

**NORTH DAKOTA  
DEPARTMENT OF TRANSPORTATION**

**MATERIALS AND RESEARCH  
DIVISION**

Experimental Study ND 2014-01

*Evaluation of Permazyme 11x™ Soil Stabilization*

**Work Plan**

SS-4-053(015)030

August 11, 2014

Prepared by

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Written by  
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## **Disclaimer**

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# Evaluation of Permazyme 11x™ Enzymatic Soil Stabilizer

## **Purpose and Need**

As construction and material costs increase, NDDOT is investigating innovative ways of improving construction processes to benefit pavement performance. There is a need for cost effective methods of reducing material demands in areas where the supply of aggregates are limited and expensive. Soil stabilization can increase soil strength and stability reducing the required base material to construct a structurally adequate pavement system. Pacific Enzymes Inc. has developed Permazyme 11x™ and promotes its capabilities system to provide additional soil strength and stability. The system uses an enzymatic soil stabilizer along with conventional compaction to create a permanent dense weather resistant subgrade.

NDDOT management has requested that Materials & Research incorporate Permazyme 11x™ into an upcoming construction project to evaluate its potential benefit and performance.

## **Objective**

The objective of this experimental project is to evaluate the long term performance benefits of Permazyme 11x™ enzymatic soil stabilizer ability to increase subgrade strength and stability as a method to reduce aggregate material demands. The long term pavement performance of the test sections will be compared with a control section that will consist of a standard grade raise practices of the same thickness.

## **Scope**

The NDDOT has identified a grade raise project scheduled for construction in the Minot District during the 2014-2015 seasons. The following project has been selected to evaluate the enzymatic soil stabilizer.

SS-4-053(015)030

PCN 20764

Requirements for the stabilized subgrade will be incorporated into the bid and construction documents by plan details and the following plan note.

234-P01 STABILIZED SUBGRADE-6IN: The contractor shall stabilize the top 6” of subgrade as indicated in the typical section with Permazyme 11x in accordance with all manufactures recommendations. The contractor shall use a rotary mixer equipped with an injection system to accomplish mixing of the soil and Permazyme 11x using the manufacturer’s recommended rate.

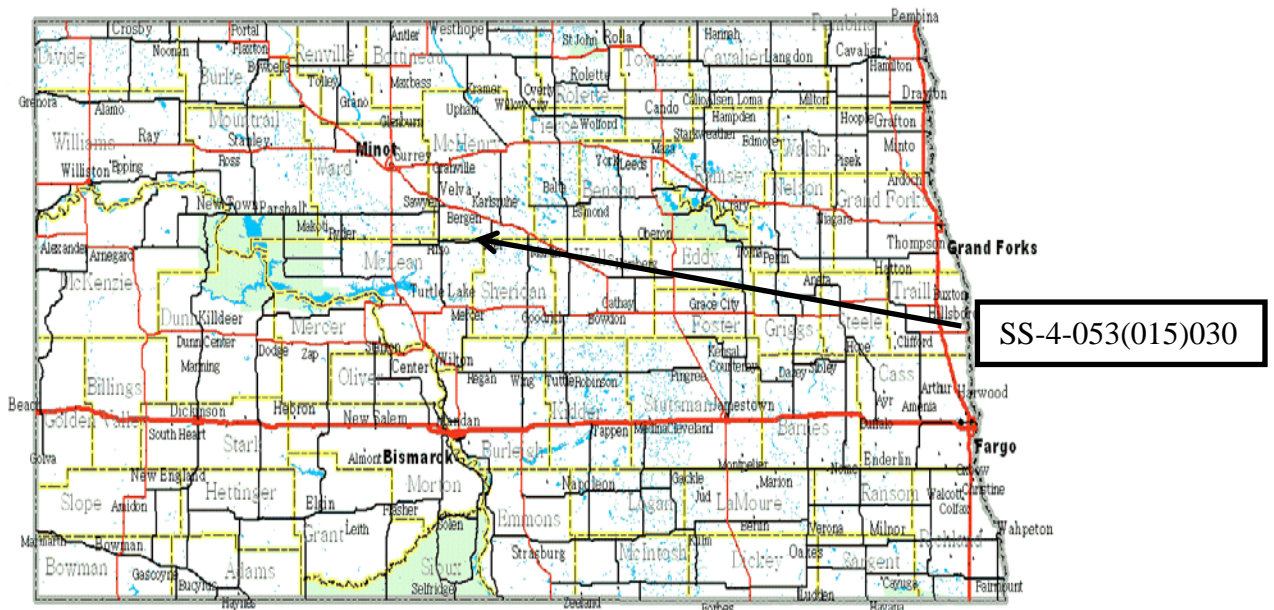
The contractor shall provide a manufacturer representative on site during the incorporation of the Permazyme 11x enzymatic soil stabilizer.

The manufacturer contact is Skip LeMaster, President, and Road Specialist  
Phone: 916-813-0326  
Email: Skip@pacificenzymes.com

The contractor shall coordinate with the project engineer and Materials and Research two weeks prior to the stabilizing process so Materials and Research engineer can be onsite during stabilization.

Payment will be plan quantity of XX SY STABILIZED SUBGRADE-6IN. This will be full compensation for furnishing all materials, equipment, labor, and incidentals to complete the work as specified.

## Location



## **Design**

The NDDOT has identified a grade raise project located near Benedict, ND on the ND 53 corridor for this experimental project. The product will be incorporated into the subgrade of the emergency grade raise project SS-4-053(015)030. The Permazyme 11x™ system will be incorporated into the top 6" of all the subgrade in the primary road prism according to manufacturer's guidelines and recommendations. The first 1000' of SS-4-053(015)030, RP 30.788 to RP 30.980 will be used as a control section and constructed with typical grade raise practices for comparison. The manufacturer specifications and recommendations are included in Appendix A.

The Permazyme 11x™ will be incorporated with a rotary mixer equipped with an injection system from RP 30.98 to RP 31.274. The Contractor also will provide a manufacturer's representative onsite during incorporation of the product.

### **SS-4-053(015)030 (Experimental Feature)**

The experimental test section was designed using AASHTO 1993 DARWin Pavement Design methodology. The typical section consists of 4.0" FAA 40 HBP on 12" of dense graded base on 6" of Permazyme 11x™ enzymatically stabilized soil.

The required structural number of 2.63 was based on 60 two-way daily flexible ESALs; 1.5 % annual ESAL growth rate; 253,204 accumulated one-way flexible ESALs; 6,000 psi soil modulus; 70% reliability and a 20 year design period.

## **Evaluation**

The field evaluation for these projects will consist of observing and documenting the construction process of the enzymatic soil stabilizer and an annual inspection of the pavement distresses with FWD testing.

During the construction of the project the following data will be collected for both the experimental and control section:

- AASTHO T-87,88,89 Soil Classification and Properties



- AASTHO T-180, Moisture Density Curves
- AASTHO T-208-10, Unconfined Compressive Strength

The research project will last five years with a construction report, an annual evaluation report, and a final report.

### **Reporting**

Data collected will be analyzed and reported annually. A final report will be published at the conclusion of the project.

## Appendix A

## **Permazyme 11x Specifications**

### **Construction:**

The aggregate, water and Permazyme 11X shall be mixed and placed by the following method.

### **Preparation of Surface:**

The in-place soil to be stabilized must be ripped, scarified, disced or rototilled into a well-pulverized mixture. If the stabilization area involves the treatment of heavy clay soils, the Project Representative may specify the use of a cross-shaft rotary mixer to assure proper pulverization and mixing. If the material to be treated is already at or above optimum moisture content, it must be dried to four percentage points below optimum in preparation for addition of the Permazyme solution. Do not prewet the soil material ahead of applying the Permazyme solution. When filling the water truck, add enzyme to water to avoid a truck full of foam. No mixing is necessary.

### **Application of Stabilizer:**

Application of the Permazyme 11X solution should be limited to the area specifically shaped and sized to receive the solution. The daily extent of work should be limited to an area the size of which allows all operations, including mixing and compaction, to be continuous and completed in one day.

Permazyme 11X solution should not be applied or mixed with in-place material if atmospheric temperature falls below 50F/10C.

Application of the Permazyme 11X must be limited to periods when rainfall is not expected during the application or during the 24 hour period following application. If rainfall is encountered during application, stop construction.

The Permazyme 11X Solution is applied at the rate of one gallon per 150 cubic yards (1 liter per 30 cubic meters) of material to be treated. The variance from the specified dilution rate will be +/- ten percent.

The amount of water to be used should be calculated to bring the soil or aggregate material to be treated to optimum moisture content. Permazyme solution should be added in increments and mixing continued so as to carefully approach optimum moisture content.

In conditions where the in-place material to be treated is already close to optimum moisture content, be aware that no less than two percent moisture must be added as part of the Permazyme 11X solution in order to properly disperse the highly concentrated Permazyme 11X. In this case, a ratio of 1:500 gallons is recommended.

The Permazyme solution can be applied to the material to be treated with a pressurized spreader truck or a water truck with a pressurized spreader bar. Uniform distribution can be accomplished by thoroughly working the enzymed soil by blading, tractor drawn spike, disk, or harrows, or by using a mixing/grinding or pulverizing machine, i.e., Asphalt Zipper, or similar.

Water should not be added to the material prior to adding the Permazyme solution. Mixing equipment shall follow no more than one quarter mile behind spray application truck.

If the entire Permazyme 11X solution has been added without achieving the range of allowable moisture content, more water may be added at a 1:10,000 dilution to bring it to the specified moisture range.

Compaction is the key to a perfect road:

Compaction operations can begin immediately following the shaping of the road. The moisture content of the material at the time of compaction shall not exceed nor be less than two (2) percentage points below the optimum moisture content. Compaction equipment should be capable of achieving compaction of the untreated material to a density no less than 95 percent of the density prescribed in ASTM D-1557-66T (Modified Proctor). 100% or more is frequently obtained with Permazyme 11X.

If site conditions warrant or compaction equipment is not of sufficient size, the road must be compacted in lifts of 3 to 4 inches maximum. However, with heavy road equipment, 6" lifts are standard. Prior to placing and compacting a second lift, the surface shall be pre-wetted to insure bonding between the lifts.

Upon completion, the surface should be smooth and in conformance with the typical sections, lines and grades of the design plans. The surface shall be properly sloped to allow runoff of surface moisture. The thickness of the compacted treated base material shall be six inches (15cm) or more. The compacted thickness should not vary one-half inch over the entire area.

### **Curing and Return to Service:**

Following final completion, the prepared soil shall be allowed to cure for three (3) days. No surface watering or curing membrane is required during this period. If the surface must be rapidly returned to service under traffic, it should be dried-back adequately so that it is not susceptible to rutting or damage by rapid acceleration or braking. The completed road will continue to harden over an extended period. The cementation effect of Permazyme in the soil is irreversible.