfer LTAP Clearinghouse,
American Public Works Association
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Got ruts in your city's intersections or washboarding in your country's roads? If so, Ultra-Thin Whitetopping (UTW) can be a candidate for resurfacing deteriorating asphalt pavements.

UTW is a relatively new technique that involves placing a thin (50 to 100 millimeters) concrete overlay to restore asphalt concrete pavements which have cracked and/or rutted. UTW is one of the candidates for rehabilitation of any area where rutting, washboarding and shoveling of asphalt is a problem.

The technique was developed specifically for low-volume roads, parking areas and light duty airports. In UTW the concrete overlay is thinner than conventional whitetopping and forms a bond with the underlying asphalt, which creates a composite action. Short joint spacing significantly improves the overlay's performance.

The first experimental application of UTW was constructed on an access road in Louisville, Kentucky in 1991. Since then over 170 UTW projects have been constructed across the United States.

The advantages of UTW

- UTW requires less time to construct and repairs last much longer.

- UTW provides a durable, wearing surface.
- UTW is cost competitive.
- UTW surfaces reflect light; thus street lighting can be reduced.
- UTW provides a cooler surface with environmental benefits.

UTW construction

The four steps to constructing UTW include:

- Prepare the surface so that it will bond the two layers. This is most often done by milling and cleaning or blasting it with water or abrasive material.
- Place, finish and cure concrete overlay using conventional techniques. The concrete mix is matched to the project's traffic conditions and requirements for opening the road to traffic. Many projects include synthetic fibers used to increase post-crack integrity of the panels. Proper curing is critical. Because the overlay is thin, it can lose water rapidly due to evaporation. Curing compound is applied at twice the normal rate.
- Cut saw joints as early as possible to control cracking.
- Open to traffic.

What's new in UTW?

To help state and local highway agencies make decisions about

using UTW, the Federal Highway Administration (FHWA) and the American Concrete Pavement Association (ACPA) launched a joint research effort to evaluate critical design factors affecting the performance of UTW.

ACPA, in cooperation with the Virginia Ready Mix Concrete Advisory Council and ACPA's Northeast Chapter, will arrange for the design of the concrete mixes and for the construction of the UTW pavement sections. FHWA will test the material properties for all pavement layers, test the pavements with Turner Fairbank Highway Research Centers (TFHRC) Accelerated Loading Facility (ALF), and provide the data for a cooperative evaluation of the design method by ACPA and FHWA. For more information on the UTW project go to the TFHRC Web site at <http://www.tfhrc.gov>.

Additional resources

(Below are several national resources on the Web, followed by some state-specific information which may help your LTAP center customize this article.)

The American Concrete Pavement Association information on UTW at their

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Web site. Go to <http://www.pavement.com>. Information includes an article, "U.S. Experience with Ultra-thin Whitetopping" by Lawrence W. Cole and James W. Mack as well as a UTW load-carrying capacity calculator.

The Indiana Ready Mixed Concrete Association offers a slide presentation on UTW at their Web site. Go to <http://www.irmca.com/utw/index.html>.

An article on UTW by the Pennsylvania Concrete Promotion Council can be found at <http://www.paconcrete.com/ultrathin.html>.

Information on a UTW project in Traverse City, Michigan can be found at <http://www.irmca.com/utw/pavement.htm>.

A Minnesota DOT research project on UTW is described at <http://mnroad.dot.state.mn.us/newsletters/gauge151.html>.

The Tennessee Ready-Mixed Concrete Association Web site offers information and a typical mix design for UTW at <http://www.trmca.org/index.htm>.

A description of a research project sponsored by the Pennsylvania DOT and FHWA can be found at

<http://restructure.fhwa.dot.gov/ptp/Whitetop/whitetop.htm>.

A Public Roads article from the September/October 1998 issue, "Ultra-thin Whitetopping" by Charles J. Churilla can also be found at <http://www.tfhrcc.gov/pavement/utwweb/article.htm>.



T2 Center Bids Darlene a Fond Farewell

After almost two years with the WST2 Center, Darlene Sharar, our Traffic Technology Engineer has decided to expand her horizons and take on new tasks. Fortunately for the rest of Highways and Local Programs, Darlene is just moving across the service center to the Operations Office, where she will be working with the Local Agency Guidelines.

We wish Darlene (and Marvin the Martian) the best!



The Winter Maintenance Mailing List

Source: LTAP T2All List Serve~ Rod Pletan/ David H. Fluharty Director, UNH Technology Transfer Center

What is it?

The Winter Maintenance Mailing List is a way for a group of people who are geographically dispersed but who all have e-mail addresses to discuss topics that are of common interest - in this case, winter maintenance.

This mailing list is sponsored by the Iowa Institute of Hydraulic Research (IIHR) at the University of Iowa and was originated by:

Wilfrid A. Nixon
Dept. of Civil and Environ.
Engineering University of Iowa
Iowa City IA 52242

e-mail:

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phone: (319) 335-5166 or -5225
fax: (319) 335-5238

Since its origin, this mailing list has become the Official Mailing List for the TRB (Transportation Research Board) Winter Maintenance Committee (A3C09) and the AASHTO Snow and Ice Cooperative Program (SICOP). It has established itself as a common platform for about 300 snow and ice experts and enthusiasts from around the world to discuss issues related to snow, ice, and winter maintenance activities.

How does it work?

Once you have subscribed to the Winter Maintenance Mailing List, whenever you or any other list member e-mails the list address snow-ice@list.uniowa.edu, every

other subscriber on the list will get a copy of that e-mail. If you or any subscriber replies to the message, the person who originated the message will automatically receive the reply. If a subscriber wants his reply to go back to all subscribers, it can be done by addressing the reply to snow-ice@list.uniowa.edu.

What is it used for?

The most common use of the Winter Maintenance Mailing List is for a subscriber to ask for information about something new that they have heard about, asking questions like "Who has knowledge about such and such?" "Has anybody else had any experience with this new idea I just heard or read about?" "Does anybody else have a possible solution to this new problem of mine?" "Does anybody know who I can contact to learn more this new product?" etc.

Another use is to simply share a success story. It is also a way to announce that you have a new report on a related subject and let people know who to contact to get a copy. Suppliers can use it to announce a new product and provide a phone, fax or e-mail address for those who would desire more information.

What about mailing list etiquette?

This is a user list, run by and for its users. The success of the mailing list is very dependent on how discretely and respectfully the subscribers use the list.

Messages to the mailing list should be short and concise, generally no longer than can be seen on one screen. If you have a commercially available item to announce, please make the announcement brief. Reference to home pages on the web is a wonderful way to keep it brief.

It is NOT ever acceptable to post binaries (ie, attachments) to messages to the mailing list. In fact, anybody who does so WILL automatically be canceled from the list. Of course, anybody replying back to the originating author can attach anything they wish.

A list of this type will typically generate a maximum of twenty e-mail messages per week. If the number rises to more than 50 such messages per week on a regular basis, a digest service will be offered. The list is not near that level yet, even though the membership has grown to over 300.

What if I don't like it or don't find it useful?

You can "unsubscribe" very easily. See below.

How do I SUBSCRIBE?

To join the Winter Maintenance Mailing List, simply send an e-mail message from your computer work station to:
**snow-ice
request@list.uiowa.edu**

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In the body of the message, on a line by itself with nothing else on the line, type the word subscribe. You will then be enrolled to the list.

How do I UNSUBSCRIBE?

To leave the list, send an e-mail message to: **snow-ice-request@list.uiowa.edu**

In the body of the message, on a line by itself with nothing else on that line, type the word unsubscribe. You will then have left the list.

How do I use it?

Simply write your e-mail message and send it to: **snow-ice@list.uiowa.edu**

What if I have any questions?

If you have any questions about the list, send an e-mail with your question to the owner's address: **owner-snow-ice@list.uiowa.edu**

IIHR hopes you find this form of discussion useful. Please feel free to send any feedback on operation or usage of the list to the owner.

Welcome to the Winter Maintenance Mailing List!



Pacific Northwest Transportation Technology Expo ~ 2000 Technology on Parade

Tired of just reading about it?! Would you like to get your hands on it, kick the tires, and watch it work?! Then, plan to attend the first technology exposition focused solely on presenting the latest technology in transportation maintenance and operations to the public agencies in the Pacific Northwest. The expo is cosponsored by the WSDOT-Field Operations Service Center, Washington State Technology Transfer Center, and FHWA to present you the most current technology targeting the areas identified by the Pacific Northwest agencies.

Come and see three days of demonstrations showing the latest technologies that can make your work easier, more

effective, and more efficient. Judge for yourself their usefulness and effectiveness.

See first hand the innovative ideas to save money, improve performance, and reduce labor developed and implemented by your peers. Play with their inventions, see how they work, and get ideas on how you can use or improve on them. Talk with the inventors and learn how they made it so you can do it yourself.

See how current research projects can help you do your work better with practical information you can apply today.

See dozens of displays of the latest tools, materials, and services to make your maintenance and operations dollars go farther.

When:

September 12,13,&14, 2000

Where:

Grant County Fairgrounds, Moses Lake, Washington


How Much: Free!!!

Who should attend:

All Engineers, Superintendents, Supervisors, and Technicians involved with transportation construction, maintenance, and operations.

TRIS On-Line Now Available on the National Transportation Library's Internet Site

By Lisa Haakon Pogue, Director of Technology Transfer, LTAP Clearinghouse



Washington, D.C., January 10-The U.S. Department of Transportation's Bureau of Transportation Statistics (BTS) and the Transportation Research Board (TRB) today announced the availability of TRIS On-line on the National Transportation Library's (NTL) Internet site.

"This initiative is another example of President Clinton's and Vice President Gore's efforts to make government more accessible to every American,"

U.S. Transportation Secretary Rodney E. Slater announced today at a ceremony inaugurating TRIS On-line at the 79th Annual Meeting of the TRB. "This partnership between the BTS and TRB further facilitates transportation research by making information more available to the American people as we move into the 21st century and the new millennium." The Transportation Research Information Service (TRIS), the world's largest and most comprehensive bibliographic database on transportation, has been by TRB over the past 30 years with support from state and federal agencies. Web access to TRIS is a result of a Memorandum of Understanding (MOU) between BTS and TRB that was signed

last year at TRB's 78th Annual meeting. The MOU provides for the development, testing, and implementation of a fully searchable public-domain, web-based version of the TRIS database.

The TRIS database contains more than 500,000 records of published and ongoing research on all modes of transportation. TRIS On-line will improve TRIS by allowing users to access electronic copies of full-text reports or to link directly to the publishers or suppliers that produce the documents. TRIS On-line is now a vital core component of the NTL being developed by BTS.

The NTL makes available major transportation materials from around the world, indexes transportation web pages, and will ultimately provide a national union catalog of the country's major public and private transportation library collections and statistical databases. The NTL staff now respond to approximately 25,000 e-mail and telephone inquiries annually.

TRIS will continue to be produced by TRB. BTS will publish the database and make it available on the Internet as a component of the NTL, and will also provide the links to full-text reports and document publishers. Within three years, it is anticipated that over 70

percent of government reports listed in TRIS On-line will be available electronically for downloading, printing, or through e-mail requests.

TRIS On-line can be found on the Internet site <http://ntl.bts.gov/tris>. The NTL's site is <http://ntl.bts.gov/>.

The mission of the Transportation Research Board is to promote innovation and progress in transportation by stimulating and conducting research, facilitating the dissemination of information, and encouraging the implementation of research results. A major focal point of the Board's activities, the Annual Meeting provides an opportunity for transportation professionals from all over the world to exchange information of common interest.

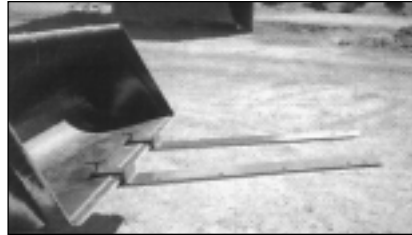
The Board was organized in 1920 and is a unit of the National Research Council, a private, nonprofit institution that is the principal operating agency of the National Academy of Sciences and the National Academy of Engineering.

For further information contact: Suzanne Schneider (202) 334-3708

Handmade Forks Do Heavy Lifting

Reprinted with permission from Iowa Technology News, August-September 1999

Steve Driscoll, the building and grounds supervisor for the city of Asbury, Iowa, public works department, developed a simple tool to do heavy lifting. He created handmade fork for a tractor loader bucket.



▲ Handmade fork lifts for a tractor loader bucket.

The fork is made of worn-out snow plow cutting edges from 11 and 8 foot plows. The two sizes are welded together for strength. The forks slip under the edge of the bucket and tightens down from the top. They are adjustable to any width.

The forks save the public works department valuable time and help prevent back strain among employees. Driscoll says, "We can now carry loads of lumber, steel pipes, road sign posts,

picnic tables and many other items. This project cost us nothing but the time it took to weld them together."

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Contact Matt Love, WSDOT Engineering Publications, at LoveM@wsdot.wa.gov or (360) 705-7430.

Y2K Hum Bug

By Roger Chappell, T2 Technology Integration Specialist

Well, for the Y2K technocrats there was a huge corporate sigh of relief as the clock struck 00. With every time zone it passed through, their smile got a little bigger. Some may even ask, was there even a bug to be squashed? The answer is YES! Regardless of what may come during the beginning of this year (a leap year), the lack of any major Y2K related emergencies worldwide must be seen as a major success. Failure of our infrastructure would have been devastating. Recovery would have been arduous and would have made any software problems much more difficult to fix. Were there glitches? Yes, but no major ones. If it hadn't been for all the hard work that was done, there would have been more serious problems.

It is like the surgeon telling you that you have cancer and if they don't remove it soon you are going to die. So they perform the surgery and you go on to live a healthy happy life. Some would say that you were going to live a healthy happy life anyway and the surgeon only wanted to use you to make their Mercedes payments. In a small number of cases that may be true, but in the vast majority of cases, the patients would have died. Our infrastructure is alive and healthy today because many skilled hands worked hard to save it.

This may sound a bit over dramatic to some, but the war analogy with dead computers and software strewn about the streets just didn't happen. The Y2K cancer was quietly cut out and the results were dramatic. The patient is doing good.

What was the surgery bill? It is estimated that companies and institutions worldwide spent between \$300 billion and \$600 billion for Y2K fixes. In the United States alone, Y2K expenditures totaled between \$150 billion to \$225 billion, according to the Gartner Group.

It was a costly treatment but the surgery had to be done. I just want to send a big "Thank You!" to all of you unsung heroes who made this a very happy and uneventful New Year.



Pilot Car Certification Requirements Delayed Until March 2000

Source: WSDOT Motor Carrier Services

Over the past years the pilot/escort vehicle industry has expanded dramatically. While the WSDOT recognizes the wealth of knowledge and professionalism held by many, there are also a growing number of operators that have been consistently breaking laws and making poor decisions resulting in a risk to the motoring public and damage to the State's infrastructure. This is not only evident in the state of Washington, but also across the country. To address this concern Washington, among several other states, has instituted a certification program for pilot/escort vehicle operators with great success.

In the state of Washington, during a 1998 rule making process, a certification program was added based on a recommendation from industry. Implementation was set for January, 1999, then subsequently moved to January, 2000 to provide added time for training. After an assessment of training in December, 1999, it was determined that a moratorium on enforcement would be placed into effect through March of 2000.

The WSDOT sets a minimum standard for a training course. The Department allows any provider to develop a course, have it approved, and conduct the classes. Currently, there is only one provider of

materials, the Evergreen Safety Council. Evergreen has provided materials, some instructor training, and driver training for well over 5,000 individuals to date.

Although grandfather rights were considered, it was impossible to determine appropriate criteria since a portion of existing operators are the immediate concern. The certification program is designed to give all operators the same base level of knowledge to operate safely and legally.

The WSDOT is also looking at reciprocity with other jurisdictions offering pilot car certification programs. Initially, it's the Department's intent to accept certifications from the states of Utah and Virginia. To date Washington has confirmed reciprocity with Utah. Communications with Virginia is on going.

For additional information please contact Pam Hughley at (360) 664-0615.



Pacific NW Bridge Maintenance Conference

April 25-26, 2000

Doubletree Hotel Columbia River, Portland, Oregon

Reserve your spot for the First Quad-State Sponsored Pacific Northwest Bridge Maintenance Conference, April 25-26, 2000, DoubleTree Hotel-Columbia River, Portland Oregon. All people involved in bridge maintenance activities are invited to come and share their knowledge, information, and expertise in what is planned to be a model for future bridge maintenance conferences. This is your chance to share your experiences with others in the bridge maintenance profession. The Pacific Northwest Bridge Maintenance Conference is planned to be a biennial event with participation by the Oregon, Washington, Idaho and Alaska Departments of Transportation (DOT), and the Federal Highway Administration.

Speakers will be coming from across the nation to share information including Michigan, Hawaii, California, Washington, Oregon, Alaska, Idaho, Montana, etc. Attendance is expected from federal agencies, tribal nations, state agencies, county and city agencies, Canada, Material and Equipment Vendors, Consultants, and Contractors. Presentations will be given by maintenance personnel and vendors who have worked together on bridge maintenance projects. There will also be outdoor equipment displays such as bridge access vehicles and maintenance trucks.

Two tours are scheduled to visit galvanizing and steel fabrication plants for the afternoon of the April 26th. Also included with your registration fee are light refreshments served at breaks and lunch on the 25th. There will be three tracks running simultaneously during the general sessions and single introduction and closing presentations.

Registration costs are \$75 for attendees and \$200 for vendor space. The conference starts at 7:00 on the April 25th with registration and sessions beginning at 8:00 a.m. Sessions end at noon on April 26th.

Please watch for your registration flyer and check the WSDOT H&LP Home Page at <http://www.wsdot.wa.gov/TA/Operations/BRIDGE/Callguts.pdf>

For information on giving a presentation or for other general conference information, please contact: Kimberly Colburn, Conference Coordinator Highways & Local Programs Service Center WSDOT (360) 705-7879 colburnk@wsdot.wa.gov



WSDOT Library Your



Helpful tips and other resources from the WSDOT Transportation Library

There are two Washington State Department Of Transportation libraries. Headquarters Library is located in the Olympic Service Center at 310 Maple Park Avenue in Olympia, 98504-7425, with a collection on transportation and related topics. Most Transportation Research Board (TRB), and American Association of Transportation Officials (AASHTO) publications are found in the collection. Reports make up the bulk of the collection and they are from the U.S. Department of Transportation and their many offices as well as from many state departments of transportation and research centers. **You can reach this library in a number of ways:**

- Phone - (360) 703-7750
- Fax - (360) 705-6871
- Email - Library@wsdot.wa.gov.

The Materials Laboratory Library, located at 1655 South Second in Tumwater, 98504-7365, contains technical materials and reports on asphalt, concrete, and geotechnical research. Many of these materials are from TRB, AASHTO, the American Society for Testing and Materials and the American Concrete Institute. **You can reach this library in a number of ways:**

- Phone - (360) 709-5404
- Fax - (360) 709-5588
- Email - Marshl@wsdot.wa.gov.

Both collections can be viewed through the Internet by going to <http://www.wsdot.wa.gov/HQ/Library>.

The library catalog is the first item listed at the top of the left column. A tutorial is available under "Help" to use the catalog to your best advantage. This catalog is comprised of collections found at the Washington State Library, Labor and Industries, Utilities and Transportation, Saint Martin and Evergreen State Colleges as well as the Department of Transportation libraries. A search can be narrowed to a specific library. Some activities such as requesting materials on-line, renewing materials and viewing your record are restricted to Washington State Library card holders.

Future articles will discuss other features of the Washington State Transportation Library Home Page and the various services provided there and by the Library. Feel free to browse the home page by going to the address given above to see for yourself how the information can be of use for your needs. We look forward to questions and suggestions you may have which would help us to provide better service.



Free Publications From Your T² Center

For Washington residents only due to limited quantities.

Name: _____

Agency: _____

Address: _____

City: _____ Zip _____

Phone: (_____) _____

Check the items you would like to order.

- Improving Highway Safety at Bridges on Local Roads and Streets, 1998
- Fish Passage through Culverts, 1998
- Scrap Tire Utilization Technologies, NAPA
- State-of-the-Art Survey of Flexible Pavement Crack Sealing Procedures in the United States, CRREL, 1992
- Maintenance of Aggregate and Earth Roads, NWT² Center (1994 reprint)
- International State-of-the-Art Colloquium on Low-Temperature Asphalt Pavement Cracking, CRREL
- Family Emergency Preparedness Plan, American Red Cross, et al.
- Getting People Walking: Municipal Strategies to Increase Pedestrian Travel, Rhys Roth, Energy Outreach Center
- The Superpave System – New Tools for Designing and Building More Durable Asphalt Pavements, FHWA
- A Guide to the Federal-Aid Highway Emergency Relief Program, USDOT, June 1995
- Pothole Primer — A Public Administrative Guide, CRREL, 1989
- Redevelopment for Livable Communities, Rhys Roth, Energy Outreach Center
- A Guidebook for Residential Traffic Management, NWT² Center, 1994
- A Guidebook for Student Pedestrian Safety, KJS, 1996
- Pavement Surface Condition Field Rating Manual for Asphalt Pavement, NWPMA, WSDOT. 1999
- A Guide for Local Agency Pavement Managers, NWT² Center, 1994
- Local Agency Pavement Management Application Guide, NWT² Center, 1997
- Positive Guidance and Older Motorists — Guidelines for Maintenance Supervisors, Texas A&M
- Evaluation of Automated Pavement Distress Data Collection Procedures for Local Agency Pavement Management, Texas A&M, WSDOT, ODOT 1996
- Traffic Calming: A Guide to Street Sharing
- Basic Metric System, WSDOT
- The Impact of Excavation on San Francisco Streets. This study evaluates the impacts utility cuts have made to the street and road network, September 1998
- Rating Unsurfaced Roads, CRREL, A Field Manual for Measuring Maintenance Problems
- The Pedestrian Facilities Guidebook, WSDOT
- 1999 Audio Visual Catalog, T² Center
- Unsurfaced Road Maintenance Management, CRREL 1992
- The New Generation of Snow and Ice Control, FHWA
- Asphalt Sea Coats, NWT² Center (1999 Reprint)

- ❑ Recommendations to Reduce Pedestrian Collisions, WSDOT, December 1999
- ❑ Highway/Utility Guide, FHWA 1993
- ❑ Manual of Practice for an Effective Anti-icing Program: A Guide for Highway Winter Maintenance Personnel, 1996
- ❑ W-Beam Guardrail Repair and Maintenance, FHWA

Workbooks and Handouts From T² Center Workshops

- ❑ Access Management, Location and Design, FHWA/NHI, 1998
- ❑ Access Management Guidelines for Activity Centers, NCHRP Report 348, TRB/NRC, 1992
- ❑ Handbook for Walkable Communities, by Dan Burden and Michael Wallwork
- ❑ Geosynthetic Design and Construction Guidelines, FHWA/NHI 1995
- ❑ Planning and Implementing Pedestrian Facilities in Suburban and Developing Rural Areas, TRB
- ❑ Historic and Archeological Preservation: An Orientation Guide, FHWA/NHI
- ❑ Construction of Portland Cement Concrete Pavements, FHWA/NHI 1996
- ❑ Bicycle Facility Planning and Design Workshop, Northwestern University

Self-Study Guides

- ❑ The following noncredit self-study guides are available through WSDOT Staff Development and can be obtained from the T² Center. An invoice will be sent with the books.
- ❑ Technical Mathematics I, \$20
- ❑ Technical Mathematics II, \$20
- ❑ Contract Plans Reading, \$25
- ❑ Basic Surveying, \$20
- ❑ Advanced Surveying, \$20

**Orders may be faxed, mailed, or phoned to
Laurel Gray
Phone: (360) 705-7386
Fax: (360) 705-6858
Mailing Address: WST² Center, WSDOT
H&LP P.O. Box 47390
Olympia, WA 98504-7390**

Computer Programs

The following computer programs may be downloaded from the Internet at:
<http://www.wsdot.wa.gov/TA/Operations/Environmental/Soft.htm>

Design Cost Estimate. A software database program that calculates cost projections based on standard items.

Materials Approval Tracking. A software program designed to track materials data, need, status, and approval of any materials sampling and documentation needed for approval.

HyperCalc. A shareware utility for converting between metric and English units.

Force Account Macros. A series of ready-made Excel spreadsheets and macros to save you time on daily force account calculations and reports, including wage and equipment rates.

APWA CAD Symbol Standards and Menus. A public domain program of standard AutoCAD symbols developed by the Washington Chapter of APWA for use with AutoCAD release 14. The program may also be downloaded at <http://users.ap.net/~fredlee>

Microsoft Access Runtime Program. Assists in running the Materials Approval Tracking and Design Cost Estimate Program.

UTEC System. A software program consisting of a main menu designed to provide a record base for identifying street locations within an agency.

Opportunities to Enhance Your Skills

For more information, contact the training provider listed.

For additional training needs contact the Washington State T² Center at:

(360) 705-7386 or 1-800-973-4496. <http://www.wsdot.wa.gov/TA/T2Center/TRAIN2.htm>

Washington State T² Center

Contact Laurel Gray, Training Coordinator

Ph: (360) 705-7386

Fax: (360) 705-6858

<http://www.wsdot.wa.gov/TA/T2Center/TRAIN2.htm>

The Basics of a Good Gravel Road

March 20, Tacoma; March 22, Moses Lake; March 23, Spokane. Fee: \$35. Instructor: Bill Heiden.

This one-day presentation is the result of forty years of experience and observation by the instructor in the construction and maintenance of roads. His methods will help to reduce unpaved road expenditures to forty percent or less of current expenditures in three to five years. All the major problems and concerns about unpaved roads will be addressed in this class. Some of these problems are: washboarding (corrugation), traffic patterns, rutting, surface drainage, dust control, surface material and roadside obstructions. This class is for anyone responsible for unpaved roads: money manager, engineers, road supervisor, grader operators.

Writing Grants

March 22 and April 12, Wenatchee; March 29 and April 19, Mount Vernon. No fee. Instructor: Dr. Sharon Bridwell. This two-day class will concentrate on developing proposals and reviewing proposal types, choosing your market and marketing your proposal, packaging and evaluating your proposal, writing narrative proposals and proposal letters, locating funding sources. You will write an actual grant in the intervening two week period between class dates.

Beginning and Advanced Welding

Coming the week of May 22; Olympia, Everett, Yakima. Instructor: Tom Cook, Cornell University. Fee: \$35. A hands-on training session that will cover basic and advanced practical welding techniques to help improve job efficiency and productivity. Areas to be discussed: welding

torch; oxyacetylene gas welding and cutting; use of torch; metal identification; heat treatment; arc welding; out of position welding; hard surfacing; welding defects; cast iron repair; soldering; specialty metals; TIG, MIG, Flux-core, Plasma Arc; fuel tank repair; maintenance of welding equipment.

Pavement Condition Rating Workshops

May/June. Dates and locations to be announced. Instructor: Paul Sachs, WSDOT. No fee. Participants will learn to rate any of the pavements commonly found in Washington. The rating values obtained using the definitions and methods learned in this course should compare favorably with those obtained and used in the Washington State Pavement Management System.

Introduction to the Endangered Species Act and Biological Assessments

Spring classes have been postponed until fall. Those sessions will be advanced classes. Fee: \$35. For updated information check out this web site: www.wsdot.wa.gov/TA/Operations/Environmental/EnvironmentalHP.htm.

WSDOT, Staff Development
Contact Laurel Gray in the
T2 Center (360) 705-7386

The 14 WSDOT construction courses listed below are offered in various locations around the state whenever enough interest warrants scheduling a class. You may call the T2 office and have names put on request lists. You will be notified when a class has been scheduled and your name included on the roster. A description of the classes can be faxed to you. No fee.

- PCC Field Testing Procedures (ABT)
- Aggregate Paving Street Inspection (ACB)
- Bituminous Surface Treatment Inspection (ACC)
- Drainage Inspection (ACF)
- Bridge Structures Inspection (ACM)
- Miscellaneous Documentation (ACY)
- Excavation and Embankments Inspection (AC3)
- Nuclear Gauge, Operator Qualification (ALG)
- Nuclear Gauge, Overview for Supervisors (ANE)
- Nuclear Gauge, Embankment/Surfacing/
Pavement Applications (ANQ)
- PCC Pavement Production and Placement (APG)
- Electrical-Illumination and Signals (API)
- Asphalt Concrete Pavement Testing Procedures (BG9)

Certification in Construction Site Erosion and Sedimentation Control

March 7-8, Vancouver; March 22-23, Spokane; March 27-28, Edmonds. This WSDOT class is for prime contractors and local agencies who are responsible for constructing or inspecting WSDOT projects that involve grading or other forms of soil disturbance. Prime contractors with current or pending WSDOT contracts and local agency personnel with jurisdiction over WSDOT projects will be given priority. This two-day course will fulfill the requirement for Certification in Construction Site Erosion and Sediment Control and Erosion Control Lead General Special Provision (GSP) to the Standard Specifications for Road, Bridge, and Municipal Construction. Contact the Environmental Affairs Office at WSDOT to enroll (360) 705-7483, or call the T2 office.

TRANSPEED, University of Washington
Contact Julie Smith
(206) 543-5539, fax (206) 543-2352
<http://www.engr.washington.edu/epp>

Course participants will earn CEUs for each course completed. The CEU is a nationally recognized measure of participation in non-credit continuing education programs which meet established criteria for increasing knowledge and competency.

Prices shown are for local agencies/all others.

Roadway Culvert Hydraulic Design

March 14-15, Seattle; June 1-2, Spokane. \$180/\$360.

Roundabout Design Concepts and Guidelines

March 29-31, Spokane. \$220/\$420

Culvert Repair and Rehabilitation

April 4-5, Seattle; June 13-14, Lacey. \$180/\$360.

Fundamentals of Traffic Engineering

April 5-7, Vancouver. \$250/\$450, \$30 textbook fee.

Stormwater Engineering for Transportation Professionals

April 12-14, Seattle; June 21-23, Spokane. \$220/420.

Bridge Foundation Design

April 26-28, Seattle. \$220/420.

Advanced Roadway Geometric Design

May 3-5, Seattle. \$220/\$420.

Hydrology and Basic Hydraulics

May 9-10, Spokane. \$180/\$360.

Design and Application of Roadway Safety Features

May 10-12, Seattle. \$220/420.

Traffic Engineering Operations

May 16-18, Vancouver. \$250/\$450.

Basic Highway Capacity Analysis for Engineers and Planners

June 6-8, Seattle. \$220/420.

University of Washington
Professional Engineering Practice Liaison (PEPL)
(206) 543-5539, fax (206) 543-2352
<http://www.engr.washington.edu/epp>

All classes are held on or near the University of Washington campus in Seattle. Prices indicate early registration/late registration. Early registration fees are applicable up until two weeks before the date of the course.

Understanding and Surviving ESA: A Technical Workshop for Project Managers
March 21-22. \$365/\$395.

Designing and Implementing Habitat Modifications for Salmon and Trout
March 28-30. \$455/495.

Achieving Real Success as a Project Manager
March 30-31. \$365/395.

Hydrologic Modeling and Design of Retention/ Detention Facilities
April 12-14. \$510/545.

Design and Retrofit of Culverts for Fish Passage in the Northwest
April 26-27. \$345/375.

New Technologies and Concepts in Stormwater Treatment
May 8-9, Vancouver; May 11-12, North Seattle.
\$365/395.

Seismic Hazard Analysis for Constructed Facilities
May 19-20. \$365/395.

Summer and Autumn 2000

System Safety and Reliability Analysis July 10-20.

Quaternary and Engineering Geology of the Central and Southern Puget Sound Lowland
August 24-26.

Effective Writing for Technical Professionals
September 12, 14, 19, 21, and 26.

Alternative On-Site Stormwater Management Techniques
September 19-10.

Site Specific Seismic Liquefaction Analysis
September 29-30.

Stormwater Treatment by Media Filtration
October 12-13.

Seismic Site Response Analysis
December 3-4, \$345/375.

Effective Project Negotiation Skills
December 8, \$215/240.

Creating Winning Technical Presentations
December 9-10, \$345/375.

University of Washington
Engineering Professional Programs (EPP)
(206) 543-5539, fax (206) 543-2352
<http://www.engr.washington.edu/epp>

For all three sessions \$735.

Fleet Facility Maintenance and Design
March 16. \$349

Vehicle Fleet Management
March 17. \$349.

Effective Shop Management
March 18. \$349

Achieving Effective Maintenance Management: Organization, Work Orders and Asset Management
May 10-12. Fee range: \$850/875/\$975

Conferences and Meetings

Road Builders' Clinic

March 7-9, 2000, Coeur d'Alene Resort, Coeur d'Alene, ID. The Superpave Asphalt Workshop is March 6-7. Washington State University Conferences and Institutes is sponsoring. Contact them at (509) 335-3530 for information.

Pacific Northwest Bridge Maintenance Conference

April 25-26, 2000, Doubletree Hotel Columbia River, Portland Oregon. Contact Gary Bowling (503) 986-3402 gary.l.bowling@state.or.us; or Greg Kolle (360) 705-7379 Kolleg@wsdot.wa.gov.

American Public Works Association Washington State Chapter Spring Conference

April 18-21, 2000, Westcoast Wenatchee Center Hotel, Wenatchee. Hotel reservations 1-800-426-0670 or (509) 662-1234. Contact Ruta Jones for information at (509) 664-3364.

Washington State Association of County Road Supervisors

April 25 Roadeo, April 26-27 Conference. Pasco Doubletree. For further information contact Tom Shawgo at (509) 648-3946.

2000 Traffic Rondabouts Conference

May 1-3, 2000, Doubletree Hotel at Seatac Airport, Seatac, WA. Contact Darlene Sharar at WSDOT for further information, (360) 705-7383.

Association of Washington Cities Annual Conference

June 19-23, 2000, Spokane. For information call (360) 753-4137.

Pacific Northwest Transportation Technology Expo - 2000 Technology on Parade

September 12-14, 2000; Grant County Fairgrounds, Moses Lake. For information: Dan Sunde (360) 705-7390, sunded@wsdot.wa.gov or Clay Wilcox (360) 705-7861 wilcox@wsdot.wa.gov

Road and Street Maintenance Supervisors' Conference

East: October 3-5, 2000; West: December 5-7, 2000. For further information contact WSU's Conferences and Institutes at (509) 335-3530.

American Public Works Association Washington State Chapter Fall Conference

September 26-29, 2000, Longview/Kelso area.

Northwest Pavement Management Association Conference

October 9-12, 2000, Columbia Doubletree, Portland, OR. For information call Paul Sachs at (360) 705-7352.

Fifth International Conference on Managing Pavements

August 11-14, 2001, Washington State Conference and Trade Center, Seattle. For more information: (206) 543-5539 or pavments@engr.washington.edu



Technology in Rural Transportation

A recent study documented more than fifty proven, cost-effective, "low-tech" solutions to rural transportation needs, most developed or implemented by local transportation professionals. One of these solutions is outlined below



Learn all about the simple solutions on the Internet at <http://inform.enterprise.prog.org>

The simple solutions report is available from Hau To at (651) 686-6321, or email: to@crc-corp.com

Lane Drop Driver Awareness

Overall goal:

To improve workzone safety and traffic operations by encouraging drivers to merge sooner in advance of construction zones.

Technical approach:

A series of portable "DO NOT PASS" signs equipped with flashing beacons is placed at the approach to a construction site. Electronic occupancy sensors are placed in the roadway. At the outset of operations only the sign nearest to the workzone has activated beacons. When a certain threshold is detected by these sensors, that is, as the volume of traffic grows more heavy at the approach to the construction, the beacons on the next sign upstream will also be activated, and so on. As traffic flow varies, the signs are activated or deactivated in sequence.

Current status:

Five signs comprising one lane drop smoothing system are currently in use. A system specification is currently being developed. The state agency that developed the system then plans to circulate this to contractors.

Location / geographic scope:

This is a site-specific application used as necessary in construction zones in Indiana.

Agencies involved:

Indiana DOT

Cost information:

The current system cost approximately \$3,500 per sign.

Key contacts:

Dan Shamo, Indiana DOT. (317) 232-5523

Have goals been achieved?

Anecdotal reports from construction personnel indicate the system is effective in encouraging drivers to merge earlier when approaching a work zone.

Solution timeline:

The system is in use. There are no formal plans to commission additional systems.

Funded by



U.S. Department of Transportation
Federal Highway Administration



ENTERPRISE



Phone Numbers

Washington State T² Advisory Committee

Walt Olsen, Chairman, County Engineer
Pend Oreille County, (509) 447-4513

Gary Armstrong, Public Works Director
City of Snoqualmie, (425) 888-5435

Phil Barto, Maintenance Engineer
Spokane County, (509) 477-7429

Wil Brannon,
Traffic Operations Supervisor/WASP
Pierce County, (253) 531-6990

Joe Bonga, Road Construction/Maint.
Bureau of Indian Affairs
(503) 231-6712

Mike Deason, Public Works Director
City of Leavenworth/APWA
(509) 548-5275

Randy Hart, Grants Program Engineer
County Road Administration Board
(360) 586-7586

Marjorie Hutchinson,
South Zone Engineer/USFS
(509) 653-2205 ext.261

Will Kinne, Maintenance Manager
Pierce County
(253) 798-2953

Jack Manicke, Staff Superintendent
Olympia Service Center, WSDOT
(360) 705-7852

Phil Meyer, Maintenance Coordinator
Whitman County/EWCRS
(509) 397-6209

Tom Rountree, Supervisor
King County Public Works
(206) 296-8100

Jim Seitz, Transportation Specialist/NWPMA
Association of Washington Cities
(360) 753-4137

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(360) 705-7383

John Easley, Road Show Trainer
(360) 705-7385

Fax
(360) 705-6858

T² Web Site
<http://www.wsdot.wa.gov/TA/t2Center/t2hp.htm>

Toll Free Training Number
1-800-973-4496



Washington State Technology Transfer Center
WSDOT-H&LP Service Center
P.O. Box 47390
Olympia, WA 98504-7390

T² Bulletin

A newsletter of the Local Technical Assistance Program (LTAP)

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The Local Technical Assistance Program (LTAP) is a national program financed by the Federal Highway Administration (FHWA) and individual state transportation departments. Administered through Technology Transfer (T²) Centers in each state, LTAP bridges the gap between research and practice by translating state-of-the-art technology into practical application for use by local agency transportation personnel.

Any opinions, findings, conclusions, or recommendations presented in this newsletter are those of the authors and do not necessarily reflect the views of WSDOT or FHWA. All references to proprietary items in this publication are not endorsements of any company or product.



**Washington State
Department of Transportation**
Highways & Local Programs Service Center



**U. S. Department of Transportation
Federal Highway Administration**