CHAPTER 8 – CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Earlier, this report stated that there were 987,518 km (613,365 mi) of road that serve Federal and Indian Lands, and that 83.6% of these miles are unpaved. The owners of these unpaved roads face a big challenge trying to keep them open and safe. Because funding to maintain these roads is often scarce, methods and products that allow the local agency to use native surfacing materials can prove to be very cost effective. Therefore, identifying methods to effectively control dust and prevent raveling, rutting, wash boarding, and potholing on varied native road surfacing materials should continue to be a goal of the FHWA Federal Lands Highway Division. Several conclusions can be drawn from this study.

Product Effectiveness

Under this 24-month study, six products were evaluated for road stabilization and dust control using both subjective and objective criteria. The ranking based on averaged normalized values of overall product performance for this non-plastic, crushed aggregate shown by higher score first was:

Lignosulphonate	(74)
Mag/Lig	(70)
Caliber	(68)
Permazyme	(64)
Terrazyme	(62)
Soil Sement	(56)

This Seedskadee NWR study was a follow-up to a previous 24-month study where these same products were used on a non-plastic granular base material at the Buenos Aires NWR. This previous study's product performance ranking shown again by higher score first was:

Caliber	(83)
Mag/Lig	(77)
Lignosulphonate	(70)
Terrazyme	(66)
Soil Sement	(65)
Permazyme	(64)

Note that the averaged normalized scores for both studies allow for comparison directly within each project, but are only relatively comparable between projects. A clear conclusion is that the three highest ranked products are the same for both projects, although their order varies. Unfortunately, neither project employed an untreated control section to provide an absolute performance reference.

Subjective and Objective Monitoring Methods

The subjective monitoring method, first used at Buenos Aires and continued at Seedskadee, compared the performance of the products to each other based on visual observations of dusting, wash boarding, raveling, rutting, and potholing. The methodology is quick and easy, and it captures subtle difference in performance. It is accomplished by simply driving the project multiple times and observing and comparing performance. This method however does not track performance over time.

The objective measurements method, only used on the Seedskadee project, involves choosing, without bias, specific sites within each product section and making multiple depth measurements for raveling, wash boarding, rutting, and potholing. Using objective criteria, the measurements are transformed into ratings. The strengths of this method are that it provides abundant data and it can track performance over time. Its weaknesses are that it is time-consuming and physically challenging, and its ultimate accuracy is highly dependent on the specific sites that get measured. This newly developed objective system needs to have some adjustments made to the objective criteria so that the ratings more closely reflect a driver's experience.

The two methodologies produced almost the same ordering of the products as to how well they performed. A correlation between the two methods was done, and reasonably good correlation was evident for dusting, wash boarding, and raveling. For rutting and potholing, correlation was poor but readily explainable. With a little more work on the objective method, correlation could improve and the subjective and objective methods could be reasonably interchangeable. The use of one system or the other should be based on the project's objectives.

No One Best Product For All Applications

The product that will perform the best at any given site depends on a number of factors including the climate and traffic conditions at that site, the characteristics of the proposed surfacing material, and the method of product application. Road owners must do their due diligence to discover the most suitable and cost effective product for their area. New products continue to appear, and the industry continues to become more sophisticated in developing site specific products.

Silt Load Test and Dust Ratings

In this study, Silt Load Test results were plotted together with dust ratings through time. For five of the six products, the trends moved similarly. This was an expected result, however a sufficient amount of Silt Load Test data is critical because these discreet samples are averaged and compared to a non-discreet overall judgment on dust. The value of this comparison of Silt Load Test results and dust ratings is that the two ratings appeared to validate each other. Whether or not to use both tests in the future depends, again, on a project's objectives.

Low Plasticity - A Key Signal

The materials used at both the Buenos Aires and Seedskadee projects were non-plastic materials. Those products that could bind together silty materials – Caliber, Lignosulfonate, and Mag/Lig – appeared to work better, whereas those products that tend to lower the plasticity index (PI) – the enzyme products and perhaps Soil Sement as well – worked less well. The lack of sufficient clay fines to glue the material together was especially noticeable on the Seedskadee project, and the material was improved the most by incorporating Lignosulfonate that actually increased the plasticity index. One result of studies at Buenos Aires and Seedskadee is that the CFLHD has increased its PI requirement in crushed aggregate base materials.

Full-Depth Stabilization

Surface applications of dust abatement and stabilization products can be done quickly, but their cost effectiveness could be scrutinized since they typically have shorter performance duration. After a short time the effect breaks down and they typically need re-application. In full depth stabilization, however, though the surface layer breaks down with use, underlying it is a fully stabilized roadway that resists further dusting, raveling, rutting, wash boarding, and potholing. This is the result seen at both the Buenos Aires and Seedskadee projects where no maintenance activities were performed on the roads for the two years during which they were monitored. Full depth stabilization may be the most significant contributor toward minimizing wash boarding and preventing rutting and potholing even though it did not prevent raveling and dusting.

Previous Study's Recommendations Still Valid

The recommendations made in the 2005 report *Road Stabilizer Product Performance - Buenos Aires National Wildlife Refuge* are still valid and are summarized in the next section.

RECOMMENDATIONS

Control Sections

Require a control section where no product is applied on any further product comparison studies so that the benefits of using rather than not using stabilizer products can be evaluated.

Increased Plasticity Index

Increase the specified plasticity index of crushed aggregate so that, despite the variability of test results, it is between 8% and 12%. As of this writing, CFLHD has already made this change.

Full depth Stabilization

Full depth Stabilization of native road materials can be cost effective and should be considered for use whenever conventional dust control methods are considered.

Buenos Aires Study's Recommendations

Recommendations from the Buenos Aires study are still valid. Because 83.6% of roads serving Federal and Indian Lands are unpaved, and there is a need to optimize use of maintenance funding, efforts to achieve the Buenos Aires recommendations should be strengthened. They are summarized here:

New Specifications are Needed that allow use of newer dust abatement and stabilization products. Products that are non-proprietary, such as magnesium chloride or lignosulphonate already have generic specifications. However, it is much more difficult to write generic specifications for the proprietary, brand-name products. The challenge that still needs to be addressed is how to produce generic specifications for product categories such as were defined by the USFS and used in these two studies. Proprietary, brand-name prodjucts can fit into these categories. Another method would be to define acceptable levels of product performance, regardless of product category.

Define an Optimum Stabilization Depth, or minimum depth that will allow for a cost effective treatment using available funds.

An Objective Method for tracking product performance over time that was needed was developed under this Seedskadee project, but it still can be improved and refined.

Track Cost Information for future comparisons, however, developing a precise economic comparison of various products is probably not feasible.

Develop a Product Class Selection Chart that starts with material composition and classification, considers climate, traffic, and environmental considerations, and finally leads to recommended prioritization of the product classes. A preliminary process that addresses this is proposed in the Appendix G.

Protect the Environment on future projects, by cooperating with not only the F&WS, but the other FLMAs as well to determine the environmental effects of using various stabilizer products.

Training for designers and construction inspection personnel on the application and use of these products can and should continue to be done.

REFERENCES

1. *Highway Statistics*. Publication No. FHWA-PL-04-009, US Department of Transportation, Federal Highway Administration, Office of Highway Policy Information, Washington, DC. 2003.

2. Surdahl, Roger W., J. Heather Woll, and Rick Marquez. *Road Stabilizer Product Performance: Buenos Aires National Wildlife Refuge*. Publication No. FHWA-CFL/TD-05-011, U.S. Department of Transportation, Federal Highway Administration, Central Federal Lands Highway Division, Lakewood, CO. October 2005.

3. *Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects, FP-03.* Publication No. FHWA-FLH-03-001, US Department of Transportation, Federal Highway Administration, Washington, DC. 2003.

4. *Seedskadee National Wildlife Refuge Comprehensive Conservation Plan*. U.S. Fish and Wildlife Service, Seedskadee National Wildlife Refuge, Green River, Wyoming, and Division of Refuge Planning, Region 6, Denver, Colorado. September 2002.

5. Contract DTFH68-04-C-00012, *WY RRP SEED 12(1) SEEDSKADEE, Seedskadee National Wildlife Refuge, Sweetwater County Wyoming*, Desert Sage Contractors, Inc., Idaho Falls, ID, U.S. Department of Transportation, Federal Highway Administration, Central Federal Lands Highway Division, Lakewood, CO. May 11, 2004.

6. Bolander, Peter, ed. *Dust Palliative Application and Selection Guide*. Project Report. 9977-1207-SDTDC. US Department of Agriculture, Forest Service, San Dimas Technology and Development Center, San Dimas, CA: 28 p. November 1999.

7. Rukashaza-Mukome, Mary C., et al. *Cost Comparison of Treatments Used to Maintain or Upgrade Aggregate Roads***.** Proceedings of the 2003 Mid-Continent Transportation Research Symposium, Iowa State University, Ames, IA. August 2003.

8. Lunsford, Lt. Gregory B., and Joe P. Mahoney. *Dust Control on Low Volume Roads: A Review of Techniques and Chemicals Used.* Publication No. FHWA-LT-01-002, US Department of Transportation, Federal Highway Administration, Office of Professional Development, Washington, DC. 2001.
.