CHAPTER 2 – PRODUCT INSTALLATION AND MONITORING

Figure 5. Photo. Typical product application.

Figure 6. Photo. Typical borrow material and product blending.

Figure 7. Photo. Typical rolling and compaction.

PRODUCT APPLICATION

All products shown in Table 3 were applied according to each supplier's recommendation. Each company provided an on-site representative to ensure their product was applied properly in two to three applications as they requested. Each product was applied to the roadway materials in windrows; blade mixed, and then compacted with a 9.4 Mg (12-ton) 9-wheel pneumatic roller to a total stabilized depth of 150 mm (6 in.) Figures 5, 6, and 7 show the typical process used to apply the products on the Buenos Aires NWR Tour Roads project.

A summary of the application processes for the products used in the individual sections is as follows:

Sections I, II, & VI (Mag/Lig, Caliber, Lignosulfonate)

- 75 mm (3 in) of Select Topping Material was bladed off and windowed to the side of the road.
- The product was applied to the bladed surface in two passes.
- 75 mm (3 in) of the windrowed material was placed on top of the applied surface.
- The product was applied to the top surface in three passes.
- The material was bladed back and forth to level it and work cobbles to the side.
- The material was rolled in with a 9-wheel pneumatic roller.

Section III (Soil Sement)

- The select borrow roadway was scarified 150 mm (6 in) deep and windrowed to one side of roadway.
- The product was applied to the bladed surface and allowed to soak in.
- The blade pulled material from the windrow and spread it in a 75 mm (3 in) lift.
- Additional product was applied to the top surface and allowed to soak in.
- The blade pulled more material from the windrow spreading it in a second 75 mm (3 in) lift.
- The product was applied a third time.
- The material was processed back and forth with a blade to level it and work cobbles to the side.
- The material was rolled in with a 9-wheel pneumatic roller.
- The following day the road was tight bladed, popping all loose and large cobbles from the surface, which were windrowed to the side.
- Plain water was applied to the road from the water truck.
- The product was applied again topically in three passes and allowed to soak in between each application.

Section IV (Permazyme)

- The select borrow roadway was scarified 150 mm (6 in) deep and windrowed to one side of roadway.
- The manufacturer's recommended dosage rate was 3.785 liters (1 gal) of product concentrate per 3785 liters (1000 gal) of water.
- The diluted product was sprayed over the section and blade mixing began. The diluted product was applied while mixing occurred until the required amount of solution was put down. For this first application, a total of two truckloads of diluted product were applied, or about 30 liters (8 gal) of concentrate.
- The material was processed and mixed using a blade with additional plain water from the water truck.
- The material was windrowed to one side of the road to promote total moisture adsorption and was left for finishing until the next day.
- On the second day, additional diluted product was applied to the windrow and roadway surface with the water truck.
- The blade pulled treated material from the windrow and spread it in a 50 to 75 mm (2 to 3 in) lift.
- The material was rolled in with a 9-wheel pneumatic roller.
- The water truck made another pass with the diluted product.
- The blade pulled more treated material from the windrow and laid it over the previous lift.
- The roller compacted the material.
- The water truck made another pass spraying the diluted product.
- The blade processed the material back and forth smoothing it out evenly.
- The water truck made a final pass with the diluted product.
- The blade continued to process the material with the water truck adding plain water as needed.

- The roller made 2 final passes over the test section.

Section V (Terrazyme)

- The select borrow roadway was scarified 150 mm (6 in) deep and windrowed to one side of roadway.
- Before the product was applied, 75 mm (3 in) of untreated select borrow roadway material was spread back over the roadway surface.
- A water diluted solution of the product was sprayed over the roadway with a water truck.
- The blade pulled more material from the windrow and spread over the roadway.
- The water truck made another pass with the diluted product.
- The remaining material from the windrow was spread over the roadway.
- The water truck made a final pass with the diluted product.
- The material was processed back and forth with a blade to level it and work cobbles to the side.
- The material was rolled in with a 9-wheel pneumatic roller.

MONITORING PROGRAM

Performance monitoring of each product occurred at 6-month intervals for a 24-month period beginning on March 2003, six months after the products were applied. Each monitoring event consisted of a visual inspection for dust generation, washboarding, raveling, potholing, rutting, and leaching. The evaluation team also performed on-site tests of DCP measurements, Silt Load evaluations, Nuclear Density Gauge readings, and GeoGage Soil Stiffness tests. Table 4 lists the sampling and testing performed during various evaluation periods.

Visual Inspection Parameters

The primary categories or parameters of visual inspection were: 1) effectiveness against visual dust, 2) degree of washboarding affecting the ride smoothness, and 3) amount of raveling. Dust was monitored using a two-vehicle caravan that traveled at 40 to 50 kph (25 to 30 mph) throughout each test section. The evaluators in the trailing vehicle noted the relative amounts of visible dust produced by the leading vehicle. Other secondary parameters such as the amount of potholing and rutting were also evaluated. Visible leaching of stabilizing material due to rain was included. Additional observations noted the overall structural appearance, that is, hardness or softness, binding or loss of material, crusting and fragmenting, and impacts on roadside vegetation.

Visual Assessment Methodology

The main goal of the monitoring project was to determine how each stabilizer product performed in relation to the others. Initially in monitoring the products, objective rating systems were tried, such as the Corps of Engineer's method [(12)], but these proved to be insensitive to subtle differences in performance. Therefore, an 11-point comparative rating system was selected that, though subjective, allowed for the desired sensitivity.

Table 4. Parameters evaluated during each monitoring period.

Monitoring Parameter	Monitoring Event				
	Initial (August 17, 2002)	**6-month** (March 4 & 5, 2003)	**12-month** (August 11, 2003)	**18-month** (March 17, 2004)	**24-month** (August 24, 2004)
Dust		X	X	X	X
Washboard		X	X	X	X
Raveling		X	X	X	X
Potholing		X	X	X	X
Rutting		X	X	X	X
Leaching		X			
Density	X	X			
Gradation	X	X			
R-value	X	X			
DCP			X	X	X
CBR	X[(a)]	X[(a)]	X[(b)]	X[(b)]	X[(b)]
Silt Loading			X	X	X
Stiffness			X		

(a) CBR values produced from laboratory testing
(b) CBR values measured from field tests with the DCP

The scale of this method was from 0 to 10 with neither 0 nor 10 referring to any absolute value, description, or picture. Rather, larger numbers indicated a better condition and smaller numbers a worse condition. The first section driven received an arbitrary rating of 5 for each parameter and served as the benchmark. Then as the 3 evaluators road in the inspection vehicle, each of them independently scored each stabilization section as comparatively better (larger numbers) or worse (smaller numbers) than the benchmark section. The individual scores were averaged, and these average values are shown in the rating tables and charts within this report.

With this comparative system, the relative standing of each product among its peers was observed. Depending on varying conditions, such as temperature and precipitation at each monitoring event, the relative standings between products was expected to vary somewhat. Therefore, an overall average standing from the four monitoring events was calculated and used in summary tables.

After completion of the study, the evaluators became aware of possible bias created by carrying out the comparative rating always starting with the same section – Section IV Permazyme. Doing the evaluations in the same order at each monitoring event perhaps created a strong pattern of expectation in the evaluators. In future studies the beginning, or baseline, section that receives a 5 rating will be rotated among the sections. The authors apologize for this procedural oversight but still believe product performance was rated fairly.

One interesting outcome from using this comparative rating system was the complete lack of any data showing expected decreasing performance over time. An objective (outside written criteria) system would provide this kind of data. However, the major study goal of determining the best performing products for soil type at the Refuge was definitely supported by the comparative rating system.

FIELD SAMPLING AND LABORATORY TESTING

Material from a wash of a local dry streambed was used as the borrow source for the select topping. This borrow material was generally of good quality and met the Special Contract Requirement Section 704.08[11]. The specific borrow characteristics prior to and after treatment are discussed in Chapter 4.

Sampling and testing were performed during the initial placement and over the 24-month evaluation period. Table 5 summarizes the specifications and other tests used to evaluate the roadway materials on this project.

Figure 8. Photo. Stockpile of granular material used for topping.

Table 5. Standard specifications, sampling and testing.

Test Number	Description
AASHTO T 11	Material Finer Than 75-µm (No. 200) Sieve in Mineral Aggregate by Washing
AASHTO T 27	Sieve Analysis of Fine and Coarse Aggregate
AASHTO T 89	Determining the Liquid Limit of Soils
AASHTO T 90	Determining the Plastic Limit and Plasticity Index of Soils
AASHTO M 145	Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes
AASHTO T 180, Method D	Moisture-Density Relations of Soils Using a 4.54 Kg (10 lb) Rammer and 457 mm (18 in) Drop
AASHTO T 190	Resistance R-value and Expansion Pressure of Compacted Soils
AASHTO T 193	The California Bearing Ratio
AASHTO T 310	In-Place Density and Moisture Content of Soil and Soil-Aggregate by Nuclear Method (shallow Depth)
ASTM D 6951	Dynamic Cone Penetrometer
40 CFR 52.128(b)(16)(i)(B)	Silt Loading
ASTM D 6758	GeoGage Soil Stiffness Modulus Testing