Baystate Roads Program
Local Technical Assistance Program (LTAP)

Tech Notes

TO PAVE OR NOT TO PAVE?

Tech Note #57

Paved roads provide improvement over gravel in ways that are hard to quantify with dollars, including improved winter surfaces, improved safety with better signage and delineation, a safer surface with higher skid resistance, a smoother surface that increases user satisfaction and reduces vehicle maintenance costs, redistribution of traffic away from gravel roads, and an increased tax base on adjacent property.

Of the estimated 4 million miles of roads in the United States, nearly half--1.5 million miles--are unpaved but do serve a valued purpose in our roadway system. Like everything else, maintenance costs for both paved and unpaved roads are rising. Reduced funding and resources require more efficient use of available money.

The decision on when to pave a gravel road is not easy, but two research reports with different objectives offer a method of cost analysis based on spending history for low-volume roads, a method for estimating maintenance and construction costs, and an economic analysis procedure.

The first is *Economics of Upgrading an Aggregate Road* (2005) by the Minnesota Local Road Research Board available at: **www.mnltap.umn.edu/resources/infrastructure/lowvolume.html** which examines surface construction and maintenance costs to determine possible threshold values to go from gravel to paved. The second is *Local Road Surfacing Criteria* (2004) by the South Dakota DOT available at the same site which compares costs associated with different types of roads to determine the most economical surface type.

To supplement these reports, a PowerPoint presentation for use at local board or public information meetings was developed. The presentation outlines information that engineers and public works staff consider when deciding whether to pave a gravel road. Two versions of this are available. One will run on its own with narration and an automatic slide show. The other is a traditional format with a speaker verbalizing the slide content and advancing slides as needed.

2 KEY QUESTIONS MUST BE ANSWERED WHEN DEVELOPING A GRAVEL ROAD MAINTENANCE PLAN

1. What is the best way to maintain one?
2. When should the roadway be paved?

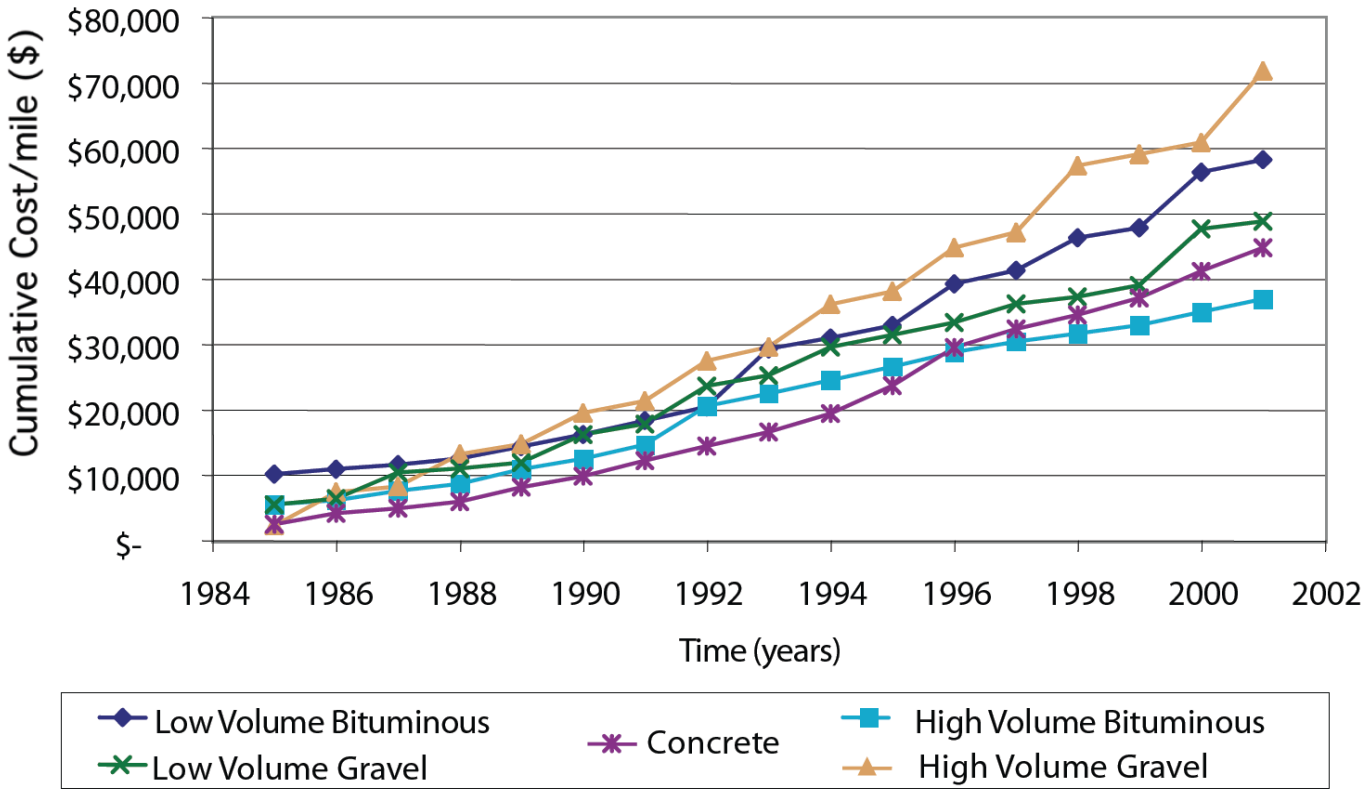

Figure 1. Cumulative Maintenance Costs/Mile for One County

Economics of Upgrading an Aggregate Road

This project, conducted in Minnesota, offers an analysis of cumulative maintenance costs, practices, and traffic volumes for individual roads. Data includes maintenance costs for both bituminous (or asphalt) and gravel roads, as well as volumes of traffic. Baseline data was obtained from annual reports submitted to the Minnesota State Aid Division and four counties were analyzed to develop typical costs per mile for a variety of surface options, including gravel and paved. Researchers conducted an initial data analysis for Waseca County, which provided a snapshot of the information.

Figure 1 shows actual maintenance costs per mile for five different roadway surfaces in Waseca County:

Low-volume bituminous roads,
Low-volume gravel roads,
Concrete pavement,
High-volume bituminous roads, and
High-volume gravel roads.

Note that high-volume gravel roads have the highest maintenance costs.

Figure 2 illustrates the effect of traffic on maintenance costs per mile for one county. The roads are grouped by traffic volume and surface type along the bottom of the graph. An increase in traffic does lead to an increase in maintenance costs, especially for gravel roads. This is due to more lost gravel due to wear, and an increased need for blading and smoothing of the road surface. Note that at traffic volumes of 200 ADT, gravel road maintenance costs increase significantly.

Using this report in your agency

The Minnesoata report can be used to assist local agencies in estimating their own maintenance costs per mile. Agencies can use that data to decide if paving a gravel road is the best alternative. The report directs users to:

1. Review the historical costs of maintaining paved roads for an agency. (If those costs are not available, review data for one of the four counties analyzed in the report to get an idea of what your costs might be.)

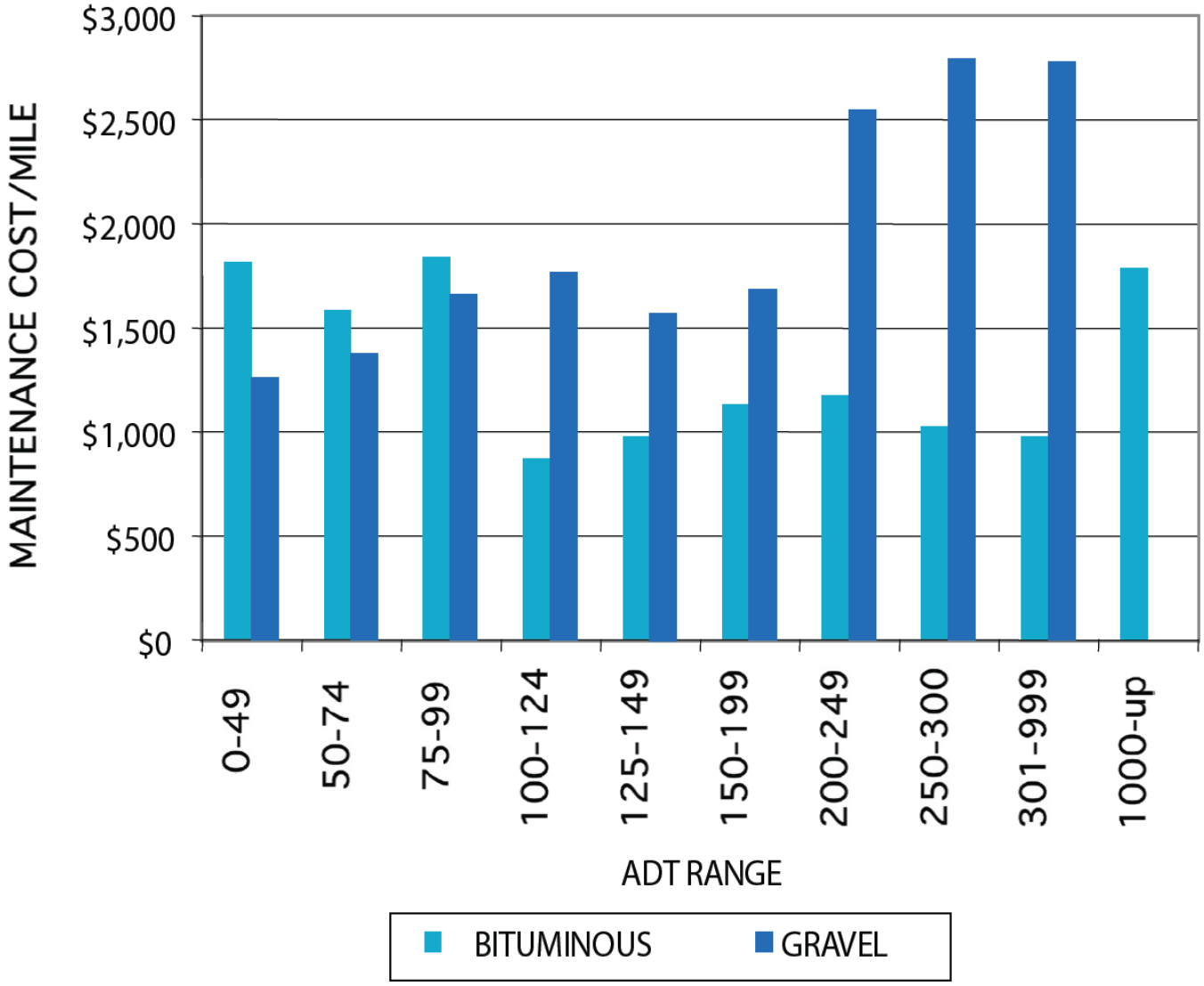

Figure 2: Maintenance Costs/Mile at Various Traffic Levels for One County

2. Compute estimated gravel road maintenance costs per mile for your agency.

3. For a proposed upgrade, develop a cost estimate in the same way a contractor would for any new construction project under consideration.

4. Evaluate this cost estimate to compare the alternatives and make a decision for each roadway segment under question.

By using the information presented, an agency can evaluate its typical maintenance and construction costs, as well as identify the annual maintenance costs for a given type of roadway (whether it is paved or unpaved) and the typical construction costs for a variety of surface projects.

Directions are also given for performing a present-worth analysis to assess maintenance and construction costs for a roadway section to see what the equivalent maintenance and construction costs are in today's dollars.

Local Road Surfacing Criteria

The second tool was completed as part of a project that investigated several surfacing criteria for low-volume roads. The main objective of this project was to create a process comparing maintenance requirements for different surface types to assist in selecting the most economical alternative under a given set of conditions. Surface types included hot-mix asphalt, blotter, gravel and stabilized gravel roads.

Many project elements are similar to the Minnesota report but South Dakota developed an easy-to-use computerized tool that allows agencies to input local costs and treatments in their own conditions. This computerized tool leads the user through a series of steps to:

1. Input information about the road section, including the project limits and the average daily traffic (ADT) count.

2. Input the actual agency maintenance and construction costs, broken down by surface type.

3. Estimate user costs, which are costs to the people who drive on the roads, and include vehicle operating and crash costs asssociated with a roadway surface type. These user costs can even be weighted to give them more or less importance in the analysis.

After all the initial input variables are submitted, the computer program summarizes total costs for building and maintaining each roadway type. The evaluator then inputs other non-economic factors that relate to all surface types, including growth rates for an area, housing concentration and dust control needs, mail route locations, truck traffic, and political considerations. Again, the evaluator is allowed to weight each factor in the analysis.

This tool provides output that is both easy to generate and understand. Cost comparisons can be computed for several alternatives. In addition, the user is assisted in selecting appropriate input variables for a typical agency. The results are objective and assist in making a clear comparison for a variety of roadway surfaces.

This tool is available online at: **www.mnltap.umn.edu/resources/infrastucture/lowvolume.html** and can be downloaded in three forms:

> Full Report--complete with references, data and research process fully outlined.

> User's Guide--hands-on guide that introduces the macro-driven, Excel-based analytical tool developed to apply the low-volume road management methodologies recommended under the project.

> Technical Brief--developed to provide a step-by-step procedure for making road surface type decisions between different surface materials (hot-mix asphalt, blotter, gravel, and stabilized gravel) on low-volume roadways.

The User's Guide outlines all steps required to download the software and populate required fields with local data. It is a comprehensive guide to understanding every input variable available for the analysis.

Summary

Results of both gravel road studies note that maintenance and construction costs vary considerably from one agency to another, and from one season to another.

Traffic is a primary factor in deciding to pave or not to pave. The Minnesota study found that gravel road maintenance costs per mile appear to increase considerably after an ADT level of 200 vehicles/day. The South Dakota study found that paved roads are most cost-effective at ADT levels above 150 vehicles/day. Informed decisions can be made based on traffic data, local construction and maintenance costs, and area growth values to determine if and when a roadway should be paved.

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Time to analyze the data!