TRB 2014 Presentations of Interest
County Engineers Research Focus Group – February 2014

1. Modeling Low-Volume Road Operating Speed Using Artificial-Computational Intelligence
   Mario De Luca, University of Naples Federico II, Italy, presenter

   a. In recent years, Artificial-Computational Intelligence (ACI) has found increasing applications in management of transportation infrastructures. Examples of ACI applications can be found in highway management however, compared to transportation planning, research of ACI methods applied to infrastructure management has been relatively limited. This is often attributed to the existence of a handful of traditional methods for addressing infrastructure management problems. In recent years, the Artificial Neural Network (ANN) procedure has been largely employed in the research field, particularly to solve issues related to transport engineering. In the scientific literature, many researches have dealt with transport systems management, above all for concerns related to road safety and the vehicle flow. The objective of the research study is to compare the predicted operating speed on tangents and circular curves for low-volume roads by using two different statistical approaches. The starting point was to predict the operating speed on investigated tangents and circular curves elements by using four regression equations developed using a traditional ordinary–least-squares method (OLS) as shown in a previous work of the authors. Then, the same database was used to calibrate new operating speed models by using ANN procedure. The results have shown that ANN models offer more reliable results in terms of predicted operating speed than those returned by OLS method on all circular curves and on tangents lengths greater than 500m. For tangents length less than 500 m, OLS method is to be preferred to ANN procedure.

2. Investigating Safety Impact of Edge Line on Narrow Rural Two-Lane Highways by Empirical Bayes Method
   Xiaoduan Sun, University of Louisiana, Lafayette, presenter

   a. Narrow, rural two-lane highways are mostly characterized by low design features, light traffic volumes with high crash rates and particularly high fatal crash rates. There are about 5,000 miles of narrow, rural two-lane highways administrated by the Louisiana Department of Transportation and Development (LADOTD). Running-off-roadway (ROR) crashes are the most common type of crashes on narrow, rural two-lane highways. As it's not required by the Manual on Uniform Traffic Control Devices (MUTCD), many highways of this type do not have edge lines because of their low traffic volumes. There are two main concerns for edge line implementation on narrow two-lane highways: (1) the potential increase in head-on collisions and; (2) added maintenance cost to the already constrained annual maintenance budget. This paper introduces the second part of a study that evaluates the safety impact of edge lines on narrow, rural two-lane highways in Louisiana. The first part of the study proved that edge lines centralize the lateral position of vehicles based on the data collected from 10 locations. This second part of the edge line study evaluates the safety performance before and after the implementation of edge lines from roadway segments selected from all LADOTD

districts. By using the Empirical Bayes (EB) method, the study shows that edge line implementation significantly reduces expected crash frequencies. While reducing ROR crashes, edge line implementation also reduces head-on crashes. It is interesting to note that the implementation of edge lines benefits primarily male drivers and young drivers. Because of the crash decreasing trend observed in the three year period that is classified as the after time period in the study, the final estimated crash modification factor (CMF) is 0.85 with a standard deviation of 0.039. The very high benefit-cost ratio strongly supports the idea of edge line implementation on narrow, rural two-lane highways in Louisiana.

3. Simple Empirical Guide to Low-Volume Road Design
   Karim Ahmed Abdel-Warith, Purdue University, presenter

   a. Low-volume roads constitute the vast majority of the United States road network. From an economic standpoint, low-volume road preservation accounts for several hundred million dollars per year, or more than half of the annual investment in roads. Although low-volume roads carry a small percentage of the overall traffic, their associated crash rates are considerably higher than those for higher volume roads. Clearly, low-volume roads are an important part of the nation's transportation infrastructure and even small improvements in their design can have significant impacts on the safety of drivers and the nation's economy. Thus, there is a need to design low-volume roads using engineering principles to ensure an economic design and avoid premature road failures. Many agencies have proposed low volume design methodologies, yet most of them require input that may not be available to local agencies. To that end, this paper develops an empirical low-volume road design methodology that is accurate, requires minimal input that is readily available to local agencies, and is simple to use, while at the same time is customizable in order to account for specific weather and sub-grade conditions.

4. New Procedure for Selecting Chemical Treatments for Unpaved Roads
   David Jones, University of California, Davis, presenter

   a. There is increasing interest in the use of chemical treatments to reduce maintenance and gravel replacement on gravel roads. However, choice of the most appropriate chemical treatment is difficult because of the proprietary nature of many of the chemical treatments available. This paper offers a new approach to the selection of an appropriate chemical treatment, which is based on the practitioner understanding the roads that require treatment in terms of traffic, climate, geometry, and materials; understanding the different chemical treatment categories; and understanding the objective for applying a chemical treatment. Based on the information collected, the most appropriate chemical treatment categories for a given situation can be selected from a series of charts and ranked using a simple mathematical formula. The ability to rank the different treatments available differentiates this procedure from previous procedures documented in the literature. The selection can be refined by evaluating expected performance using prediction charts that are based on material properties determined from the same simple, inexpensive laboratory tests required as input to the selection procedure.

5. Collecting Decision Support System Data via Remote Sensing of Unpaved Roads
   Richard Dobson, Michigan Tech Research Institute, presenter

   a. Unpaved roads make up roughly 33 percent road system within the United States and are vitally important to rural communities to transport people and goods. Effective asset management of unpaved roads requires frequent inspections to determine the asset's condition and the appropriate preventive maintenance or rehabilitation. The major challenge with managing unpaved roads is collecting low-cost, condition data that is compatible with a decision support system (DSS). The advent of cheap, reliable remote sensing platforms such as unmanned aerial vehicles (UAVs) along with the development of commercial off-the-shelf image analysis algorithms provides a revolutionary opportunity to overcome these data volume and efficiency issues. This paper outlines the development of a market-ready system to detect unpaved road distress that are compatible with a DSS by taking advantage of these technological leaps. The system uses areal imagery that can be collected from a remote controlled (RC) helicopter or manned fixed-wing aircraft to create a three dimensional model of sensed road segments. Condition information on potholes, ruts, washboarding, loss of crown and float aggregate berms are then detected and characterized to determine the extent and severity of the distresses. Once detection and analysis is complete, the data are imported into a GIS-based DSS (Roadsoft) for use by road managers to prioritize preventive maintenance and rehabilitation efforts.

6. Research Using Waste Shingles for Stabilization or Dust Control for Gravel Roads and Shoulders
   Thomas J. Wood, Office of Materials and Road Research, Minnesota Department of Transportation

   a. Recycled Asphalt Shingles (RAS) include both manufacture waste scrap shingles (MWSS) and post-consumer tear-off scrap shingles (TOSS). It is estimated that Minnesota generates more than 200,000 tons of shingle waste each year. Recently, a portion of this waste has been incorporated into hot-mixed asphalt (HMA) pavement mixtures. The current technology limits the amount of RAS in HMA to no more than 5 percent by weight. This leaves a lot of underutilized shingle waste material throughout the st ate. This has prompted MnDOT to investigate other potential uses RAS. One potential use is to improve the performance of gravel surfacing and reduce dust by replacing common additives such as calcium chlorides with RA S. This is especially relevant as gravel sources in Minnesota have been depleted and/or have declined in quality, which has affected the performance of gravel surfacing. These poorer quality fines can increase the amount of dust generated and increase the difficulty of keeping the roadway smooth. Some agencies have used dust control additives to help the performance of these lower quality gravels. Successful implementation has the potential of removing valuable RAS materials from the waste stream to supplement the use of more expensive virgin materials and improve the performance of local roads.

7. Performance of Chip Seals Using Local and Minimally Processed Aggregates For Preservation of Low Traffic Volume Roadways
   Scott Shuler, Colorado Department of Transportation

   a. This report documents the performance of two low traffic volume experimental chip seals constructed using locally available, minimally processed sand and gravel aggregates after four winters of service. The projects were constructed by Colorado Department of Transportation (CDOT) maintenance personnel during the summer of 2009 using two sources of aggregate. These aggregates consisted of locally available products representing 1) materials routinely utilized and 2) materials that were marginal with respect to aggregate gradation and crushing requirements. An objective of this work was to evaluate the feasibility and cost/benefit of using aggregates in chip seals of lower quality than normally used with respect to gradation on low volume roadways. Because the cost of transporting high quality aggregates from front range sand and gravel and quarry locations to the eastern regions of Colorado is high and much of the pavement preservation activities in eastern Colorado are on low volume roadways, utilizing locally available aggregates would provide economic benefits if acceptable performance were demonstrated. After four winters and three summers service both experimental chip seals are performing well. Condition surveys of each pavement were conducted after each winter and summer to document pavement condition. Results indicate that pavement distress is in the form of longitudinal and transverse cracking and localized flushing due to non-uniform asphalt emulsion application during construction. Based on results from the last condition survey, both test pavements should perform acceptably for the next several years assuming no significant change in traffic levels. No significant differences were measured in performance for any of the evaluation sections. It appears that locally available, minimally processed aggregates can be successfully applied as chip seal aggregate on low volume roadways.

8. Forty-Year Study of Geotextiles in an Unpaved Road
   Brian Howard Whitaker, Fiberweb

   a. One of the earliest field studies on geotextile performance in roads began in 1972 on a farm access road in Smyrna, Delaware. An initial report on the site was prepared in 1974 and key samples were taken after 20, 35 and 40 years of service. The material characteristics of these samples have been tested extensively to determine the long-term survivability and impact of geotextile materials on road base and surface integrity. The 40-year data and site observations, presented here and offering an update on data presented to TRB in 1994, show that a significant and beneficial roadway performance can be maintained across decades when geotextiles are used for soil separation and filtration/drainage improvement in the subgrade. The continued integrity of the subgrade, supported by the geotextile, has minimized erosion of the unpaved surface of the farm access road. The data are important not only for farm access roads but for roads in general. Unpaved roads are a strong predictor of paved road performance. In lacking the extra surface layer (e.g., asphalt), an unpaved road's resistance to surface erosion and subgrade instability provides a path to better paved road service lives and lower maintenance costs. Also, the data are significant in that the original study was not intended to assess long-term durability; yet, that has become the focus with the site still accessible and functioning.