ORANGE COUNTY STORMWATER PROGRAM

APPENDIX E3
EROSION CONTROL BMP EFFECTIVENESS STUDY

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A cooperative project between the Orange County and San Bernardino County Regional Stormwater Management Programs.

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Executive Summary

This document proposes a study to evaluate the effectiveness of a group of selected Best Management Practices (BMPs) for controlling erosion during construction, as required by Section XII.A.8 of Order No.R8-2002-0010, NPDES permit No. CAS618030 (County of Orange, local jurisdictions, and special purpose districts), and Section XII.A.11 of Order No. R8-2002-0012, NPDES permit No. CAS618036 (the San Bernardino Flood Control District, the County of San Bernardino, and the Incorporated Cities of San Bernardino)issued by the Santa Ana Regional Water Quality Control Board. Based on the results of the proposed study, the Counties will identify one or more BMPs as preferred for erosion control during construction.

This proposal is the result of a collaborative effort by the two Principal Permittees to develop a common strategy for addressing erosion control at construction sites. By developing a joint proposal and study it is possible to develop a more cost effective, comprehensive assessment of the appropriate use of various erosion control measures than could be achieved by each county acting alone. Collaboration by the Counties to develop a common erosion control strategy will also result in better regional consistency for implementation of erosion control practices.

The proposed study includes an analysis of existing guidance documents and related published reports, and a field study of the performance of selected controls. The study will review previous guidance on the use of temporary erosion controls, such as the CASQA (California Stormwater Quality Association) BMP Handbooks, and published reports of erosion control performance. Objectives of this review are to refine the previous guidance so that it applies specifically to Orange and San Bernardino Counties and to reformat the material so that it is more useful for a construction person in the field, rather than being buried in an inaccessible technical report.

The selection of the BMPs for the field study was based on those most commonly used in the area, those recommended in the California BMP Handbooks, as well as promising emerging technologies, such as the use of polyacrylamides (PAM) for soil erosion control. The study proposal tentatively identifies and prioritizes five BMPs for the study; however, final selection will be made after consultation between the counties and area stakeholders.

An informal survey of erosion control practices among contractors in the study area identified bonded fiber matrix (BFM), hydraulic mulches, hydroseeding, erosion control blankets and blown / tackified straw as the most common measures implemented at construction sites. Within each category there are proprietary products supplied by a number of vendors; consequently, it is not necessarily enough to identify differences among these broad categories, but may require

distinctions among individual products within each class. For instance, hydraulic mulches differ by the type and characteristics of the mulch, the type of binder, and other special additives developed by each manufacturer of these products. Therefore, there are often substantial differences between the erosion control performance of hydraulic mulches from different suppliers.

Independent research on the effectiveness of erosion control products has been conducted at a variety of university and independent laboratories including San Diego State University (SDSU), Utah State University, and the Texas Transportation Institute (TTI) among others. TTI, which is located at Texas A&M University, is easily the largest tester of erosion control products among this group.

Testing conducted at SDSU and TTI answer many of the questions related to the relative performance of 14 types of blankets, matting, hydraulic mulches, and other products. The research performed by SDSU for Caltrans clearly differentiate the performance of various categories of material, while the focus at TTI is the testing of different proprietary products within the areas of hydraulic mulches and blankets / matting, with 105 products evaluated to date. The testing at both sites is accomplished using rainfall simulators; consequently, the results are not affected by environmental variables and comparison among the products is facilitated.

The data developed to date by SDSU and TTI indicates the relative performance of various erosion control products at slopes of 2:1 and 3:1 and at extremely high rainfall intensities (equal to the 10-year storm for evaluations at SDSU, and up to 7 in / hr at TTI). At these slopes and intensities, BFM and certain types of erosion control blankets are far superior to mulches and other soil treatments; however, under average rainfall intensities and lower slopes the differences in performance among the various types of products may not be nearly as large.

The more effective erosion control products (BFM and blankets) are generally much more expensive, however, and less expensive, but effective options are needed where conditions may not be as demanding (lower slope steepness, less intense rainfall, less erosive soil types). Consequently, an important data gap is information about the conditions (specifically the limiting conditions) under which each of the products provides adequate protection from soil erosion.

One shortcoming of the data collected at SDSU is that little information is gained about the life expectancy of any of the tested products. Testing of each product can occur in as little as a week, so little is known about the long-term performance or the effect of sunlight, wind and other environmental variables on product life. New testing protocols implemented at TTI are similar.

The recommended approach for the field study of erosion control materials is to pursue a qualitative assessment of their performance. A qualitative testing program would consist of determining the applicability of various products for use in the San Bernardino/Orange County area without trying to develop a numerical index of their performance. This program would be a field evaluation conducted in the area that used empirical observations to indicate whether a given control performed effectively in the installation observed. This, in essence, would be a more comprehensive and rigorous inspection program. The goal of the study would be to develop the data that would allow the each county to identify "County-preferred BMPs" for particular applications (i.e., slope, soil type, life, etc.).

As noted previously, an informal survey of erosion control practices among contractors in the area identified bonded fiber matrix, hydraulic mulches, hydroseeding, erosion control blankets and blown/tackified straw as the most common measures implemented at construction sites. A qualitative program would assess under what conditions (slopes, soil types, traffic level, etc.) that each of these products provide adequate water quality protection by performing site inspections over the course of one or more wet seasons and documenting the performance through photographs and narrative descriptions as appropriate.

The basic idea would be to select a certain number of active construction sites just before the wet season that represent a variety of slopes and soil types, or, select a field location where test plots could be constructed. At each of the sites, small areas would be delineated for observation and control measures installed. Over the course of the wet season, routine inspections would be performed at each of these sites to document amount of any observed erosion, cause of failure, relative plant density (if seeded), and other relevant factors. These observations would be recorded on standard forms and supplemented with photographs as necessary. Over the course of the wet season, changes in the performance among the sites would be documented.

The goal of the study would be to answer questions such as:

1. What is the effect of time and weathering on product condition?
2. How frequently must a product be applied to be effective?
3. What is the maximum slope under which a particular product will perform effectively?
4. How do the various soil types of the area affect the performance of each control?

The focus of this study will be on determining the limits of applicability, primarily based on duration of effectiveness and on slope and soil type, for some of the less expensive erosion

control measures. The following controls are proposed for field testing: two types of hydraulic mulches, hydroseeding, blown / tackified straw, and PAM, for a total of five types of erosion controls.

There are two main criteria for selection of candidate field test sites. The first is to identify sites that are typical in soil type to large portions of the study area. This will ensure that the study results obtained will be applicable to the largest possible area. The second objective is to find sites with slopes less than the 2:1 slopes used in the Caltrans study conducted by SDSU.

The experimental testing program will consist of empirical observations and photographic documentation of the performance of 5 erosion control measures installed on bare, clayey soil. All materials will be applied using the manufacturer's recommendations.

The test plot for each material will be approximately 40 feet by 100 feet, with an intervening area 10 feet wide to facilitate observation of the plots and prevent overlap of the treatments. These intervening areas will be covered by an erosion control blanket. Each type of control will be tested on an area with a slope of less than 5% and on a slope of between 10 and 20%. The sloping test plots will be oriented so that the long dimension is in the direction of the slope.

Each of the test plots will be observed over the course of a single wet season. Observations of the performance of each type of control will be made following every rain event that exceeds 0.25 inches. Documentation of the condition of each plot and a record of the location and mechanism of any failure will be recorded.

Major milestones for the project include:

November 15, 2003 – Submit study proposal to Santa Ana Regional board for approval of proposed BMP selected for evaluation

January 1, 2004 – Receive Regional Board Approval

February 1, 2004 – Begin technical evaluation of existing guidance manuals and published reports on erosion control use and effectiveness to adapt recommendations specifically to this study area

June 1, 2004 – Finalize selection of measures for field testing

August 15, 2004 – Begin site selection for field study

September 15, 2004 Begin preparation of experimental test plots

October 15, 2004 – Completion of application of erosion control measures to selected plots

October 15, 2004 – April 30, 2005 Monitor test installations

May 1, 2005 Begin preparation of final report

June 31, 2005 Final study report and revised erosion control guidance documents submitted to Orange and San Bernardino Counties

The permits issued by the Santa Ana Regional Board require only that the study be completed during the term of the permit; consequently, it is not necessary to complete the entire study in a single wet season. If sufficient viable sites are not identified for testing all of the proposed measures in a single season, then the study may continue for a second wet season, with the final study report submitted to the counties on June 31, 2006.

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E3-1.1 Background

The NPDES municipal stormwater permits for the County of Orange and local jurisdiction Co-Permittees (#R8-2002-0010, Section XII.A. 8) and the San Bernardino Flood Control District, the County of San Bernardino, and the Incorporated Cities of San Bernardino (R8-2002-0012, Section XII.A.11) issued by the Santa Ana Regional Water Quality Control Board require the development of a proposal for a study to evaluate the effectiveness of a group of selected BMPs for controlling erosion during construction. Based on the results of the proposed field study and literature review, the Counties will identify one or more BMPs as preferred for erosion control during construction and incorporate these in a guidance document for local contractors and construction inspectors. The control of erosion at construction sites is a critical component of stormwater management in this area.

This proposal is the result of a collaborative effort by the two permittees to develop a common strategy for addressing erosion control at construction sites. By developing a joint proposal and study it is possible to develop a more cost effective, comprehensive assessment of the appropriate use of various erosion control measures than could be achieved by each county acting alone. Collaboration by the Counties to develop a common erosion control strategy will also result in better regional consistency for implementation of erosion control practices.

E3-1.2 Study Objectives

This report develops a detailed study proposal to evaluate the effectiveness of a group of selected BMPs for controlling erosion during construction, review the performance of BMPs recommended for California, modify previous recommendations to reflect new information gained in a field evaluation, and to develop site specific guidance for contractors and construction inspectors in the two counties.

The literature review portion of the study will review previous guidance on the use of temporary erosion controls, such as the CASQA BMP Handbooks, and published reports of erosion control performance. Objectives of this review are to refine the previous guidance so that it applies specifically to Orange and San Bernardino Counties and to reformat the material so that it is more useful for a construction person in the field, rather than being buried in an inaccessible technical report.

The objective of the field evaluation is to answer questions such as:

1. What is the effect of time and weathering on product condition?
2. How frequently must a product be applied to be effective?
3. What is the maximum slope under which a particular product will perform effectively?
4. How do the various soil types of the area affect the performance of each control?

The selection of the BMPs for the field study was based on those most commonly used in the area, those recommended in the California BMP Handbooks, and those which are in promising emerging technologies, such as the use of polyacrylimides (PAM) for soil erosion control. The study proposal identifies and prioritizes five BMPs for the study.

The study proposal identifies:

- The study goals / objectives and approach and methodologies;
- Other related research underway for potential cooperative efforts;
- The selection process, types and quantities of the erosion control BMPs to be evaluated;
- The site selection procedures and development projects where the BMPs will be evaluated;
- The monitoring plan;
- The proposed schedule for the study;
- The cost of the study; and
- Opportunities for grant funding and / or cooperative study efforts with other agencies having similar requirements within a comparable time frame

The long-term objective of the study is to develop a list of preferred erosion control BMPs that are deemed to be cost-effective and appropriate for various site conditions.

E3-2 Basis for Study Design

E3-2.1 Identify Existing Practices

The two most basic categories of temporary control methods for construction-generated pollution are erosion and sediment controls. Erosion controls are used to prevent soil on the construction site from being mobilized and transported by stormwater runoff. Vegetative stabilization, slope coverings, and diversion of runoff away from exposed areas can effectively prevent erosion. Sediment controls may be considered as the second line of defense and include sedimentation ponds, silt fences, berms and other temporary barriers that temporarily

detain the runoff. Runoff velocities are reduced in these controls allowing sediment in the runoff to settle out. The focus of this study is exclusively on erosion control.

Common erosion control practices and their application are summarized in Table E3-1. These include a wide variety of practices including diverting runoff from exposed areas, soil coverings, and measures to preserve existing vegetation. Practices used to manage off site and mid-site runoff include interceptor swales, diversion dikes, pipe slope drains, outlet stabilization, level spreaders, and subsurface drains. These measures are used in site specific situations, rather than as a general approach to erosion control. These are not interchangeable, so their relative performance is not a selection criterion. Therefore these measures will not be evaluated in this study.

Table E3-1 Summary of Erosion Control Practices

Practice	Area	Application
Interceptor Swale	< 5 ac	Used as a perimeter control or to shorten slope
Diversion Dike	<10 ac	Used to route runoff away from disturbed areas
Pipe Slope Drain	<5 ac	Transport runoff down steep, erodible slopes
Outlet Stabilization	NA	Prevent erosion at outlet of channel or conduit
Level Spreader	Based on flow	Outlet device for dikes and diversions
Subsurface Drain	NA	Prevent soils from becoming saturated and prevent seeps
Tree Protection	NA	Erosion control and aesthetic benefits
Temporary Vegetation	NA	Temporary stabilization of disturbed areas
Blankets / Matting	NA	Used in channels and on steep slopes
Blown Straw	NA	Stabilization of bare areas
Hydraulic Mulch / Seeding	NA	Stabilization of newly seeded areas
Soil Binders	NA	Temporary stabilization where no foot or vehicle traffic
Sod	NA	Immediate stabilization in channels, around inlets, or for aesthetics

Several erosion control practices are related to vegetation: tree protection, temporary vegetation, and sodding. Trees are relatively uncommon in many undeveloped areas of San Bernardino / Orange County area and the mass grading approach used by most developers is not consistent with their protection. Sod is more appropriate for use as final stabilization because of its cost. Consequently these measures are not proposed for study.

There are numerous fiber mulches, soil stabilizers or combinations of materials that, when mixed with water in a hydraulic mulcher and applied to the soil surface, form three-dimensional matrices that help prevent erosion and foster the growth of plants. These materials range from simple mixtures of plant mucilage and paper mulch to precise combinations of engineered fibers and binders with complex chemical formulations.

Hydraulic mulch consists of applying a mixture of shredded wood fiber or a hydraulic matrix, and a stabilizing emulsion or tackifier with hydro-mulching equipment. This provides temporary protection of exposed soil from erosion by raindrop impact or wind. Hydraulic mulch is suitable for soil disturbed areas requiring temporary protection until permanent stabilization is established, and disturbed areas that will be re-disturbed following an extended period of inactivity. Wood fiber hydraulic mulches are generally short lived and need 24 hours to dry before rainfall occurs to be effective. They may require a second application in order to remain effective for an entire rainy season.

Blown / tackified straw mulch consists of placing a uniform layer of straw and incorporating it into the soil with a studded roller or anchoring it with a tackifier stabilizing emulsion. Straw mulch protects the soil surface from the impact of rain drops, preventing soil particles from becoming dislodged. Straw mulch is suitable for soil disturbed areas requiring temporary protection until permanent stabilization is established. Straw mulch is typically used for erosion control on disturbed areas until soils can be prepared for permanent vegetation. Straw mulch is also used in combination with temporary and / or permanent seeding strategies to enhance plant establishment.

Hydroseeding consists of applying a mixture of wood fiber, seed, fertilizer, and stabilizing emulsion with hydromulch equipment. This measure will potentially have the added benefit of vegetation establishment for better long-term erosion control. Hydroseeding is suitable for soil disturbed areas requiring temporary protection until permanent stabilization is established, and disturbed areas that will be re-disturbed following an extended period of inactivity.

Soil binders consist of applying and maintaining a soil stabilizer to exposed soil surfaces. Soil binders are materials applied to the soil surface to temporarily prevent water induced erosion of exposed soils on construction sites. Soil binders also prevent wind erosion. Polyacrylamide

(PAM) is a long chain polymer used as a type of soil binder that is typically applied to disturbed areas requiring short-term temporary protection. Because soil binders can often be incorporated into the work, they may be a good alternative to mulches in areas where grading activities will soon resume. One drawback of these materials is that they can not be used where there is foot or vehicular traffic. Testing of PAM for erosion control is rare; however, these polymers have been widely evaluated for use in agricultural applications.

A relatively new product category is the bonded fiber matrix (BFM). This material is a hydraulically applied erosion control composed of long strand fibers bound together by a high strength adhesive. Upon curing, the BFM adheres to the soil surface to form a continuous, porous and erosion resistant mat that does not inhibit the germination and growth of plants beneath and through the matrix.

Blankets and matting material are soil coverings that can be used as an aid to control erosion on critical sites during establishment period of protective vegetation. The most common uses are: in channels where designed flow exceeds 3.5 feet per second; on interceptor swales and diversion dikes when design flow exceeds 6 feet per second; on short, steep slopes where erosion hazard is high and planting is likely to be slow to establish adequate protective cover; and on tidal or stream banks where moving water is likely to wash out new vegetative plantings.

An informal survey of erosion control practices among contractors in the area identified bonded fiber matrix, hydraulic mulches, hydroseeding, erosion control blankets and blown/tackified straw as the most common measures implemented at construction sites. Within each category there are proprietary products supplied by a number of vendors; consequently, it is not necessarily enough to identify differences among these broad categories, but among individual products within each class. For instance, hydraulic mulches differ by the type and characteristics of the mulch, the type of binder, and other special additives developed by each manufacturer of these products. Therefore, there are often substantial differences between the erosion control performance of hydraulic mulches from different suppliers.

E3-2.2 Evaluate Previous Field and Laboratory Test Studies

Independent research has been conducted at a variety of university and independent laboratories including San Diego State University, Utah State University, and the Texas Transportation Institute (TTI) among others. TTI, which is located at Texas A&M University, is easily the largest tester of erosion control products among this group. The work of selected labs is described below.

San Diego State

The San Diego State University Soil Erosion Laboratory (SDSU/SERL) integrates beneficial features from some of the primary soil erosion research facilities in the United States. Funding for the facility was provided by Caltrans, (California State Department of Transportation) as part of a 1998-2000 erosion control pilot study, in which design, construction and operation of the SERL was supervised by URS Greiner Woodward Clyde and SDSU faculty. Actual modification of Industrial Technology Building Room #103 and construction of the soil test bed was carried out by the SDSU Physical Plant.

In designing the SDSU laboratory, members of the study team studied the physical layout, testing protocols, and past research activities of the following soil erosion laboratories:

- Utah Water Research Laboratory (UWRL) at Utah State University, Logan, Utah;
- USDA-Agricultural Research Service National Soil Erosion Research Laboratory

- (NSERL) at Purdue University, West Lafayette, Indiana; and Texas DOT/Texas Transportation Institute (TTI) Hydraulics and Erosion Control Laboratory at Texas A & M, College Station, Texas.

SDSU does not maintain a comprehensive list of products tested or their relative effectiveness. In general, results of the testing are supplied only to the manufacturers, who are the primary sponsors of the material evaluation. The goal of the manufacturers is to develop information to be used in their marketing campaigns.

SDSU has completed one comprehensive field and laboratory evaluation of many different products for the Caltrans study referred to previously (Caltrans, 2000). Rather than evaluate many competing products within a narrow type, the goal was to evaluate the performance of a broad range of controls. The laboratory evaluation consists of applying a simulated storm to a sloping channel where the erosion control measure has been installed.

The rainfall simulation device selected for the SDSU Soil Erosion Laboratory is the Norton Ladder Rainfall Simulator, which was developed at the USDA-ARS National Soil Erosion Research Laboratory by Dr. Darrell Norton. This apparatus has been used worldwide, is reasonably inexpensive, and is easily transported and operated. The Norton simulator is reliable and is documented as giving reproducible results. For testing in the indoor laboratory, multiple simulators (4) were installed in parallel above the soil test bed to uniformly apply precipitation over the entire test plot area.

The basic unit of the simulator is an aluminum frame 5.3 meters long, 0.32 meters wide, and 0.25 meters deep. Each frame is a self-contained unit, which includes nozzles, oscillating mechanism, drive motor, pump, float valve, piping, and sump. The drop former used for the Norton simulator is the Spraying Systems Veejet 80100 nozzle, and the nozzles are spaced 1.1 meters apart. For uniform intensity across the plot, the center of spray patterns from two laterally adjacent nozzles meet at the plot surface. This gives a 2.25 mm median drop size, a nozzle exit velocity of 6.8 m/s, and a spherical drop. The impact velocities of almost all drops from the Veejet nozzle are nearly equal to the impact velocities of those from natural rain storms when the nozzle is at least 2.4 meters above the soil surface.

The rainfall intensity applied in tests is equivalent to that of the 10-year storm for Los Angeles. The procedure consisted of applying simulated rainfall at a rate of 5 mm/hr for 30 minutes, followed by 40 mm/hr for 40 minutes, and concluding with an intensity of 5 mm/hr for 30 minutes. This sequence is applied in three successive tests.

The soil test bed is a 3-meter wide by 10-meter long (323 square feet) metal frame which rests on a series of pivots located at the lower end of the bed, and is supported by two hydraulic cylinders near the upper end of the bed. These telescopic cylinders extend to tilt the test bed from its horizontal position to a maximum 2H:1V slope gradient, which is the slope at which tests are conducted. The test bed is designed to support a 30.5-cm (1-foot) depth of soil. The depth of 30.5 cm is sufficient to allow placement and compaction of soil and the implementation of the various surface roughness practices to evaluate their effect on erosion rates. The soil type selected for use in the laboratory test program was clayey sand.

Water and soil runoff from the test bed is collected by plastic edging, flume, and collection containers. The components of the sediment collection system on the test bed are installed prior to each rainfall simulation. For most erosion control treatment evaluations, the plastic edging is installed prior to application of the erosion control treatment.

In order to obtain accurate results from the rainfall simulation/erosion rate evaluations, the municipal water supply is treated by reverse osmosis and softened to remove minerals. This treatment process produces “softer” water that is more similar in quality to natural rainfall. Using municipal water without treatment would cause a decrease in sediment load, because minerals in the water serve to decrease erosion.

Treated water is stored in a 1,000 gallon (3,785 liter) polyethylene storage tank for use in the laboratory simulations. For outdoor test plots, two 200 gallon (757 liter) tanks are truck or trailer-mounted to deliver treated water to the field for rainfall simulations.

This test setup was used to generate the data presented in Figure E3-1 and Figure E3-2. Figure E3-1 compares the relative effectiveness compared to bare soil for a number of erosion control measures evaluated in the Caltrans study. Bonded Fiber Matrix (BFM) and various erosion control blankets performed best at reducing the amount of erosion. The best performing materials almost completely eliminated all soil loss. Unfortunately, these material are fairly expensive, so they would normally only be used in more difficult settings. The least effective products in these tests included compost and various mulches.

Figure E3-2 compares the change in runoff volume relative to bare soil. In general, there is not a good correlation between reduction in runoff volume and prevention of erosion. The best performing product in this area was the coconut blanket, which reduced runoff compared to bare soil by approximately 90% and was one of the top performers for soil retention. It is noteworthy that a number of products, consisting mostly of mulches, increased the amount of runoff compared to the bare soil. This is likely the result of these products producing a water repellent surface that sheds water when protecting the underlying soils.

This testing conducted by SDSU evaluated only a few of the numerous individual products within each category. These other product formulations may perform quite differently than those tested. This variability in performance within a product category

Figure E3-1 Comparison of Erosion Control Effectiveness Compared to Bare Soil

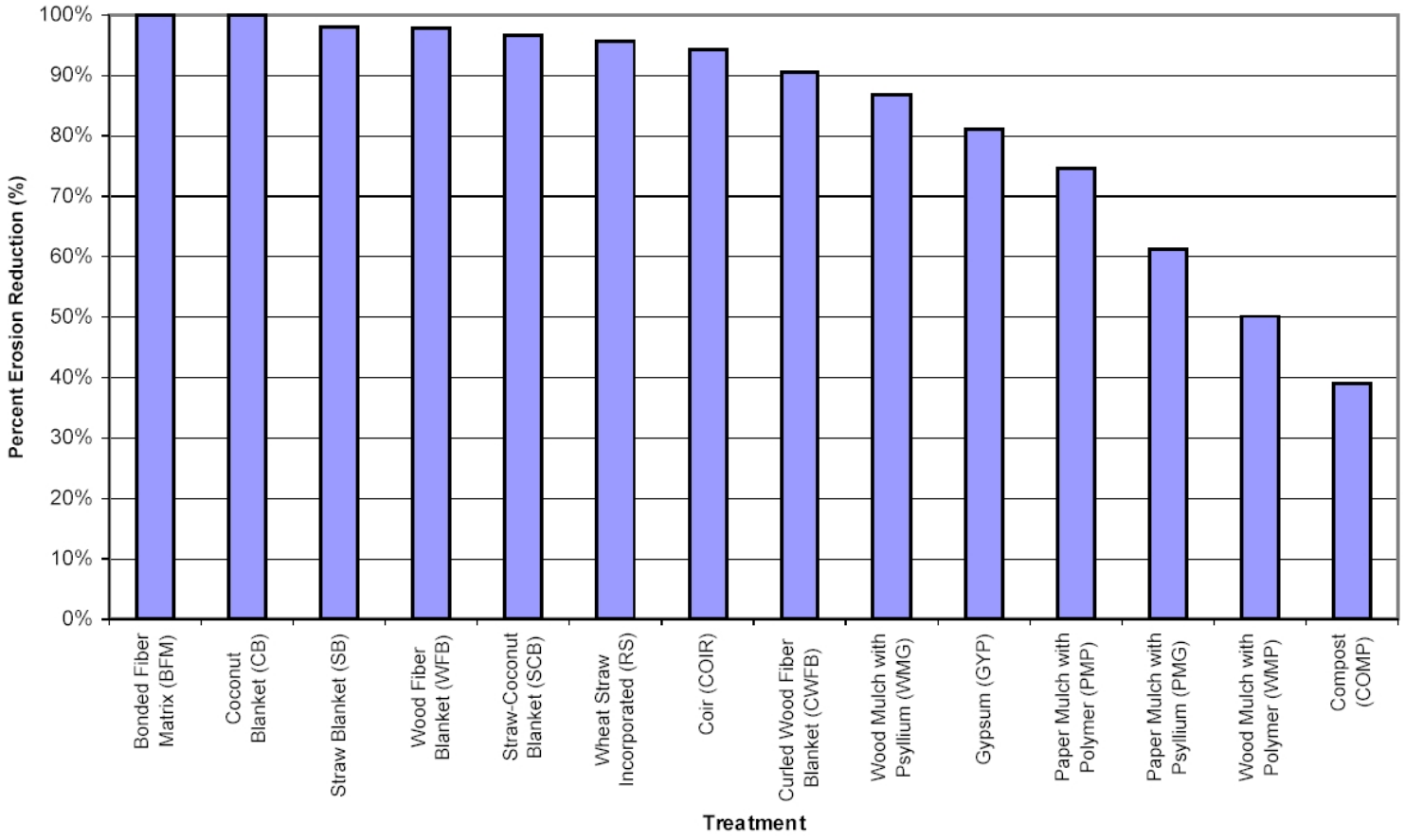
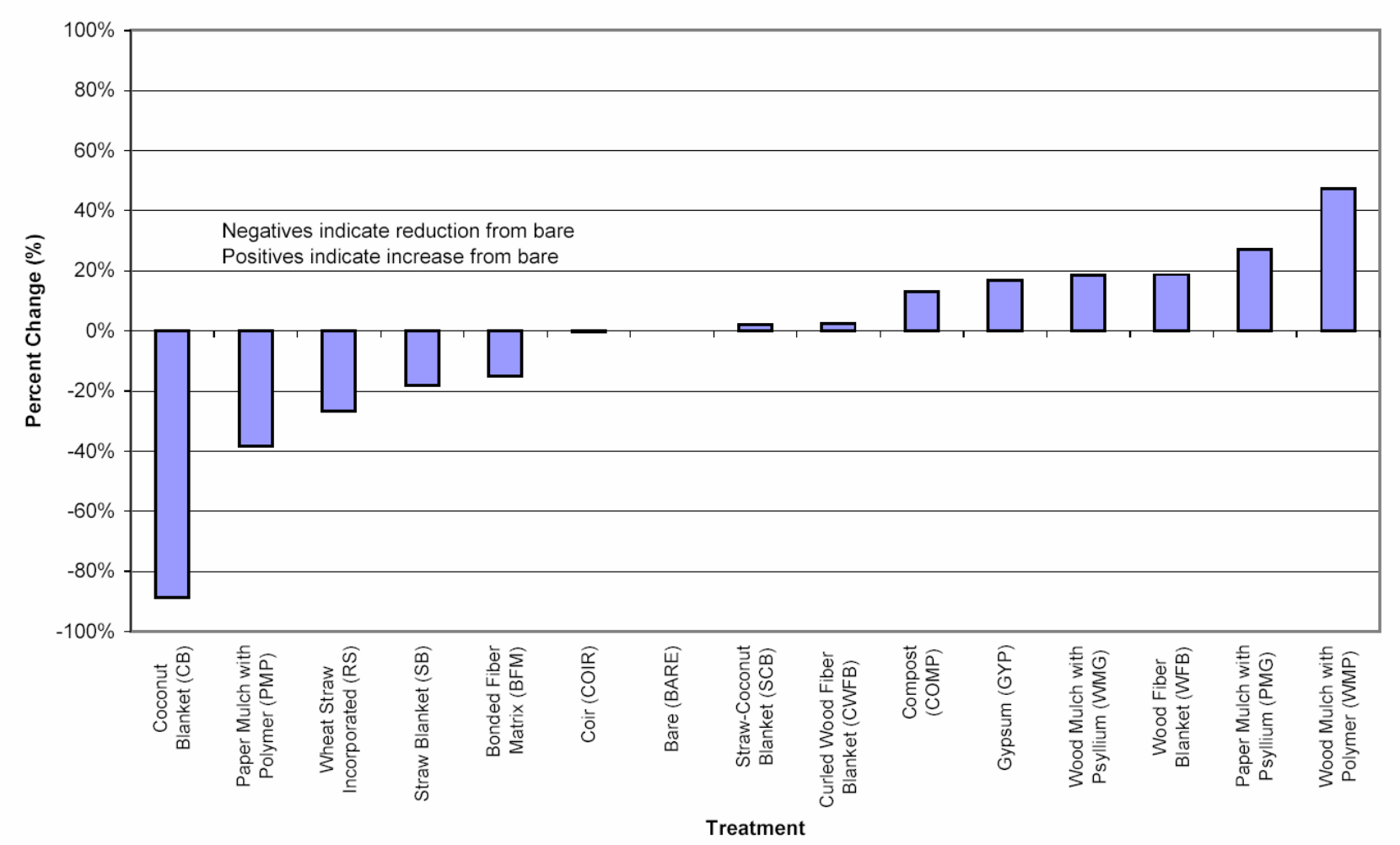


Figure E3-2 Comparison of Change in Runoff Volume Compared to Bare Soil



is evident in the data collected by TTI, which provides more definitive product-specific performance data.

Texas Transportation Institute

Since 1989, the TTI/TxDOT Hydraulics and Erosion Control Field Laboratory at the Texas Transportation Institute (TTI) proving grounds has provided erosion control research, data and performance information to the Texas Department of Transportation (TxDOT). TxDOT provides the principal funding for the project, and over 15 states and several international consulting firms use the data gathered.

The Hydraulics, Sedimentation, and Erosion Control Laboratory was originally constructed to faithfully represent the highway environment to the greatest degree possible, while providing the capability of collecting data on the critical performance factors of roll-type erosion control products and flexible channel liners. For ten years this facility provided side-by-side, full-scale performance comparisons of these materials used.

Until 2001, all testing of erosion control products at TTI were conducted in an outdoor facility. Although simulated rainfall was used during the testing, environmental variables especially variation in natural rainfall could influence the testing. A new facility has been constructed to meet the program objectives and a new testing protocol has been put in place. The facility includes a building with two runoff beds and rainfall simulator to evaluate soil protection products. An outdoor flume is used to evaluate channel liner products. Two greenhouses are used to establish vegetation in trays and flumes before and during the testing cycle on a year round basis. This facility is similar in many respects to that at SDSU even though the designs were developed independently.

Through the 2001 product testing cycle 105 proprietary erosion control products have been tested using a design rainfall event. TxDOT has defined the critical performance factors for the products, and has established minimum performance standards which must be met for any product seeking to be approved for use within any of TxDOT's construction or maintenance activities.

With respect to the rolled and spray on products being promoted by industry for slope protection and flexible channel liner protection, TxDOT adopted the following critical performance factors:

- How well the product protected the seedbed of an embankment or a drainage channel from the loss of sediment during simulated rainfall or channel flow events; and

- How well the product promoted the establishment of warm-season, perennial vegetation.

Furthermore, TxDOT recognized that the above rolled and spray-on products are promoted by industry within two general use classifications including:

- Products designed for overland flows associated with typical slope or embankment protection applications, and
- Products designed for concentrated water flows associated with typical highway drainage channels.

With respect to standard hydraulic mulches being promoted by industry for typical revegetation applications, TxDOT did not feel that products should be expected to provide the same degree of surface-protection benefits as could be achieved by the Class 1 products, and adopted the following single critical performance factor:

- How well the product promoted the establishment of warm-season, perennial vegetation.

By statistically analyzing the performance data produced through controlled, field-performance tests, TxDOT is able to maintain discrete minimum performance standard for each classification of product evaluated at the TxDOT / TTI Hydraulics and Erosion Control Laboratory (Lab). In order for a product to be placed upon TxDOT's Approved Product List, the product must meet (or exceed) all adopted minimum performance standards for that application. Failure to meet any of the adopted minimum performance standards will automatically reject the product from being placed on the list. Each of the products can be tested at 2:1 or 3:1 slopes with either sandy or clayey soils and each test consists of three repetitions of three, 10-minute storms in the range of 4 to 7 in / hr.

The maximum soil loss for approved products for each soil and slope combination is shown in Table E3-2 (John Mason, personal communication). Products must also allow vegetation to establish to the extent that 40% coverage is established within 90 days for clay soils and 10% coverage is obtained for sandy soils. As evident from the performance thresholds shown in Table E3-2, soil loss is much greater for sandy soils, which are less cohesive than clay soils. In addition soil loss for sandy soils is greater for steeper slopes, while there is little impact of slope on sediment loss for clay soils.

Table E3-2 TxDOT Performance Standards for Erosion Control Materials

Soil Type	Slope	Soil Loss (gm/10ft²)
Sand	3:1	363.42
Clay	3:1	7.95
Sand	2:1	857.94
Clay	2:1	7.90

A list of the products, a description of their formulation, and the results of the testing are shown in Appendix A. This appendix is a comprehensive source of definitive and comparative performance data for the products currently available.

Utah Water Research Laboratory (UWRL)

Erosion control products were frequently tested at the UWRL at Utah State University using UWRL's unique combination of rainfall and sunlight simulators, a variable slope test bed, a wind generator, and a high-velocity test flume to evaluate the effectiveness of a wide range of erosion control practices and products.

The rainfall simulator provided a range of from 1 to 31 inches of rain per hour, and the sunlight simulator provided the heat and light necessary for laboratory plant growth. To simulate the sloping of a hillside, UWRL used a slanting test bed while UWRL's wind generator tested the ability of tackifiers and staples to hold various products in place.

The test flume was used to evaluate products developed as liners for channels that are exposed to high-velocity water flows. Through these tests, materials were identified that can be successfully used in place of the more expensive rip rap and concrete lining which have been used traditionally in flood channels and storm drains. Most of the erosion control testing was directed by Earl Israelsen, who is now retired; consequently, there is no contemporary testing data and no summary comparison of previously tested products available.

E3-2.3 Identify Data Gaps and Define Pilot Study Scope

Guidance documents for the use of temporary erosion controls provide general recommendations about the potential use of many types of controls. These documents have normally been developed for use in large geographical areas where climate, soil type, and other factors vary greatly. Consequently, these guidance documents often lack enough detail on selection and deployment of erosion controls for their use in the field at actual construction

sites. Therefore, there is a need for erosion control guidance developed specifically for Orange and San Bernardino Counties.

Field testing conducted at SDSU and TTI answer many of the questions related to the relative performance of 14 types of blankets, matting, hydraulic mulches, and other products. The research performed by SDSU for Caltrans clearly differentiate the performance of various categories of material, while the focus at TTI is the testing of different proprietary products within the areas of hydraulic mulches and blankets / matting, with 105 products evaluated to date. The testing at both sites is accomplished using rainfall simulators; consequently, the results are not affected by environmental variables and comparison among the products is facilitated.

The data developed to date by SDSU and TTI indicates the relative performance of various erosion control products at slopes of 2:1 and 3:1 and at extremely high rainfall intensities (equal to the 10-year storm for evaluations at SDSU, and up to 7 in / hr at TTI). At these slopes and intensities, BFM and certain types of erosion control blankets are far superior to mulches and other soil treatments; however, under average rainfall intensities and lower slopes the differences in performance among the various types of products may not be nearly as large.

The more effective erosion control products (BFM and blankets) are generally much more expensive, however, and less expensive options are needed where conditions may not be as demanding (lower slope steepness, average rainfall, less erosive soil types). Consequently, an important data gap is information about the conditions (specifically the limiting conditions) under which each of the products provides adequate protection from soil erosion.

One shortcoming of the data collected at SDSU is that little information is gained about the life expectancy of any of the tested products. Testing of each product can occur in as little as a week, so little is known about the long-term performance or the effect of sunlight, wind and other environmental variables on product life. New testing protocols implemented at TTI are similar.

The performance data collected to date is not very suitable for indexing BMP performance to the lower range of slope and soil types, which could lead to more erosion control applications through more cost-efficient designation of effective measures corresponding to site needs. A clearer understanding of boundary conditions for use of expensive versus less expensive products would promote better understanding by public jurisdiction authorities and developers, more cost-efficient erosion control decisions, and greater cooperation of the development community with local regulators.

There are two fundamentally different strategies that the counties could take in terms of developing additional information relative to the performance of erosion controls and their applicability for use on construction products in the County: quantitative or qualitative.

E3-2.3.1 Quantitative Testing

Quantitative testing would involve developing numerical assessments in terms of pounds/acre of soil loss for each product selected to be tested. This would allow a direct comparison with all the products previously evaluated at SDSU and TTI.

Quantitative testing of erosion control products in the field would be relatively expensive ($400,000) and likely lead to results that are not directly comparable to any previous work. For instance, quantitative testing conducted during a wet season with low rainfall would be expected to result in less soil loss for a given product than one conducted during a wet season with high rainfall. For this reason, it would not be possible to compare the quantitative results from tests conducted in different years. Therefore, any quantitative testing should be performed in the laboratory by either of the existing testing facilities using established protocols. At the current time, TTI has a waiting list of products to be evaluated, so any testing of this type would need to occur at SDSU. A major advantage of this strategy is the relatively low cost associated with a laboratory evaluation ($85,000). One shortcoming of additional laboratory work is that the question of product life would not be answered because the control would not be exposed to the elements and the test would be conducted over such a short time frame.

Another consideration in defining the pilot study scope is how the data will be used. The Santa Ana permit (2002) requires that the county use the study results to identify County recommended erosion controls. Should the County elect to perform quantitative tests on four different proprietary hydraulic mulches, then the County would be forced to identify a particular sole source product as recommended for use on construction sites, in effect endorsing a proprietary product.

The Counties could elect to evaluate a range of types of erosion control products; however, all of the popular options for the area, except for PAM, were tested previously by Caltrans at SDSU.

E3-2.3.2 Qualitative Testing

A qualitative testing program would consist of determining the applicability of various products for use in Orange and San Bernardino Counties without trying to develop a numerical index of their performance. This program would be a longer term, field evaluation that used

empirical observations to indicate whether a given control performed effectively in the installation observed. This, in essence, would be a more comprehensive and rigorous inspection program. The goal of the study would be to develop the data that would allow the County to identify "County-preferred BMPs" for particular applications (i.e., slope, soil type, life, etc.).

As noted previously, an informal survey of erosion control practices among contractors in the area identified bonded fiber matrix, hydraulic mulches, hydroseeding, erosion control blankets and blown/tackified straw as the most common measures implemented at construction sites. A qualitative program would assess under what conditions (slopes, soil types, traffic level, etc.) that each of these products provide adequate water quality protection by performing site inspections over the course of one or more wet seasons and documenting the performance through photographs and narrative descriptions as appropriate. The cost for this type of evaluation would likely be similar to that of a laboratory evaluation ($80,000).

The basic idea would be to select a certain number of active construction sites just before the wet season that represent a variety of slopes and soil types, or, select a field location (possibly County owned land) where test plots could be constructed. At each of the sites, small areas would be delineated for observation and control measures installed. Over the course of the wet season, routine inspections would be performed at each of these sites to document amount of any observed erosion, cause of failure, relative plant density (if seeded), and other relevant factors. These observations would be recorded on standard forms and supplemented with photographs as necessary. Over the course of the wet season, changes in the performance among the sites would be documented.

The goal of the study would be to answer questions such as:

1. What is the effect of time and weathering on product condition?
2. How frequently must a product be applied to be effective?
3. What is the maximum slope under which a particular product will perform effectively?
4. How do the various soil types in the area affect the performance of each control?

E3-2.3.3 Recommendations

The Counties should begin a technical evaluation of the existing data and guidance manuals to develop information specifically for the study area. This evaluation would consist of an in-depth analysis of the CASQA BMP Handbooks as well as recently published reports on erosion control performance and applicability. In addition, conditions that strongly affect the performance of erosion control such as soil type, slope, and rainfall characteristics should be

assessed for the two counties to determine whether separate documents for each county should be developed. This information on the proper use of erosion controls should be distilled into supplemental fact sheets to guide the implementation of erosion controls in the two counties.

The recommended option for the field evaluation is to pursue a qualitative approach for assessing the performance of erosion control materials. Quantitative testing at SDSU and TTI has already been performed on a large segment of the controls now available, but these data are not sufficient to instruct the potential user in how, where and when each of the types of controls should be deployed. In addition, a large amount of data is currently available on the performance of appropriate (more expensive) erosion controls for steeper slope conditions.

The qualitative approach conducted in the field, at active construction sites in the area, will develop unique information about the use and maintenance of the most commonly used controls, which will be specific to the climate, soils, and other conditions in the area. Although one could conduct quantitative field testing, the additional cost (4 to 5 times the cost of the proposed option) would not be justified.

Once the field evaluation has been completed a new guidance document for this area will be developed. This guidance will incorporate the results of the field testing program and a modification of existing erosion control manuals to specifically address those conditions commonly encountered in Orange and San Bernardino Counties.

E3-3 Field Study

E3-3.1 BMP Selection

It is the intent of this study to select BMPs for evaluation that are among those recommended in the California BMP Handbooks, promising emerging technologies, such as the use of polyacrylamides (PAM), as well as those most commonly used in the two counties for soil erosion control. Several types of erosion control measures are proposed below for evaluation in the field study. Final selection of the measures will occur during Spring 2004 after consultation between the counties and with input from environmental groups, contractors, and other area stakeholders.

The California BMP Handbooks scheduled for release in April 2003 recommend the following erosion control technologies:

- Hydraulic mulch
- Hydroseeding
- Soil binders
- Straw mulch
- Geotextiles and mats
- Wood mulching
- Polyacrylamide (PAM)

An informal survey of erosion control practices among contractors in the local area identified bonded fiber matrix, hydraulic mulches, hydroseeding, erosion control blankets and blown / tackified straw as the most common measures implemented at construction sites. Within each category there are proprietary products supplied by a number of vendors; consequently, there are differences not only among these broad categories, but among individual products within each class.

Previous testing conducted at SDSU indicated that geotextiles and mats, and bonded fiber matrix (a type of hydraulic mulch) are highly effective even for relatively steep slopes (50%) and high rainfall intensities (10 year storm). Unfortunately, these measures are quite expensive compared to some of the alternative products. For instance, the average cost for installation of wood fiber mulch is $900 / acre while that of bonded fiber matrix is $5,500 / acre.

One would expect that some of the measures that performed poorly under extremely adverse conditions may provide substantial benefit when installed in less demanding applications. In addition, there are many cases where erosion control is only required for a very short period between earth disturbing activities on a given site. Consequently, the focus of this study will be on determining the limits of applicability, primarily based duration of effectiveness and on slope and soil type, for some of the less expensive measures such as hydraulic mulches.

Based on these requirements, the following controls are tentatively proposed for field testing: two types of hydraulic mulches, hydroseeding, blown/tackified straw, and PAM, for a total of five types of erosion controls. For this study, the proposed hydraulic mulches would consist of one wood and one paper based mulch applied using a polymer or psyllium tackifier. The specific PAM copolymer formulation specified for this testing will be anionic. Only the highest drinking water grade PAM, certified for compliance with ANSI/NSF Standard 60 for drinking water treatment, will be used for soil applications in this study.

E3-3.2 Site Selection

There are two main criteria for selection of candidate field test sites. The first is to identify sites that are typical in soil type to large portions of the two counties. This will ensure that the study results obtained any will be applicable to the largest possible area. The second objective is to find sites that with slopes less than the 2:1 slopes used in the Caltrans study conducted by SDSU.

Both counties have a wide variety of soil types with sandy soils prevalent in the lowland areas, especially in the area north of the current channel of the Santa Ana River in Orange County, and in alluvial fans. Clayey soils are more prevalent in the hills and upland areas. The lowland, valley areas are more highly developed and consequently less construction activity is occurring in these areas. The main areas of large tract residential development are now occurring in the uplands, such as the new Shady Canyon development by The Irvine Company. Consequently, an important study objective will be to assess the performance of erosion controls for clayey soils. Testing in the foothill areas would have the additional benefit of increased frequency and amounts of precipitation relative to lowland areas.

The previous studies conducted at SDSU in their erosion control laboratory used a 2H:1V slope (50%), which is much higher than that occurring in many portions of new developments. The goals of this study would be to assess erosion control performance under these two conditions: fairly flat areas, slope less than 5%, which would represent finished pads for future construction, and moderately sloping areas with slopes of between 10 and 20% (10:1 to 5:1).

Actual test plots would be identified in late summer or early to fall, prior to the beginning of the wet season when testing would be conducted.

E3-3.3 Sampling and Analysis Plan

E3-3.3.1 Experimental Testing Program

The experimental testing program will consist of empirical observations and photographic documentation of the performance of 5 erosion control measures installed on bare, clayey soil. The tentatively proposed measures consist of a paper and wood mulch applied with a tackifier, hydroseeding, blown/tackified straw, and PAM. These measures will be applied using the manufacturer's recommendations.

The test plot for each material will be approximately 40 feet by 100 feet, with an intervening area 10 feet wide to facilitate observation of the plots and prevent overlap of the treatments. These intervening areas will be covered by an erosion control blanket. Each type of control will be tested on an area with a slope of less than 5% and on a slope of between 10 and 20%. The sloping test plots will be oriented so that the long dimension is in the direction of the slope.

Each of the test plots will be observed over the course of a single wet season. Observations of the performance of each type of control will be made following every rain event that exceeds 0.25 inches and at approximately the first of each month, which will allow observation of the effects of wind and sun weathering during longer intervals without precipitation. Documentation of the condition of each plot and a record of the location and mechanism of any failure will be recorded. This documentation will provide discerning information regarding performance difference between different slope conditions and erosion control measures. A sample form to be used to document the observations is provided in Figure E3-3.

E3-3.3.2 Test Plot Requirements

Sufficient area would be needed at any proposed site so that each tested group of controls could be installed adjacent to each other and consequently have the same exposure, slope, and soil type. Each test plot would have dimensions of approximately 40 feet by 100 feet. This would be large enough to apply the erosion control treatment using standard procedures. To test all five proposed treatments each of the flat (<5%) and sloping areas (10-20%) would need to be about one half acre for a total experimental area of about one acre. Each erosion control test plot would be separated by about 10 feet to facilitate observation of the performance without walking directly on the test plot. The plots located on slopes must be located at the top of the slope to prevent failure of erosion controls located higher on the slope or of concentrated flow from affecting the test results.

Figure E3-3 Example Empirical Observation Form

Counties of Orange and San Bernardino
Erosion Control Testing Program
Empirical Observations Field Data Log Sheet

GENERAL INFORMATION:

Date:	Time In:	Time Out:

Team Leader's Name:

Location of Facility:

Erosion Control Type:

Purpose of Visit: ☐ Post Storm Event Inspection ☐ Monthly Inspection

Time Since Measure Installed (days):

Photographic File Names:

RAINFALL SINCE LAST INSPECTION:

Rainfall Volume (mm):

Maximum Rainfall Intensity (mm/hr):

Rainfall Duration (hr):

OBSERVATIONS:

Evidence of Rills: ☐ No ☐ Yes

If yes, describe number, length, depth , and width: _____

_____

_____

Weathering of Control: ☐ Like New ☐ Light Weathered Appearance ☐ Heavily Weathered ☐ None Remaining

Comments: _____

Percent Coverage Intact:

Movement of Sediment off Test Plot: ☐ No ☐ Yes

If yes, describe volume: _____

Does Erosion Control need to be reapplied? ☐ No ☐ Yes

Vegetation on test plot: ☐ No ☐ Yes

If yes, description: _____

Comments:

_____

_____
(Team Leader's Signature)

The soil type for the plots will consist of Hydrological Soil Group C and D. These soils are typical of the upland areas within the area and are prevalent in many areas where new residential construction is occurring.

E3-3.3.3 Maintenance of Test Plots

No maintenance of the test plots will occur during the study period. Goals of the study are to assess the duration that each of the products remains effective and to establish the mode and mechanism of failure. If failure occurs in a small area of the plot then that area will be observed during subsequent inspections to determine the extent and speed with which that failure expands over the treated area.

In the case of catastrophic failure of the erosion control measure, the evaluation of that particular measure will be terminated and a more effective material installed on the plot to prevent substantial and continuing soil loss from the test area.

E3-3.3.4 Rainfall Measurements

A tipping bucket type rain gauge and recorder will be installed in the vicinity of the test plots. This gauge will record continuously for the duration of the wet season. Both cumulative and individual storm depths will be recorded. For each event the maximum intensity over a 5 minute interval will be noted. Expected life of each type of erosion control material can then be related both to the time and cumulative rainfall since installation.

E3-3.3.5 Study Expectations

The final study report will document findings and observations of the erosion testing program. The data will be presented in a series of figures or tables as appropriate to illustrate the impact of time and cumulative rainfall depth on the condition and performance of the selected controls. Photo documentation will support these findings by providing graphic evidence of the condition of all the tested materials.

An important component of this report will be recommendations for erosion control measures for the flatter slope conditions evaluated. These recommendations will include guidance on:

- Maximum slope under which each product proved effective
- Frequency that the product will have to be reapplied to maintain effectiveness

E3-4 Development of Erosion Control Guidance Manual

As a result of the field study and technical evaluation of existing manuals and published reports, a detailed guidance manual will be developed for Orange and San Bernardino Counties. The information on the appropriate use, expected life span, performance, cost, and other factors will be summarized in fact sheets to facilitate the proper use of these measures by area contractors and other field personnel. To the extent that site conditions might vary substantially between the two counties, the guidance and fact sheets will be modified to reflect these variations.

E3-6 Study Schedule

The anticipated study schedule by major task is shown on the attached Microsoft Project graphic. Major milestones for the project include:

November 15, 2003 – Submit study proposal to Santa Ana Regional board for approval of proposed BMP selected for evaluation

January 1, 2004 – Receive Regional Board Approval

February 1, 2004 – Begin technical evaluation of existing guidance manuals and published reports on erosion control use and effectiveness to adapt recommendations specifically to this study area

June 1, 2004 – Finalize selection of measures for field testing

August 15, 2004 – Begin site selection for field study

September 15, 2004 Begin preparation of experimental test plots

October 15, 2004 – Completion of application of erosion control measures to selected plots

October 15, 2004 – April 30, 2005 Monitor test installations

May 1, 2005 Begin preparation of final report

June 31, 2005 Final study report and revised erosion control guidance documents submitted to Orange and San Bernardino Counties

The permit issued by the Santa Ana Regional Board requires only that the study be completed during the term of the permit; consequently, it is not necessary to complete the entire study in a single wet season. If sufficient viable sites are not identified for testing all of the proposed measures in a single season, then the study may continue for a second wet season, with the final study report submitted on June 31, 2006.

E3-7 Cost Containment

Evaluation of various erosion control measures represents a substantial financial commitment for the two counties, but generates data that would be useful for a number of other parties, including other agencies required to undertake similar studies, regulatory agencies, and manufacturers of these products. Consequently, the counties may wish to solicit funds from these other stakeholders to reduce the county contribution to overall study cost.

E3-7.1 Grant Funding

Grant funding is a traditional source of support for measures to reduce the impact of stormwater runoff on the environment. These funds are available on a state and federal level.

Water Quality Cooperative Agreements

Under authority of Section 104(b)(3) of the Clean Water Act, EPA makes grants to state water pollution control agencies, interstate agencies, and other nonprofit institutions, organizations, and individuals to promote the coordination of environmentally beneficial activities. These activities include storm water control, sludge management, and pretreatment.

Among efforts eligible for funding under the Section 104(b)(3) program are research, investigations, experiments, training, environmental technology demonstrations, surveys, and studies related to the causes, effects, extent, and prevention of pollution.

EPA's Regional Offices select grant proposals that are most likely to advance the states' and EPA's ability to deal with water pollution problems. EPA also manages grants that address concerns of a national scope. Section 104(b)(3) grants may not be used to fund ongoing programs or administrative activity.

The EPA received more than 430 Initial Proposals in response to their October 31, 2002, *Federal Register* Notice, so this is a very competitive program. Additional information at: http://www.epa.gov/owm/cwfinance/waterquality.htm

319(h) Funds

Clean Water Act Section 319(h) funds are provided only to designated state and tribal agencies to implement their approved nonpoint source management programs. State and tribal nonpoint source programs include a variety of components, including technical assistance, financial assistance, education, training, technology transfer, demonstration projects, and regulatory

programs. Each year, EPA awards Section 319(h) funds to states in accordance with a state-by-state allocation formula that EPA has developed in consultation with the states.

In accordance with guidance issued by EPA under Section 319 of the Clean Water Act, Section 319(h) funding decisions are made by the states. States submit their proposed funding plans to EPA. If a state's funding plan is consistent with grant eligibility requirements and procedures, EPA then awards the funds to the state.

In California the State coordinators responsible for allocating these funds to specific projects are:

Syed Ali
State Water Resources Control Board
Water Pollution Prevention Section
1001 I Street
Sacramento, CA 95814
Phone: (916) 341-5555
Fax: 916 341-5252
alis@dwq.swrcb.ca.gov

Bill Campbell
State Water Resources Control Board
Watershed Project Support Section
1001 I Street
Sacramento, CA 95814
Phone: (916) 341-3849
Fax: 916 341-5463
campb@dwq.swrcb.ca.gov

California normally solicits projects for funding in the spring with the deadline for applications occurring in early summer. Information on the requirements and goals of the program are available in last year's request for proposals, which is available at: http://www.swrcb.ca.gov/nps/docs/cwarfp/319rfpfyy2003funds.doc. Unfortunately, in many cases these funds may not be available to projects required in NPDES permits.

E3-7.2 Contributions from Manufacturers

Historically, the manufacturers of erosion control products have been one of the major sources of funds for their evaluation. All the studies performed at TTI and those at SDSU except the Caltrans study and have been paid for in part by the manufacturers. They have had little option in Texas, since successful evaluation at TTI is required before any of these products can be used

on highway construction projects. In addition, many other DOTs use the TxDOT approved products list in their states.

Where approval is not required for use, manufacturers have not been as willing to contribute funds, even though the results could be used for promotional purposes. Manufacturers may want to approve the testing protocol, data analysis or other parts of the study to ensure that the evaluation of their product is likely to be successful. Once candidate products in each category are selected for testing, the manufacturers can be contacted to determine if they would be willing to contribute to the cost of the study.

E3-8 References

California Regional Water Quality Control Board Santa Ana Region, Order No. R8-2002-0010, NPDES No. CAS618030.

Caltrans, 2000. *District 7 Erosion Control Pilot Study,* Report CTSW-RT-00-012, California Department of Transportation, Sacramento, CA.

Mason, John, 2003. Personnel Communication, Texas Department of Transportation, Maintenance Division – Vegetation Management Section.

TTI, 2001. *Field Performance Testing of Selected Erosion Control Products Final Performance Analysis through the 2001 Evaluation Cycle*, (http://www.dot.state.tx.us/insdtdot/orgchart/cmd/erosion/contents.htm) Texas A&M University.

Attachment A:
Erosion Control Materials Tested at
Texas Transportation Institute

	Brand Name	Manufacturer or Distributor	Tested As	Private Label Names
1	Agri-Fiber [99]	Greenstone Industries, 3264 Villa Lane, Napa, CA 94558; 707-256-0715	Mulch	None
2	Airtrol®	U.S. Gypsum Co., 700 North Highway 45, Libertyville, IL 60048-1296; (708)970-5138	Slope	None
3	Airtrol® Plus	U.S. Gypsum Co., 700 North Highway 45, Libertyville, IL 60048-1296; (708)970-5138	Slope	None
4	American Fiber Mulch	American Fiber Manufacturing Inc., 1701 Bench Mark Drive, Austin, TX 78728; (512)251-3401	Mulch	None
5	American Fiber Mulch (with Fiber-Plus)	American Fiber Manufacturing Inc., 1701 Bench Mark Drive, Austin, TX 78728; (512)251-3401	Mulch	None
6	American Fiber Mulch (with Hydro-Stik)	American Fiber Manufacturing Inc., 1701 Bench Mark Drive, Austin, TX 78728; (512)251-3401	Mulch	None
7	Anti-Wash®/Geojute®	Belton Industries, Inc., 8613 Roswell Road, Atlanta, GA, 30350; (800)225-4099	Slope	Soil Saver
8	BioD-Mat™ 90	RoLanka International, Inc., 6476 Mill Court, Morrow, GA 30260; (800)760-3215	Channel	None
9	BioD-Mesh™ 60	RoLanka International, Inc., 6476 Mill Court, Morrow, GA 30260; (800)760-3215	Slope	None
10	Conwed 3000 Bonded Fiber Matrix [99]	Conwed Fibers, 1002 Buck's Industrial Dr., Statesville, NC 28677; 303-933-7770	Slope	None
11	Conwed® Hydro	Conwed Fibers, 1st Plaza, Suite 350, 1985	Mulch	None

	Brand Name	Manufacturer or Distributor	Tested As	Private Label Names
	Mulch®	Tabe Blvd., SE, Hickory, NC 28601; (704)327-6670		
12	Curlex® I	American Excelsior Company, 900 Avenue H East, PO Box 5624, Arlington, TX 76011; (800) 777-2691	Slope	None
13	Curlex® II (Double Sided)	American Excelsior Company, 900 Avenue H East, PO Box 5624, Arlington, TX 76011; (800) 777-2691	Channel	None
14	Curlex® II (Stitched)	American Excelsior Company, 900 Avenue H East, PO Box 5624, Arlington, TX 76011, (800) 777-2691	Channel	None
15	Curlex® III (Stitched)	American Excelsior Company, 900 Avenue H East, PO Box 5624, Arlington, TX 76011; (800) 777-2691	Channel	None
16	Curlex® Channel Enforcer I	American Excelsior Company, 900 Avenue H East, PO Box 5624, Arlington, TX 76011; (800) 777-2691	Channel	None
17	Curlex®-LT	American Excelsior Company, 900 Avenue H East, PO Box 5624, Arlington, TX 76011; (800) 777-2691	Channel	None
18	EarthBound [99]	Earth Chem, Inc., PO Box 272627, Fort Collins, -CO 80527; 1-800-764-5726	Slope	None
19	Earth-Lock	Erosion Control Systems, Inc., 1800 McFarland Blvd., Suite 180, Tuscaloosa,	Channel	1. Enkamat® Earthlock

	Brand Name	Manufacturer or Distributor	Tested As	Private Label Names
		AL 35406; (800)943-1986		
20	Earth-Lock II	Erosion Control Systems, Inc., 9015 Energy Lane, Northport, AL 35476; 205-333-3080	Channel	None
21	EcoAegis™	Canadian Forest Products, Panel and Fibre Division, 430 Canfor Avenue, New Westminister, B.C., Canada V3L 5G2 (800)363-8873	Slope	None
22	Econo-Jute [99]	Belton Industries, 8613 Roswell Rd., Atlanta, GA 30350; 1-800-225-4099	Slope	None
23	ECS High Impact Excelsior	Erosion Control Systems, Inc., 9015 Energy Lane, Northport, AL 35476-6542; (800)942-1986	Channel	None
24	ECS High Velocity Straw Mat	Erosion Control Systems, Inc., 9015 Energy Lane, Northport, AL 35476-6542; (800)942-1986	Slope	None
25	ECS Standard Excelsior	Erosion Control Systems, Inc., 9015 Energy Lane, Northport, AL 35476-6542; (800)942-1986	Slope Channel	None
26	ECS Standard Straw	Erosion Control Systems, Inc., 9015 Energy Lane, Northport, AL 35476-6542; (800)942-1986	Slope	None
27	Enkamat Composite 30 [99]	Colbond Geosynthetics, PO Box 1057, Enka, NC 28728; 828-665-5023	Channel	None
28	Enkamat Composite NPK	Colbond Geosynthetics, PO Box 1057, Enka	Channel	None

	Brand Name	Manufacturer or Distributor	Tested As	Private Label Names
		NC 28728, (828)665-5023		
29	Enkamat® 7018	AKZO / NOBEL, PO Box 7249, Asheville, NC 28802; (704)665-5050	Channel	None
30	Enkamat® 7020	AKZO / NOBEL, PO Box 7249, Asheville, NC 28802; (704)665-5050	Channel	None
31	Enviro-Gro	Southwest Environmental Services, Inc., PO Box 134, Tyler, TX 75710; (903)531-2312	Mulch	None
32	EnviroGuard Plus [98][99]	Tascon, Inc., PO Box 41846, Houston, TX 77241; (800)937-1774	Slope	None
33	Evercycle™ Hydro-Mulch	Evergreen Global Resources, Inc., P.O. Box 130189, Tyler, TX 75713;	Mulch	None
34	Excel® Fibermulch II with Exac-Tac™	American Excelsior Company, 900 Avenue H East, PO Box 5624, Arlington, TX 76011; (800) 777-2691	Mulch	None
35	FORMULA 480 Liquid Clay	Enviro Group, Inc., 290 Noble Street, Suite A, Greenwood, IN 46142; (317)882-9369	Slope	None
36	Futerra®	Conwed Fibers, 1002 Bucks Industrial Park, Statesville, NC 28677; (704)871-8500	Slope	None
37	GEOCOIR® / DeKoWe® 700	Belton Industries, Inc., 8613 Roswell Rd., Atlanta, GA, 30350; (800)225-4099	Slope	None
38	Geogro	US Gypsum Corporation, 700 North Highway 45, Libertyville, IL 60048; (847)970-5138	Slope	None
39	Geojute® Plus	Belton Industries, Inc., 8613 Roswell Rd.,	Slope	None

	Brand Name	Manufacturer or Distributor	Tested As	Private Label Names
		Atlanta, GA, 30350; (800)225-4099		
40	Geojute® Plus 1	Belton Industries, Inc., 8613 Roswell Rd., Atlanta, GA, 30350; (800)225-4099	Slope	None
41	Geojute® Plus Regular High Velocity	Belton Industries, Inc., 8613 Roswell Rd., Atlanta, GA, 30350; (800)225-4099	Slope	None
42	Grass Mat	Kenaf Marketing, Inc., 11690 Indian Hill Rd., Amarillo, TX 79124-2374; (806)353-7265	Channel Slope	None
43	Greenfix CFO72RP	Greenfix America, 604 East Mead Rd., Brawley, CA 92227; 760-348-7600	Channel	1. Enkamat Composite P/T
44	Greenfix CF072RR	Greenfix America, 604 East Mead Rd., Brawley, CA 92227, 760-348-7600	Channel	None
45	Greenfix WSO72 [99]	Greenfix America, 604 East Mead Rd., Brawley, CA 92227; 760-344-6700	Slope	None
46	GREENSTREAK® PEC-MAT™	Greenstreak, Inc., 3400 Tree Court Ind. Blvd., St. Louis, MO 63122; (800)325-9504	Slope Channel	None
47	K-MAT	Oklahoma Wood Fibers, 3 NW Texas Street, Idabel, OK (580)286-4363	Slope	None
48	Koirmat™ 400	Nedia Enterprises, 89-66 217th St., Jamaica, NY 11427; (718)740-5171	Channel	None
49	KoirMat™ 700	Nedia Enterprises, 89-66 217th St., Jamaica, NY 11427; (718)740-5171	Channel	None
50	KoirMat™ 740	Nedia Enterprises, 89-66 217th St., Jamaica, NY 11427; (718)740-5171	Slope	None
51	Landlok BonTerra CS2	Synthetic Industries, Inc., 4019 Industry	Slope	Contech

	Brand Name	Manufacturer or Distributor	Tested As	Private Label Names
	[99]	Drive, Chattanooga, TN 37416; 1-800-621-0444		Straw / Coconut Fiber Mat; GeoTech environmental Systems TechMat SC
52	Landlok BonTerra C2	Synthetic Industries / BonTerra, 4019 Industry Drive, Chattanooga, TN 37416; (423)899-0444,	Channel	None
53	Landlok BonTerra EcoNet ENCS2	Synthetic Industries / BonTerra, 4019 Industry Drive, Chattanooga, TN 37416; (423)899-0444,	Slope	Straw / Coco-nut Fiber Mat w / Kraft Net; TechMat™ SCKN
54	Landlok BonTerra S1	Synthetic Industries / BonTerra, 4019 Industry Drive, Chattanooga, TN 37416; (423)899-0444,	Slope	None
55	Landlok BonTerra® S2™	Synthetic Industries / BonTerra, 4019 Industry Drive, Chattanooga, TN 37416; (423)899-0444,	Slope	None
56	Landlok BonTerra® SFB™	Synthetic Industries / BonTerra, 4019 Industry Drive, Chattanooga, TN 37416; (423)899-0444,	Channel	None
57	Landlok BonTerra® SFB12™	Synthetic Industries / BonTerra, 4019 Industry Drive, Chattanooga, TN 37416; (423)899-0444,	Channel	Tensar TB1000

	Brand Name	Manufacturer or Distributor	Tested As	Private Label Names
58	Landlok BonTerra EcoNet ENS2	Synthetic Industries / BonTerra, 4019 Industry Drive, Chattanooga, TN 37416; (423)899-0444, Inc., 355 West Chestnut Street, Genesee, ID 83832; (800)285-0701	Slope	None
59	Landlok BonTerra® CP2	Synthetic Industries / BonTerra, 4019 Industry Drive, Chattanooga, TN 37416; (423)899-0444,	Channel	Coconut/Poly Fiber Mat; TechMat™ CP 3-D
60	Landlok BonTerra® EcoNet™ ENC2[98]	Synthetic Industries / BonTerra, 4019 Industry Drive, Chattanooga, TN 37416; (423)899-0444,	Channel	Coconut mat w/Kraft Net; TechMat™ CKN
61	Landlok 407GT	Synthetic Industries, Inc., 4019 Industry Dr., Chattanooga, TN 37416; (800)621-0444	Slope	Contech C-Jute; TerraJute
62	Landlok FRS 3112	Synthetic Industries, Inc., 4019 Industry Dr., Chattanooga, TN 37416; (800)621-0444	Slope	None
63	Landlok TRM 435	Synthetic Industries, Inc., 4019 Industry Dr., Chattanooga, TN 37416; (800)621-0444	Slope Channel	Contech C-35; Maccaferri MX287; Webtec Terraguard 44P

	Brand Name	Manufacturer or Distributor	Tested As	Private Label Names
64	Landlok TRM 450	Synthetic Industries, Inc., 4019 Industry Dr., Chattanooga, TN 37416; (800)621-0444	Channel	Contech TRM C-45 Webtec; Terraguard 45P
65	Landlok TRM 1050	Synthetic Industries, Inc., 4019 Industry Dr., Chattanooga, TN 37416; 1-800-621-0444	Channel	None
66	Landlok TRM 1060	Synthetic Industries, Inc., 4019 Industry Dr., Chattanooga, TN 37416, (800)621-0444	Channel	None
67	Lay-Low Mulch	Oklahoma Wood Fibers, Inc., P.O. Box 761, Idabel, OK 74745; (580-286-4363	Mulch	None
68	Miramat® 1000	Nicolon Mirafi Group, 3500 parkway Ln., Suite 500, Norcross, GA 30092; (404)447-6272	Slope	None
69	Miramat® TM8™	Nicolon Mirafi Group, 3500 parkway Ln., Suite 500, Norcross, GA 30092; (404)447-6272	Channel	None
70	Multimat 100 [99]	Tenax Corporation, 4800 East Monument St., Baltimore, MD 21205; 410-522-7000	Channel	None
71	North American Green C125 BN [99]	North American Green, Inc., 14649 Highway 41 North, Evansville, IN 47711, (800)772-2040	Channel	None
72	North American Green	North American Green, Inc., 14649	Channel	None

	Brand Name	Manufacturer or Distributor	Tested As	Private Label Names
	C350™ Three Phase™	Highway 41 North, Evansville, IN 47711; (800)772-2040		
73	North American Green P350	North American Green, Inc., 14649 Highway 41 North, Evansville, IN 47711; (800)772-2040	Channel	None
74	North American Green S150	North American Green, Inc., 14649 Highway 41 North, Evansville, IN 47711; (800)772-2040	Slope Channel	None
75	North American Green S150BN	North American Green, Inc., 14649 Highway 41 North, Evansville, IN 47711; (800)772-2040	Slope	None
76	North American Green S75	North American Green, Inc., 14649 Highway 41 North, Evansville, IN 47711; (800)772-2040	Slope	None
77	North American Green S75 BN	North American Green, Inc., 14649 Highway 41 North, Evansville, IN 47711; (800)772-2040	Slope	None
78	North American Green SC 150 BN [99]	North American Green, Inc., 14649 Highway 41 North, Evansville, IN 47711; (800)772-2040	Channel	None
79	North American Green SC150	North American Green, Inc., 14649 Highway 41 North, Evansville, IN 47711; (800)772-2040	Slope	None
80	North American Green S350	North American Green, Inc., 14649 Highway 41 North, Evansville, IN 47711; (800)772-2040	Channel	None

	Brand Name	Manufacturer or Distributor	Tested As	Private Label Names
81	Oasis Fiber-Mulch [99]	International Cellulose Corporation, 12315 Robin Road, Houston, TX 77045; 713-433-6701	Mulch	None
82	PennzSuppress®	Pennzoil Products Company, PO Box 2967, Houston, TX 77252-2967; 713-456-6126	Slope Mulch	None
83	Permamat 150F	Western Excelsior, PO Box 659, Mancos, CO 81328, (623)435-1741	Channel	None
84	Permamat 200F	Western Excelsior, PO Box 659, Mancos, CO 81328, (623)435-1741	Channel	None
85	POZ-O-CAP®	Chemical Lime Company, PO Box 121874, Fort Worth, TX 76107; (800)365-6724	Slope	None
86	Pro Mat®	Tascon, Inc. 7607 Fairview, Houston, TX 77041; (713)937-0900	Mulch	None
87	Pro Mat® (with Airtak)	Tascon, Inc. 7607 Fairview, Houston, TX 77041; (713)937-0900	Mulch	None
88	Pro Mat® XL	Tascon, Inc. 7607 Fairview, Houston, TX 77041; (713)937-0900	Mulch	None
89	Pyramat®	Synthetic Industries, Inc., 4019 Industry Dr., Chattanooga, TN 75230; (800)621-0444	Channel	None
90	Second Nature® Recycled Paper Fiber	Central Fiber Corporation, 4815 Fiber Lane, Wellsville, KS 66092; (800)654-6117	Mulch	None
91	Seed-Guard™	Belton Industries, 8613 Roswell Rd.,	Slope	None

	Brand Name	Manufacturer or Distributor	Tested As	Private Label Names
		Atlanta, GA 30350; (404)587-0257		
	Mat-Fiber Plus®	Mat, Inc. 12402 Highway 2 Floodwood, MN 55736, (888)477-3028	Mulch	None
93	Soil Guard™	Mat, Inc., 12402 Highway 2 Floodwood, MN 55736, (888)477-3028	Slope	None
94	SuperGro™	AMOCO Fabrics and Fibers, 260 The Bluffs, Austell, GA 30001; (770)944-4419	Slope	None
95	Tensar® Erosion Blanket TB1000 *** NO LONGER MANUFACTURED ***	The Tensar Corporation, 1210 Citizens Pkwy, Morrow, GA 30260; (404)250-1290	Channel	LANDLOK® BonTerra SFB12 (orig manuf)
96	Tensar® Erosion mat TM3000 *** NO LONGER MANUFACTURED***	The Tensar Corporation, 1210 Citizens Pkwy, Morrow, GA 30260; (404)250-1290	Channel	None
	Terra-Control®	Acumen International, PO Box 41303, Houston, TX 77241; (713)896-0050	Slope	None
99	verdyol® ERO-MAT®	Verdyol Alabama, Inc., PO Box 605, Pell City, AL 35125; (205)338-4411	Slope	None
100	verdyol® Excelsior High Velocity	Verdyol Alabama, Inc., PO Box 605, Pell City, AL 35125; (205)338-4411	Slope Channel	None
101	verdyol® Excelsior Standard	Verdyol Alabama, Inc., PO Box 605, Pell City, AL 35125; (205)338-4411	Slope	Winters Excelsior Inc. “Poplar Excelsior Blanket”

	Brand Name	Manufacturer or Distributor	Tested As	Private Label Names
102	Xcel PP-5	Western Excelsior, PO Box 659, Mancos, CO 81328, (623)435-1741	Channel	None
103	Xcel Regular	Western Excelsior, PO Box 659, Mancos, CO 81328, (623)435-1741	Slope	Contech Standard; Green Triangle Regular
104	Xcel Superior	Western Excelsior, PO Box 659, Mancos, CO 81328, (623)435-1741	Slope	Contech Standard Plus; Green Triangle Superior

Disclaimer: The product descriptions shown in this table are general and are intended for overall product comparison purposes only. They are not to be used for specification purposes. Refer to individual manufacturer's literature for complete product material specifications for specific product brand or trade names.

	Brand Name of Product	Tested As	Material Description
1	Agri-Fiber	Mulch	Recycled Fiber Mulch manufactured entirely from recycled fibers. No trees or other virgin pulp are sacrificed in the process. Water holding capacity 1200 Grams (90% min); Moisture Content 12.0 ± 3%; Organic Matter 98 ± 2%; Ash content Approx 1.5%; Packaged in 50 lb bags net.
2	Airtrol®	Slope	A cementious plaster binder produced from high-purity gypsum and applied in conjunction with an approved cellulose fiber mulch through a hydraulic process. The plaster is nontoxic, noncombustible, and harmless to fish, birds, plants and animals.
3	Airtrol ® Plus	Slope	A cementious plaster binder produced from high-purity gypsum and applied in conjunction with an approved cellulose fiber mulch through a hydraulic process. The plaster is nontoxic, noncombustible, and harmless to fish, birds, plants and animals. Tackifibers, as produced by Synthetic Industries, Inc., is added to the plaster binder.
4	American Fiber Mulch	Mulch	Hydraulic mulch produced from recycled paper. No published literature available.
5	American Fiber Mulch (with Fiber Plus)	Mulch	Hydraulic mulch produced from recycled paper. No published literature available. Fiber-Plus is a specially coated synthetic fiber tackifier with long fiber length, as available through the Finn Corporation.

	Brand Name of Product	Tested As	Material Description
6	American Fiber Mulch (with Hydro-Stick)	Mulch	Hydraulic mulch produced from recycled paper. No published literature available. - Hydro Stick is a special gum-based tackifier as available through the Finn Corporation.
7	Anti-Wash®/Geojute®	Slope	Heavy jute mesh of undyed, unbleached yarn. Yarn count: warp - 78 per width min; weft - 42 per linear yard, min; Typical weight = 0.92 lbs/sq yd. Typical roll width = 48 inches.
8	BioD-Mat™ 90	Channel	Woven bristle coir blankets. Typical weight = 29 oz/sq yd; Typical wide width dry tensile strength = 159 lbs/in; Typical elongation at failure dry % 33; open area = 38; Typical thickness = 0.35 inch.
9	BioD-Mesh™ 60	Slope	Spun mattress coir yarns, 100% natural. Typical weight = 18 oz/sy; Typical wet tensile strength = 340x310 lbs/feet; Typical dry tensile strength = 525 x 473 lbs/feet; Typical limiting shear stress bare soil = 3.6 lbs/ft^2.
10	Conwed 3000 Bonded Fiber Matrix [99]	Slope	Hydraulically applied, fiber mulch system comprised of long strand, thermally defibrated wood fibers (±90% by weight), bound together by a high strength polysaccharide polymer
			adhesive (±10% by weight). Wood fibers are thermo-mechanically defibrated from clean whole wood chips, containing a minimum of 25% of the fibers averaging 10mm long, with a minimum of 50% or more retained on a #24 mesh screen. Organic bonding tackifiers are of a high viscosity colloidal polysaccharide tackifier (4000 cps min) with activating agents.

	Brand Name of Product	Tested As	Material Description
11	Conwed® Hydro Mulch®	Mulch	Wood fiber mulch consisting of virgin wood fibers manufactured expressly from whole wood chips and not produced from recycled materials such as sawdust, paper, cardboard, or residue from pulp and paper plants. Typical bag weight = 100 lbs; typical moisture content = 10% ± 3%; typical ash content 0.8% ± 0.2% OD basis.
12	Curlex® I	Slope Channel	Machined mat of curled wood excelsior of 80%, six-inch or longer fibers. The top of each blanket is covered with a photodegradable extruded plastic mesh. Typical weight = 0.975 lbs / sq yd; typical roll width - 48 or 96 inches; typical roll length = 90 feet.
13	Curlex® II (Double Sided)	Channel	Wood-machined mat of curled wood excelsior of 80%, six-inch or longer fibers. Both the top and the bottom of the blanket is covered with a photodegradable, extruded plastic mesh. Typical weight = 1.0 lb / sq yd; typical roll length = 112.5 feet or 180 feet; typical roll width = 4 feet.
14	Curlex® II Stitched	Channel	Natural excelsior blanket of 100% Great Lakes Aspen with curled, interlocking fibers with barbed edges. 80% of the fibers are a minimum of 6 inches. Net material is polypropylene with green or white UV degrader additive. Net openings are ¾" x 1 5 / 8".
15	Curlex® III Stitched	Channel	Natural excelsior blanket made of 100% Great Lakes Aspen with curled interlocking fibers with barbed edges. Top and bottom are covered with heavy duty black polypropylene netting with ¾"x3 / 4 " openings. Weight: 1,25 lbs. / SY. Water absorption ' 250%.

	Brand Name of Product	Tested As	Material Description
			Will remain on the soil for a minimum of 3 years.
16	Curlex® Channel Enforcer I	Channel	Natural, excelsior blanket made of 100% aspen excelsior, covered on the top and bottom sides with a polypropylene netting with approximate ¾" x ¾" openings Typical weight = 1.25 lbs / SY; typical roll width = 4 & 8 feet; typical roll length = 100 & 50 feet.
17	Curlex®-Channel Enforcer II	Channel	Natural, excelsior blanket of 100% aspen excelsior, 80% of fibers a minimum of 6" long with polypropylene - black netting on the top side and heavy-duty black netting on the bottom. Typical widths = 4 and 8 feet; typical lengths = 100 and 50 feet; typical weight = 55.5 lbs.
18	Curlex®-LT	Slope	Natural, excelsior blanket made of 100% virgin aspen excelsior, covered on the top and bottom sides with polypropylene netting with approximate ¾" x 1-5 / 8" openings. Typical weight = 0.64 lbs / sq yd; typical roll width = 8 feet; typical roll length = 90 feet.
19	EarthBound [99]	Slope	An anionic polyacrylamide erosion control agent and mulch tackifier designed to bind fine soil particles to soil.. Product is available in 5-lb and 35-lb containers.
20	Earth-Lock	Channel	Machine-produced mat of curled wood excelsior of 80%, 9 inches or longer fiber length with consistent thickness and the fiber evenly distributed over the entire area of the mat. The excelsior shall be stitched to the plastic mesh and geogrid on a minimum of three inch centers with synthetic yarn. Typical roll weight = 75 lbs ± 10%; typical roll width = 7.5 feet; typical roll width = 6.5 feet.

	Brand Name of Product	Tested As	Material Description
21	Earth-Lock II [99]	Channel	Machine produced mat of curled wood excelsior of 80%, 9 inches or longer fiber length with consistent thickness and the fiber evenly distributed over the entire area of the mat. The bottom side of the mat shall be a high strength nylon geomatrix. The curled wood excelsior is stitched to reinforced netting and a high strength geomatrix on 1 ½" centers with synthetic yarn. Roll width 6.35 ft; roll length 120 ft; weight per roll – 103 lbs ±10%; volume per roll – 84 Sq yds; mesh – ¾ " x ¾" one side; high strength nylon geomatrix – one side.
22	EcoAegis™	Slope	Bonded Fiber Matrix composed of proprietary blend of materials that work in combination to bond wood fibers into a durable matrix. Composition is refined wood fiber (90% by weight) and blended hydrocolloid-based binder (10%) by weight, natural in color, designed to be applied through conventional hydraulic seeding equipment with mechanical agitation.
23	Econo-Jute[99]	Slope	100% biodegradable erosion control fabric woven from 100% jute yarns. Weight per roll – 56 lbs. Roll size – 4' x 225'; roll coverage – 100 sq yds; Open area – 50-60%.
24	ECS High Impact Excelsior	Channel	Wood fiber mat produced of wood excelsior of 80% eight-inch or longer fiber lengths. Blanket shall be of consistent thickness and each side covered with a photo-degradable plastic mesh and stitched on 3" centers. Typical width = 7.5 feet; typical length - approx 96 feet; typical weight = 80 lbs / roll ±10%.

	Brand Name of Product	Tested As	Material Description
25	ECS High Velocity Straw Mat	Slope Channel	Mats produced of wheat straw filler and reinforced by lightweight, ¾" photo-degradable netting stitched on 1.5" centers. Typical width = 7.5 feet; typical length = approx 120 feet; typical weight = 55 lbs / roll ± 10%
26	ECS Standard Excelsior	Slope	Extra long fibers of interlocking stitched wood excelsior mat. Typical weight per roll = 68 lbs ± 10%; typical roll length = 96 feet; typical roll width = 7.5 feet.
27	ECS Standard Straw	Slope	Organic blanket made from virgin wheat straw covered on the top side by netting. Typical roll weight - 50 lbs ± 10%; typical roll width = 7.5 feet; typical roll length = 120 feet.
28	Enkamat Composite 30 [99]	Slope	No product literature had been furnished
29	Enkamat® 7018	Channel	Mat consisting of heavy nylon monofilaments fused at their intersection. 97% of the geomatrix shall be open space available for soil and root interaction. Matting will have three-dimensional stability without laminated or stitched layers. Typical weight = 8.6 oz / sq yd; typical roll length - 227 feet; typical roll width = 39 inches.
30	Enkamat® 7020	Channel	Mat consisting of heavy nylon monofilaments fused at their intersection. 97% of the geomatrix shall be open space available for soil and root interaction. Matting will have three-dimensional stability without laminated or stitched layers. Typical weight = 12 oz / sq yd; typical roll length - 227 feet; typical roll width = 39 inches.
31	Enkamat Composite NPK	Channel	Three-dimensional black nylon mesh combined with a biodegradable mat bonded with high strength UV resistant thread.

	Brand Name of Product	Tested As	Material Description
32	Enviro-Gro	Mulch	Hydraulic mulch - no product literature available for this product.
33	EnviroGuard Plus	Slope	Natural soil amendment made from recycled waste paper and animal manure
34	Enviromat	Channel	Manufacturer's literature not supplied.
35	Evercycle™ Hydro-Mulch	Mulch	Hydraulic mulch manufactured from municipal solid waste containing paper, plastics and organics. Generally free of weed seed and contain no growth-inhibiting foreign matter.
36	Excel® Fibermulch II (with Exact-Tac™)	Mulch	Hydraulic mulch manufactured from 100% Aspenwood fibers and contains measured amounts of a green, water-activated dye, and Exact-Tac™ tackifier. Typical moisture content = 10% ± 3%; typical ash content = 0.7% ±0.2% (OD basis)
37	FORMULA 480 Liquid Clay	Slope	Biodegradable clay concentrate formulated to combine properties of minerals and tight film to give strength and resistance to water. Semi-paste consistency once mixed with water. Product permits needed ground vapors to escape. Total solids=49WT%; wt / Gal 9.0 lbs.
38	Futerra®	Slope	Lightweight, nonwoven erosion control blanket composed primarily of virgin wood fiber with a small percentage of recycled synthetic fibers. Accelerated photodegradable polypropylene netting is laminated to the surface of the blanket. Typical roll widths = 40 & 82 inches; typical roll length = 135 feet; typical roll weight (40 inch) = 20 lbs ± 10%; typical roll weight (82 inch) = 42 lbs ± 10%.

	Brand Name of Product	Tested As	Material Description
39	Geocoir® / DeKoWe ® 700	Slope	100% spun coir mat derived from the husk of coconuts. Typical weight = 20.6 oz / sq yd; typical open area 50%; typical roll length = 50 meters; typical roll width = 1, 2, 3 or 4 meters.
40	Geogro	Slope	No product literature available
41	Geojute® Plus	Slope	Woven jute mat, undyed and unbleached. Yarn count 78 - width warp; 180 per linear yard weft; typical roll weight = 2.82 lbs / linear yard; typical roll length 100 feet; typical roll width = 4 feet.
42	Geojute® Plus 1	Slope	No product literature available.
43	Geojute® Plus - Regular High Velocity	Channel	No product literature available
44	Grass Mat	Channel	100% biodegradable blend of natural fibers from the kenaf plant; lightweight and flexible; Typical roll width of 5'; typical roll length = 50'.
45	Greenfix CFO72RP [99]	Slope	No product literature had been furnished.
46	Greenfix CFO72RR (00)	Channel	Three dimensional black nylon mesh combined with a biodegradable coconut mat bonded together with a high strength UV resistant thread and net. Rolls are 6.5 x 55.5 feet.
47	Greenfix WSO72 [99]	Slope	Blanket containing 100% fiber content; roll width = 8'; roll length = 67.5 feet; Roll area = 60 sq yds; Weight = 0.70 Lbs. / Sq Yd; Weight per blanket = 42 lbs; Functional longevity = 10-12 months; light photodegradable top netting and medium photodegradable bottom netting.
48	GREENSTREAK® PEC-	Channel	Flexible mat of non-woven, randomly-oriented

	Brand Name of Product	Tested As	Material Description
	MAT™	Slope	monofilaments, thermally welded together into a three-dimensional porous web. Typical weight = 28 oz / sq yd; typical roll width = 6 feet.
49	K-MAT [98]	Slope	Bonded fiber matrix of blended natural and cellulose fiber. Intense green in color. Organic matter >99%; moisture content = 12% ±3%; water holding capacity = 1,300 grams per 100 grams of fiber; pH range 6.5 ±1%
50	KoirMat™ 400	Slope	No product literature available
51	Koirmat™ 700	Channel	Made from 100% white coir fiber. Typical thickness = 0.30 inch; typical mass per unit area (min) = 20 lz / sq yd;
52	KoirMat ™ 740	Channel	No product literature available
53	Landlok ® BonTerra® CS2™	Slope	70% straw and 30% coconut fiber mat with a lightweight photo-degradable netting on the bottom side, and a long-lasting, UV-stabilized netting on the top side, sewn on two inch centers. Typical roll weight = 40 lbs (0.5 lbs / sq yd); Typical roll length = 90 feet; typical roll width = 7.5 feet.
54	Landlok BonTerra C2	Channel	100% mattress grade coconut fiber (0.670 lb / sy) covered on both sides by netting sewn with UVI treated polypropylene, black thread minimum 1000 denier. Typical width = 7.5 feet; typical length = 90 feet; typical roll weight = 45 lbs.
55	Landlok ® BonTerra® EcoNet™ ENCS2	Slope	Manufactured from 70% wheat straw (.35 lb / sy) and 30% coconut fiber by weight (0.15 lb / sy); machine-fabricated mat covered on both sides by a biodegradable netting and sewn on two inch centers. Typical width = 7.5 ft; typical length = 90- feet; typical weight = 48 lbs approx.

	Brand Name of Product	Tested As	Material Description
56	Landlok ® BonTerra® S1	Slope	Machine-produced mat of 100%, weed-free wheat straw by weight, covered on the top side with a lightweight, photodegradable polypropylene netting with an approximate ½" x ½" opening, sewn together on 2 inch centers. Typical weight = 0.5 lbs / sq yd. Typical roll length = 90 feet. Typical roll width = 7.5 feet.
57	Landlok ® BonTerra® S2	Slope	Machine-produced mat of 100% weed-free wheat straw by weight, covered on the top and bottom sides with a lightweight, photodegradable, polypropylene netting with approximate ½" x ½" openings, sewn together on two inch centers. Typical weight = 0.5 lbs / sq yd; typical roll width = 7.5 feet; typical roll length = 90 feet.
58	Landlok ® BonTerra® SFB™	Channel	Manufactured from 100% synthetic polyolefin staple fiber, homogeneously blended and evenly distributed, covered on both sides by high strength oriented netting, and sewn together on 2-inch centers. Fiber = 10 oz / sy; Netting on both sides approx 3 lb / 1000 sf; Thread UVI treated polypropylene, min 1000 denier; Typical width - 7.5 ft; Typical length = 90 feet;

	Brand Name of Product	Tested As	Material Description
59	Landlok ® BonTerra® SFB12™	Channel	100% synthetic fiber mat consisting of long-lasting, UV-stabilized netting on the bottom, and heavy-duty, UV-stabilized netting on the top, sewn on two inch centers. Typical roll weight = 57 lbs. Typical roll width = 7.5 feet. Typical roll length = 90 feet.
60	LANDLOK® BonTerra EcoNet ENS2	Slope	Manufactured from 100% weed free wheat straw by weight (0.50 lb / sy), covered on both sides by biodegradable netting and sewn on two inch centers with high wet strength kraft thread. Typical width = 7.5 feet; typical length = 90 feet; typical weight = 48 lbs approx.
61	Landlok ® BonTerra® CP2	Channel	50% coconut fiber, .38 lb / SY - 50% UVI treated polypropylene fiber - .38 lb / SY; UVI treated polypropylene black thread; typical roll width = 7.5 feet; typical roll length = 90 feet. Bottom net UVI treated polypropylene openings of approx 5 / 8" x 5 / 8". Top net UVI treated polypropylene with openings of approx ½" x ½".
62	Landlok BonTerra EcoNet ENC2	Channel	100% mattress grade coconut fiber (.60 lb / SY) with high wet strength kraft leno weave netting on top and bottom sewn together on 2 inch centers with approximate openings of ½" x 1". Typical roll width - 7.5 feet; typical roll length = 90 feet.
63	Landlok® 407GT	Slope	Flexible, non-organic, open-weave geotextile consisting of perpendicular rows of multifilament and tape yarns woven together resulting in a dimensionally-stable matrix. Typical weight = 10.5 oz / sq yd; typical width = 6.5 feet; typical length - 138.5 feet.

	Brand Name of Product	Tested As	Material Description
64	Landlok® FRS 3112	Slope	Fiber roving system consisting of continuous fibrillated, fine-denier, polypropylene yarn fibers, processed such that interlocking fibrils attach to slightly coarser stem fibrils, without UV stabilization, designed for application through an air-gun process. Typical yarn is wound onto two, cylindrical packages weighing 18 - 25 lbs.
65	Landlok® TRM 435	Slope Channel	Dense web of green polypropylene fibers positions between two biaxially-oriented nets and mechanically bound together by parallel stitching with polypropylene thread. Matrix is stabilized against ultraviolet degradation and inert to chemicals normally found in a natural soil environment. Typical mass per unit area = 8.5 oz / yd^2; typical thickness 0.40 inch; typical ground cover factor = 70%; typical roll sizes = 6.5 feet x 138.5 feet (100 yd2 - 50 lbs).
66	Landlok® TRM 450	Channel	Dense, three-dimensional web of polyolefin fibers positioned between two, biaxially-oriented nets and mechanically bound together by parallel stitching with polyolefin thread. Typical weight = 10.5 oz / sq yd; typical roll width = 12.5 feet (4 ft width optional).
67	Landlok TRM 1050 [99]	Slope	Turf reinforcement mat consisting of a lofty web of black polypropylene fibers positioned between two high strength nets, mechanically bound together by parallel stitching with polypropylene thread. Every component is UV stabilized. Mass per unit area = 10.0 oz / sq yd; thickness = 0.40 inch; ground cover factor = 50%.
68	Landlok TRM 1060 (00)	Channel	Three-dimensional web of black polyolefin fibers bound

	Brand Name of Product	Tested As	Material Description
			between two high strength, biaxially oriented nets.
69	Lay-Low Mulch	Mulch	Hydraulic mulch composed of natural cellulose fiber; water holding capacity = 1400%; moisture content = 7.9%; organic matter = 99.2%; Ash content = 0.75; pH range = 6.5; Boron = 22 ppm
70	Miramat® 1000	Slope	A flexible, three-dimensional web of bonded polypropylene monofilaments. Typical weight = 9.6 oz / sq yd; typical roll width = 4.3 feet; typical roll length = 210 feet.
71	Miramat® TM8™	Channel	Flexible, three-dimensional synthetic mat. Typical weight = 12 of / sq yd; typical roll width = 12 feet; typical roll length = 100 feet.
72	Multimat 100 [99]	Slope	Turf reinforcement matrix and erosion control revegetation matrix blanket is a three-dimensional structure securing two high strength, high modulus biaxially oriented nets above and below a corrugated center netting. Mass per unit area = 9.4 oz / sq yd; thickness = 700 mills; roll width = 7.2 feet; roll length = 98.5 feet; roll area = 710 feet.
73	North American Green C125 BN	Channel	Machine-produced 100% biodegradable mat with 70% agricultural straw and 30% coconut fiber blend matrix. Blanket is covered on top and bottom sides with 100% biodegradable woven natural organic fiber netting. Roll width 6.5 feet; roll length 83.5 feet; roll weight 40 lbs ±10%; roll area 60 sq yds.
74	North American Green C350™ Three Phase™	Channel	100% coconut fiber, stitch-bonded between a heavy-duty, UV-stabilized bottom net, and a heavy-duty, UV-stabilized cuspated (crimped) middle netting, overlaid with a heavy

	Brand Name of Product	Tested As	Material Description
			duty, UV-stabilized top net. The three nettings are stitched together on 1.5 inch centers, with UV-stabilized, polyester thread. Typical weight = 0.92 lbs / sq yd
75	North American Green P350	Channel	Permanent mat consisting of 100% UV stabilized high denier polypropylene fiber stitch bonded between heavy duty UV stabilized bottom net and a heavy duty UV stabilized crimped middle netting overlaid with a heavy duty UV stabilized top net. Typical mass per unit area - 1.0 lb / SY; typical roll width = 6.2 feet; typical roll length = 55.5'.
76	North American Green S150	Slope Channel	Machine-produced mat of 100% agricultural straw, covered on the top and bottom sides with a polypropylene net having an approximate opening of ½" x ½", and sewn together by cotton thread. Typical roll weight = 30 lbs ± 10% per roll; typical roll width = 6.5 feet; typical roll length - 83.5 feet.
77	North American Green S150 BN [98]	Slope	Machine-produced, 100% biodegradable mat with agricultural straw fiber matrix. Mat covered on top and bottom with 100% biodegradable woven natural fiber net. Typical roll weight = 40 lbs ± 10%; typical roll length = 83.5 feet ± 5%; typical roll width = 6.5 feet ± 5%.
78	North American Green S350	Channel	Machine produced mat of 100% wheat straw matrix. Mat is covered with super heavy duty polypropylene matting. Rolls are 6.5x55.5 feet that covers 40 sq. yards.
79	North American Green S75	Slope	Machine-produced mat of 100% agricultural straw, covered on the top side with a polypropylene net having an approximate ½" x ½" mesh, sewn together with cotton thread. Typical roll weight = 30 lbs ± 10%; typical roll length

	Brand Name of Product	Tested As	Material Description
			= 83.5 feet.
80	North American Green S75 BN	Slope	Machine-produced mat of 100% straw fiber. The blanket shall be covered on the top side with a 100% biodegradable woven natural organic fiber netting having an approx ½" x 1" opening. Typical roll width = 6.5 feet; typical roll length = 83.5 feet; typical roll weight = 35 lbs ± 10%.
81	North American Green SC150 BN	Slope	
82	North American Green SC150	Slope	Machine-produced mat consisting of 70% agricultural straw and 30% coconut fiber, covered on the top side by a polypropylene net having an approx 5/8" x 5/8" mesh, and on the bottom side by a polypropylene net with an approx ½" x ½" mesh, sewn together with cotton thread. Typical roll weight = 30 lbs ± 10% per roll; typical roll length = 83.3 feet; typical roll width = 6.5 feet.
83	Oasis Fiber Mulch	Mulch	Manufactured from a blend of 100% recycled fiber without growth or germination inhibiting factors. Moisture content 12%± 3%; Ash content 4%±3%; Organic matter = 96% ±2%; Moisture holding capacity = 1200-1500 grams per 100 grams oven dry fiber
84	PennzSuppress®	Slope Mulch	No literature available
85	Permamat 150F	Channel	Biodegradable mat produced from heavy Aspen wood excelsior, underlaid with a non-woven fabric and encapsulated by a permanent UV stabilizing netting with a minimum life expectancy of 20 years. Typical roll width 4 or

	Brand Name of Product	Tested As	Material Description
			8 feet; typical roll length - 75 or 50 feet; typical roll weight - 58 lbs or 77 lbs.
86	Permamat 200F	Channel	Machine-produced mat of evenly distributed Aspen wood excelsior fibers, 80% of which are six-inches or longer. The mat is completely encased in a black, extruded-plastic netting , treated to retain intact both in direct sunlight and when buried. The netting mesh size is approx ¾" x 3/8". Plasting netting is securely attached to the excelsior. Typical weight = 2.34 lbs/sq yd; typical roll length = 75 feet; typical roll width = 4 feet.
87	POZ-O-CAP®	Slope	Product consisting of dry powder mix of cementious and hydrated lime, with a dry, cellulose-derived fiber reinforcing additive, applied through standard hydraulic seeding processes.
88	Pro Mat®	Mulch	Recycled cellulose fiber mulch manufactured from corrugated paper fibers. Typical bag width = 50 lbs; typical moisture content = 12% ± 3%; typical ash content = 1.6% maximum.
89	Pro Mat® XL	Mulch	Natural, cellulose wood fiber hydro-mulch, manufactured from 85% recycled newspaper. Ash content less than 1.6% (dust); moisture content of not more than 15%.
90	Pro Mat® XL with Airtak	Mulch	Natural, cellulose wood fiber hydro-mulch, manufactured from 85% recycled newspaper. Ash content less than 1.6% (dust); moisture content of not more than 15%. No product literature available on Airtak.
91	Pyramat®	Channel	Three-dimensional, lofty, woven polypropylene geotextile,

	Brand Name of Product	Tested As	Material Description
			composed of polypropylene monofilament yarns woven into a uniform configuration of resilient pyramid-like projections. Typical weight = 15 oz / sq yd; typical roll length = 90 feet; typical roll width = 6 feet.
92	Second Nature® Regenerated Wood Fiber Mulch	Mulch	Recycled, natural fiber mulch. Typical bag weight = 50 lbs; typical moisture content = 12% ± 3%.
93	Seed-Guard™	Slope	Natural green mat woven from photo-degradable, polypropylene yarns
94	Silva-Fiber Plus®	Mulch	100% virgin wood fiber with 3% tackifier. Typical bag weight = 50 lbs; typical moisture content = 12% ± 3%; typical ash content 1.0%
95	Soil Guard™	Slope	A bonded fiber matrix material produced from 100% wood fiber with natural binders. The product is designed to disperse rapidly in water, remain in uniform suspension under agitation, and be applied through standard hydraulic seeding processes.
96	SuperGro™	Slope	Flexible, light-weight geocomposite, consisting of nonwoven, isotactic, polypropylene staple, uniform fiber blanket, reinforced with polypropylene netting, earthtone in color. Typical weight = 1.0 oz / sq yd; typical roll length - 250 linear yards; typical roll width = 4 feet.
97	Tensar TB 1000 *** NO LONGER AVAILABLE ***	Slope Channel	Lofty web of polyolefin fibers between two, high-strength, biaxially-oriented nets, and bound securely together by parallel stitching with polyolefin thread, stabilized against ultraviolet degradation and inert to chemicals normally

	Brand Name of Product	Tested As	Material Description
			encountered in a natural soil environment. Typical weight = 10 oz per yd (ASTM D-3776); typical roll length = 120 feet; typical width = 7.5 feet. ***** By letter of 1/28/2000, Tensar Earth Technologies, Inc., advised that this product is no longer being manufactured *****
98	Tensar™ Erosion Mat TM 3000 *** NO LONGER AVAILABLE***	Channel	Consists of polymer nettings, fused at the intersections of the fibers and formed into a strong and dimensionally stable mat. Material is UV stabilized with a minimum of 2% carbon black. Typical weight = 12 oz / sq yd (min); typical roll length = 100 feet; typical roll width = 5 feet. ***** By letter of 1/28/2000, Tensar Earth Technologies, Inc., advised that this product is no longer being manufactured *****
99	Terra Control	Slope	Polyvinylacetate dispersion containing easily-biodegradable placticizers, formulated as a milky-white, bio-degradable synthetic resin dispersion in water, designed for hydraulic applications.
100	verdyol® ERO-MAT™	Slope	Machine-produced mat of agricultural straw, covered on one side of the blanket with a photodegradable, synthetic mesh adhered to the straw by a knitting process using degradable thread. Typical roll weight = 50 lbs ± 1 lb per roll; typical width = 7.5 feet; typical length = 120 feet.
101	verdyol® EXCELSIOR High Velocity	Slope Channel	Machine-produced mat of 100% clean wood excelsior fibers processed from hardwood. The top and bottom sides of the blanket is covered with an extruded, degradable

	Brand Name of Product	Tested As	Material Description
			polypropylene netting of ¾" x ¾" openings. Typical weight = 1.1 lbs / sq yd; typical roll width = 7.5 feet; typical roll length = 96 feet.
102	verdyol® EXCELSIOR Standard	Slope	Machine-produced mat of 100% clean wood excelsior fibers processed from hardwood. The top and bottom sides of the blanket is covered with an extruded, degradable polypropylene netting of ¾" x ¾" openings. Typical weight = 0.85 lbs / sq yd; typical roll width = 7.5 feet; typical roll length = 96 feet.
103	Xcel PP5	Channel	Manufacturer's literature not provided.
104	Xcel Regular®	Slope	Machine-produced mat of curled wood excelsior of 80%, six-inch or longer fiber length, covered on the top side by a photo-degradable extruded plastic net. Typical weight = 0.98 lbs / sq yd ± 0.10 lbs / sq yd; typical width = 48 inches ± 1 inch; typical length = 180 feet (min)
105	Xcel Superior®	Slope	Machine-produced mat of curled wood excelsior of 80%, six-inch or longer fiber length, covered on the top and bottom sides by a photo-degradable, extruded plastic net. Typical weight = 1.0 lbs /sq yd ± 0.1 lbs /sq yd; typical width = 48 inches ± 1 inch; typical length = 180 feet (min)

Cycle	No	Product Evaluated	1:2 Clay	1:2 Sand	1:3 Clay	1:3 Sand
1991	1	Anti-Wash®/Geojute®	XXX	XXX		
	2	Curlex® I	XXX	XXX	XXX	XXX
	3	Greenstreak® Pec-Mat™	XXX	XXX	XXX	XXX
	4	Landlok® 407GT	XXX	XXX		
	5	North American Green S75			XXX	XXX
	6	North American Green S150	XXX	XXX		
	7	North American Green SC150	XXX	XXX		
	8	verdyol® ERO-MAT®			XXX	XXX
	9	Xcel Regular			XXX	XXX
	10	Xcel Superior	XXX	XXX		

Cycle	No	Product Evaluated	1:2 Clay	1:2 Sand	1:3 Clay	1:3 Sand
1992	1	Airtrol™	XXX	XXX	XXX	XXX
	2	Curlex™ I		XXX	XXX	XXX
	3	Geocoir®/DeKoWe® 700	XXX	XXX		

1993	Entire Cycle Canceled due to Weather Damage

Cycle	No	Product Evaluated	1:2 Clay	1:2 Sand	1:3 Clay	1:3 Sand
1994	1	Airtrol®		XXX		XXX
	2	Curlex® I		XXX		XXX
	3	Geocoir®/DeKoWe® 700		XXX		
	4	Geojute® Plus	XXX	XXX		
	5	Miramat® 1000	XXX	XXX		
	6	Soil Guard™	XXX	XXX		
	7	Super Gro™	XXX	XXX	XXX	XXX

Cycle	No	Product Evaluated	1:2 Clay	1:2 Sand	1:3 Clay	1:3 Sand
1995	1	Airtrol®		XXX		XXX
	2	Landlok® BonTerra® S1™			XXX	XXX
	3	Landlok® BonTerra® S2™	XXX	XXX		
	4	Curlex® I				XXX
	5	ECS Straw Blanket Standard			XXX	XXX
	6	Geocoir®/DeKoWe® 700		XXX		
	7	Geojute® Plus 1	XXX	XXX		
	8	Landlok® FRS 3112	XXX	XXX		
	9	Miramat® TM8™	XXX	XXX		
	10	POZ-O-CAP®			XXX	XXX
	11	SuperGro™		XXX	XXX	XXX
	12	verdyol® Excelsior Standard			XXX	XXX
	13	verdyol® Excelsior High Velocity	XXX	XXX		

Cycle	No	Product Evaluated	1:2 Clay	1:2 Sand	1:3 Clay	1:3 Sand
1996	1	Airtrol® Plus	XXX	XXX		
	2	Landlok® BonTerra® S2™		XXX		
	3	Landlok® BonTerra® CS2™	XXX	XXX		
	4	Curlex®™-LT			XXX	XXX
	5	ECS Excelsior Blanket Standard			XXX	XXX
	6	Geogro	XXX	XXX	XXX	XXX
	7	Geojute® Plus 1	XXX	XXX		
	8	KoirMat™ 400	XXX	XXX		
	9	Landlok® FRS 3112		XXX		
	10	North American Green S75	XXX	XXX		
	11	POZ-O-CAP®			XXX	XXX
	12	Seed-Guard™	XXX	XXX		
	13	Tensar® Erosion Blanket TB1000	XXX	XXX		
	14	Terra-Control®			XXX	XXX

Cycle	No	Product Evaluated	1:2 Clay	1:2 Sand	1:3 Clay	1:3 Sand
1997	15	verdyol® Excelsior High Velocity	XXX	XXX		
	1	Airtrol® Plus	XXX	Destroyed *		
	2	BioD-Mesh™ 60			XXX	XXX
	3	Landlok® BonTerra® CS2™	XXX			
	4	Landlok® BonTerra® EcoNet™ ENCS2	XXX	Destroyed *		
	5	Landlok® BonTerra®EcoNet™ ENS2			XXX	XXX
	6	Curlex™-LT			XXX	
	7	EcoAegis™	XXX	Destroyed *	XXX	XXX
	8	ECS High Velocity Straw Mat	XXX	Destroyed *		
	9	Geogro	XXX	Destroyed *	XXX	XXX
	10	Landlok™ TRM 435	XXX	Destroyed *		
	11	North American Green S75		Destroyed *		
	12	Terra-Control®			XXX	XXX
	*In June, 1997, an intense rainstorm destroyed all products installed on the 1:2 Sand Plots. Due to lack of compatible growing season length, products were not re-installed.					

Cycle	No	Product Evaluated	1:2 Clay	1:2 Sand	1:3 Clay	1:3 Sand
1998	1	Landlok® BonTerra® EcoNet™ ENCS2		XXX		
	2	EcoAegis™	XXX	XXX		XXX
	3	ECS High Velocity Straw Mat		XXX		
	4	EnviroGuard Plus	XXX	XXX	XXX	XXX
	5	Formula 480 Liquid Clay	XXX	XXX		
	6	Futerra	XXX	XXX	XXX	XXX
	7	K-MAT	XXX	XXX	XXX	XXX
	8	Landlok™ TRM 435		XXX		
	9	North American Green S150 BN	XXX	XXX		
	10	North American Green S75		XXX		
	11	North American Green S75 BN			XXX	XXX
	12	PennzSuppress®	XXX	XXX		
Cycle	**No**	**Product Evaluated**	**1:2 Clay**	**1:2 Sand**	**1:3 Clay**	**1:3 Sand**
1999	1	Conwed 3000 Bonded Fiber Matrix	XXX	XXX	XXX	XXX
	2	EarthBound	XXX	XXX	XXX	XXX
	3	Econo-Jute	XXX	XXX	XXX	XXX
	4	ECS Standard Straw	XXX	XXX		
	5	EnviroGuard Plus	XXX	XXX		XXX
	6	Grass Mat	XXX	XXX	XXX	XXX
	7	Greenfix WSO72	XXX	XXX		
	8	Landlok BonTerra CS2	XXX			
	9	Pennzsuppress		XXX		
2000	**Entire cycle was lost due to slope failure from inclement weather**					

PRODUCT PERFORMANCE - 2000 EVALUATION CYCLE ONLY						
No	Product Name	Year	Slope	Soil	Sediment Loss	Vegetation Density
1						
2	Entire Cycle was lost due to slope failure from inclement weather					
3						
4						
5						
6						
7						
8						

PRODUCT PERFORMANCE - 1991 THROUGH 2000 EVALUATION CYCLES						
No	Product Name	Year	Slope	Soil	Sediment Loss	Vegetation Density
	Landlok® TRM 435	1997	1:2	Clay	0.18	92.28
	Curlex® I	1991			0.19	97.83
	ECS High Velocity Straw Mat	1997			0.20	85.58
	North American Green SC150	1991			0.21	89.98
	Geocoir®/DeKoWe® 700	1992			0.22	73.72
	North American Green S150	1991			0.23	92.01
	Landlok® 407GT	1991			0.24	96.15
	Airtrol®	1992			0.24	86.09
	KoirMat™ 400	1996			0.25	74.07
	Landlok BonTerra EcoNet ENCS2	1997			0.25	90.39
	Greenstreak® PEC-MAT™	1991			0.25	87.58
	EnviroGuard Plus	1999			0.26	95.94
	Soil Guard™	1994			0.27	83.99
	Anti-Wash®/Geojute®	1991			0.27	90.06
	Landlok® FRS 3112	1995			0.28	96.51
	Greenfix WSO72	1999			0.28	85.91
	Landlok BonTerra CS2	1999			0.28	87.29
	Futerra®	1998			0.29	90.83
	Landlok® BonTerra® CS2™	1996			0.30	71.98
	North American Green S75	1996			0.31	87.39
	verdyol® Excelsior High Velocity	1996			0.31	82.48
	Formula 480 Liquid Clay	1998			0.31	86.38
	Conwed 3000 BFM	1999			0.31	84.98
	EarthBound	1999			0.31	81.23

No	Product Name	Year	Slope	Soil	Sediment Loss	Vegetation Density
	ECS Standard Straw	1999			0.31	81.77
	Miramat® TM8™	1995			0.32	91.24
	Landlok® BonTerra® S2™	1995			0.32	96.58
	Xcel Superior	1991			0.32	98.81
	Geojute® Plus 1	1996			0.32	79.75
	North American Green® S150 BN	1998			0.32	95.92
	Tensar® Erosion Blanket TB1000	1996			0.33	91.24
	SuperGro™	1994			0.33	96.35

PRODUCT PERFORMANCE - 1991 THROUGH 2000 EVALUATION CYCLES						
No	Product Name	Year	Slope	Soil	Sediment Loss	Vegetation Density
	Pennzsuppress®	1998	1:2	Clay	0.33	83.96
	Landlok® BonTerra® CS2™	1997			0.35	89.55
	EcoAegis™	1998			0.36	82.33
	EcoAegis™	1997			0.37	82.98
	K-Mat	1998			0.37	85.66
	EnviroGuard Plus	1998			0.38	81.41
	Grass Mat	1999			0.39	81.05
	Geojute® Plus 1	1995			0.39	83.35
	verdyol® Excelsior High Velocity	1995			0.39	88.84
	Airtrol® Plus	1996			0.40	71.51
	Geogro	1996			0.42	87.30
	Miramat® 1000	1994			0.42	65.81
	Seed-Guard™	1996			0.42	74.21
	Geojute® Plus	1994			0.69	72.65
	Airtrol® Plus	1997			1.04	81.51
	CONTROL	91-98			2.06	74.70
	Geogro	1997			2.29	78.76

PRODUCT PERFORMANCE - 2000 EVALUATION CYCLE ONLY						
No	Product Name	Year	Slope	Soil	Sediment Loss	Vegetation Density
1						
2	Entire Cycle was lost due to slope failure from inclement weather					
3						
4						
5						
6						
7						
8						

PRODUCT PERFORMANCE - 1991 THROUGH 2000 EVALUATION CYCLES						
No	Product Name	Year	Slope	Soil	Sediment Loss	Vegetation Density
1	Soil Guard™	1994	1:2	Sand	8.04	86.74
2	Geojute® Plus	1994			8.16	3.88
3	SuperGro™	1994			8.97	69.57
4	Curlex® I	1994			9.12	89.46
5	Geocoir®/ DeKoWe® 700	1994			10.39	49.62
6	Miramat® 1000	1994			11.82	81.47
7	Airtrol®	1994			13.42	17.61
8	Landlok® FRS 3112	1995			14.25	64.76
9	Landlok® BonTerra® S2™	1995			15.30	68.35
10	Xcel Superior	1991			15.68	85.81
11	verdyol® Excelsior High Velocity	1995			16.73	63.54
12	Tensar® Erosion Blanket TB1000	1996			16.82	65.71
13	Landlok® FRS 3112	1996			16.94	90.42
14	Landlok® 407GT	1991			18.77	74.30
15	EnviroGuard Plus	1999			19.63	94.50
16	Landlok® BonTerra® CS2™	1996			19.98	70.76
17	North American Green SC150	1991			20.82	76.41
18	Curlex® I	1992			21.81	47.34
19	ECS Standard Straw	1999			23.61	78.67
20	Miramat® TM8™	1995			22.73	85.60
21	SuperGro™	1995			23.17	51.09
22	Landlok® TRM 435	1998			23.38	72.57

PRODUCT PERFORMANCE - 1991 THROUGH 2000 EVALUATION CYCLES						
No	Product Name	Year	Slope	Soil	Sediment Loss	Vegetation Density
23	Seed-Guard™	1996			23.40	66.88
24	Futerra®	1998			23.76	75.17
25	North American Green S150	1991			23.92	84.75
26	Landlok® BonTerra®ENCS2™	1998			24.43	82.76
27	Geocoir®/DeKoWe® 700	1995			24.59	49.19
28	Greenfix WSO72	1999			24.89	82.28
29	ECS High Velocity Straw Mat	1998			25.14	76.85
30	Landlok® BonTerra® S2™	1996			25.23	83.24
31	North American Green® S150 BN	1998			25.40	76.48
32	Geojute® Plus 1	1996			26.11	80.40

PRODUCT PERFORMANCE - 1991 THROUGH 2000 EVALUATION CYCLES						
No	Product Name	Year	Slope	Soil	Sediment Loss	Vegetation Density
33	Formula 480 Liquid Clay	1998	1:2	Sand	26.24	68.85
34	North American Green® S75	1998			26.42	68.91
35	verdyol® Excelsior High Velocity	1996			26.98	38.09
36	North American Green S75	1996			27.01	72.06
37	Geojute® Plus 1	1995			27.03	80.80
38	KoirMat™ 400	1996			27.05	57.44
39	Conwed 3000 BFM	1999			27.31	73.88
40	Geogro	1996			27.33	70.47
41	EnviroGuard Plus	1998			27.42	73.38
42	Pennzsuppress	1999			27.53	63.41
43	EarthBound	1999			27.85	72.54
44	K-Mat	1998			28.94	64.66
45	Curlex® I	1991			29.80	52.67
46	EcoAegis™	1998			29.98	81.01
47	Airtrol® Plus	1996			30.00	72.79
48	Anti-Wash®/Geojute®	1991			30.30	51.37
49	Econ-Jute	1999			30.79	64.78
50	Greenstreak® PEC-MAT™	1991			31.14	38.86
51	Grass Mat	1999			32.17	71.98
52	Airtrol	1992			37.89	41.88
53	CONTROL	91-99			50.34	31.96

Note: In June, 1997, an intense rainstorm destroyed all products which had been installed for evaluation on the 1:2 Sand plots. Due to lack of compatible growing season now remaining compared to previously completed evaluation cycles, the products were not re-installed and evaluated

PRODUCT PERFORMANCE - 2000 EVALUATION CYCLE ONLY						
No	Product Name	Year	Slope	Soil	Sediment Loss	Vegetation Density
1						
2	Entire Cycle was lost due to slope failure from inclement weather					

PRODUCT PERFORMANCE - 1991 THROUGH 2000 EVALUATION CYCLES						
No	Product Name	Year	Slope	Soil	Sediment Loss	Vegetation Density
1	SuperGro™	1994	1:3	Clay	0.08	70.38
2	Curlex® I	1992			0.12	98.13
3	Curlex® I	1991			0.15	63.23
4	verdyol® ERO-MAT®	1991			0.15	87.81
5	Landlok BonTerra EcoNet ENS2	1997			0.15	82.26
6	Curlex™-LT	1997			0.18	85.37
7	Greenstreak® PEC-MAT™	1991			0.20	90.53
8	Terra Control	1997			0.22	83.32
9	Airtrol®	1992			0.24	86.44
10	ECS Excelsior Blanket Standard	1996			0.25	83.36
11	Landlok® BonTerra® S1™	1995			0.25	93.42
12	BioD-Mesh™ 60	1997			0.26	81.19
13	North American Green S75	1991			0.27	96.19
14	Futerra®	1998			0.27	87.79
15	Curlex™-LT	1996			0.28	75.39
16	ECS Straw Blanket Standard	1995			0.29	90.71

PRODUCT PERFORMANCE - 2000 EVALUATION CYCLE ONLY						
No	Product Name	Year	Slope	Soil	Sediment Loss	Vegetation Density
17	Econo-Jute	1999			0.29	82.98
18	Conwed 3000 BFM	1999			0.30	84.56
19	SuperGro™	1995			0.31	89.42
20	EcoAegis™	1997			0.31	82.10
21	North American Green® S75 BN	1998			0.31	86.81
22	Xcel Regular	1991			0.32	90.17
23	verdyol® Excelsior Standard	1995			0.32	92.21
24	EnviroGuard Plus	1998			0.32	82.00
25	K-Mat	1998			0.32	57.05
26	EarthBound	1999			0.33	81.07
27	Grass Mat	1999			0.34	82.31
28	Terra-Control®	1996			0.35	92.09
29	POZ-O-CAP®	1995			0.36	83.48
30	Geogro	1996			0.38	87.95
31	POZ-O-CAP®	1996			0.42	90.31
32	Geogro	1997			0.43	77.39
33	CONTROL	91-98			1.24	74.43

PRODUCT PERFORMANCE 2000 CYCLE ONLY						
1						
2	Entire Cycle was lost due to slope failure from inclement weather					
3						
4						
5						

PRODUCT PERFORMANCE - 1991 THROUGH 2000 EVALUATION CYCLES						
No	Product Name	Year	Slope	Soil	Sediment Loss	Vegetation Density
1	Curlex® I	1994	1:3	Sand	2.94	48.63
2	SuperGro™	1994			3.00	39.19
3	Curlex® I	1992			4.12	37.26
4	Curlex® I	1991			4.41	60.22
5	Xcel Regular	1991			4.71	70.51
6	Landlok® BonTerra® S1™	1995			6.29	77.09
7	verdyol® Excelsior Standard	1995			7.41	75.33
8	Curlex® I	1995			7.84	63.96
9	Landlok BonTerra EcoNet ENS2	1997			7.98	82.87
10	ECS Straw Blanket Standard	1995			8.06	80.28
11	North American Green S75	1991			8.10	81.06
12	Curlex™-LT	1996			8.47	76.03
13	EnviroGuard Plus	1999			8.61	94.50
14	verdyol® ERO-MAT®	1991			9.08	73.20

PRODUCT PERFORMANCE 2000 CYCLE ONLY						
15	Airtrol®	1994			9.26	27.82
16	SuperGro™	1995			9.74	56.89
17	ECS Excelsior Blanket Standard	1996			10.01	77.25
18	Terra-Control®	1997			10.48	81.60
19	EarthBound	1999			11.06	72.09
20	Futerra®	1998			11.19	72.17
21	North American Green® S75 BN	1998			11.44	75.55
22	Econo-Jute	1999			11.74	63.41
23	EcoAegis™	1998			11.93	71.75
24	EnviroGuard Plus	1998			12.04	50.74
25	K-Mat	1998			12.14	65.21
26	EcoAegis™	1997			12.26	75.19
27	Airtrol®	1992			12.39	55.65
28	Airtrol®	1995			13.02	26.18
29	BioD-Mesh™ 60	1997			13.03	86.14
30	Terra-Control®	1996			13.15	72.32
31	Geogro	1996			13.39	73.25
32	POZ-O-CAP®	1996			13.44	69.81
33	Conwed 3000 BFM	1999			13.68	84.36
34	Grass Mat	1999			14.53	73.84
35	Geogro	1997			15.35	71.48
36	Greenstreak® PEC-MAT™	1991			16.40	60.04
37	CONTROL	91-99			27.21	43.26

CLASS 2 "FLEXIBLE CHANNEL LINER" APPLICATIONS								
1991	Channel Construction Not Completed							
1992	Channel Construction Not Completed							
1993	Channels Completed but Cycled Canceled due to Weather Damage to Facility							
1994	Began shear stress flows immediately after installation. No channel was able to produce vegetation and all channels exhibited significant and unacceptable sediment loss. Evaluation protocol was revised to provide a 90-day resting period between installation and initial shear stress flows. New evaluation protocol scheduled to begin during 1995 evaluation cycle.							
Year	**Chnl**	**Product Evaluated**	**Shear Stress Level Flows (Pascals/Lb Sq Ft)**						
			96 / 2	114 / 3	192 / 4	239 / 5	287 / 6	335 / 7	383 / 8
1995	1	Miramat® TM8™	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	2	North American Green C350™ Three Phase	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	3	Landlok® TRM450	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	4	Enkamat® 7020	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	5	Greenstreak® PEC-MAT™	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	6	Tensar® Erosion Mat TM3000	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	7	Geojute®Plus-Regular High Velocity	XXX	XXX	XXX				
	8	CONTROL	XXX	XXX	XXX				
	9	Permamat 200F	XXX	XXX	XXX	XXX			
	10	Curlex®II (Double Sided)	XXX	XXX					
		Total Products Evaluated:	**10**	**10**	**9**	**7**	**6**	**6**	**6**
1996	1	verdyol® Excelsior High Velocity	XXX	XXX	XXX	XXX	XXX		
	2	Enkamat® 7018	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	3	Earth-Lock	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	4	Landlok® BonTerra® SFB12™	XXX	XXX	XXX	XXX	XXX	XXX	XXX

CLASS 2 "FLEXIBLE CHANNEL LINER" APPLICATIONS									
	5	Tensar® Erosion Blanket TB1000	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	6	Pyramat®	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	7	Curlex® I	XXX	XXX	XXX				
	8	CONTROL	XXX	XXX	XXX				
	9	North American Green S150	XXX	XXX	XXX				
	10	KoirMat™ 740	XXX	XXX	XXX				
		Total Products Evaluated:	**10**	**10**	**10**	**6**	**6**	**5**	**5**
1997	1	Pyramat®	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	2	BioD-Mat™ 90	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	3	Koirmat™ 700	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	4	Miramat® TM8™	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	5	Landlok® BonTerra® SFB™	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	6	Earth-Lock	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	7	ECS High Impact Excelsior	XXX	XXX	XXX				
	8	CONTROL	XXX	XXX	XXX				
	9	BonTerra® C2	XXX	XXX	XXX				
	10	Curlex® Channel Enforcer I	XXX	XXX	XXX				
		Total Products Evaluated:	**10**	**10**	**10**	**6**	**6**	**6**	**6**

CLASS 2 "FLEXIBLE CHANNEL LINER" APPLICATIONS									
Year	**Chnl**	**Product Evaluated**	**Shear Stress Level Flows (Pascals/Lb Sq Ft)**						
			96 / 2	114 / 3	192 / 4	239 / 5	287 / 6	335 / 7	383 / 8
1998	1	Landlok® TRM 435	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	2	Greenstreak Pec-Mat	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	3	Curlex Channel Enforcer II	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	4	Permamat 150F	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	5	North American Green P350	XXX	XXX	XXX	XXX	XXX	XXX	XXX

	6	BonTerra CP2	XXX	XXX	XXX	XXX	XXX	XXX	XXX
CLASS 2 "FLEXIBLE CHANNEL LINER" APPLICATIONS									
Year	**Chnl**	**Product Evaluated**	**Shear Stress Level Flows (Pascals/Lb Sq Ft)**						
			96 / 2	114 / 3	192 / 4	239 / 5	287 / 6	335 / 7	383 / 8
	7	BonTerra ENC2	XXX	XXX	XXX	XXX			
	8	CONTROL	XXX	XXX	XXX	XXX			
	9	ECS High Velocity Straw Mat	XXX	XXX	XXX	XXX			
	10	Grass Mat	XXX	XXX	XXX	XXX			
		Total Products Evaluated:	**10**	**10**	**10**	**10**	**6**	**6**	**6**
1999	1	Earth-Lock II	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	2	Landlok TRM 1050	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	3	Greenfix CFO72RP	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	4	BonTerra C2	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	5	Enkamat Composite 30	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	6	Multimat 100	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	7	North American Green SC150 BN	XXX	XXX	XXX	XXX			
	8	CONTROL	XXX	XXX	XXX	XXX			
	9	North American Green C125 BN	XXX	XXX	XXX	XXX			
	10	ECS Standard Excelsior	XXX	XXX	XXX	XXX			
		Total Products Evaluated:	**10**	**10**	**10**	**10**	**6**	**6**	**6**
2000	1	North American Green® S350	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	2	Enviromat	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	3	Landlok TRM 1060	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	4	Curlex® III Stitched	XXX	XXX	XXX	XXX	XXX	XXX	XXX
	5	Enkamat Composite NPK	XXX	XXX	XXX	XXX	XXX	XXX	XXX

6	Xcel PP5	XXX	XXX	XXX	XXX	XXX	XXX	XXX

CLASS 2 "FLEXIBLE CHANNEL LINER" APPLICATIONS									
Year	**Chnl**	**Product Evaluated**	**Shear Stress Level Flows (Pascals/Lb Sq Ft)**						
			96 / 2	114 / 3	192 / 4	239 / 5	287 / 6	335 / 7	383 / 8
	7	Greenfix CFO72RR	XXX	XXX	XXX				
	8	CONTROL	XXX	XXX	XXX				
	9	Spraymat	XXX	XXX	XXX				
	10	Curlex® II Stitched	XXX	XXX	XXX				
		Total Products Evaluated:	**10**	**10**	**10**	**6**	**6**	**6**	**6**

Channels 1 through 6 are 7% centerline gradient channels.

Channels 7 through 10 are 3% centerline gradient channels.

SHEAR STRESS RANGE = 0 - 96 PASCAL (0 - 2 LBS / SQ FT)

PRODUCT PERFORMANCE - 2000 EVALUATION CYCLE ONLY				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
2000	1	North American Green S350™	0.62	86.78
	2	Xcel PP-5	0.73	79.95
	3	Greenfix CFO 72RR	0.74	81.21
	4	Landlok TRM 1060	0.75	82.90
	5	Curlex® III Stitched	0.79	78.52
	6	Curlex® II Stitched	0.81	81.54
	7	Enkamat NPK	0.85	79.82
	8	Enviromat	0.88	78.64
	9	SprayMat	1.07	48.39

PRODUCT PERFORMANCE - 1995 THROUGH 2000 EVALUATION CYCLES				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
1995	1	North American Green C350™ Three Phase™	0.35	79.98
1996	2	KoirMat™ 740	0.42	65.64
1996	3	Earth-Lock	0.49	69.88
1995	4	Geojute®Plus-Regular High Velocity	0.50	59.49
1996	5	Landlok® BonTerra® SFB12™	0.50	72.63
1997	6	Curlex® Channel Enforcer I	0.53	73.70
1997	7	ECS High Impact Excelsior	0.56	82.44
1995	8	Landlok® TRM 450	0.56	78.12

1995	9	Tensar® Erosion Mat TM3000	0.57	92.85
PRODUCT PERFORMANCE - 1995 THROUGH 2000 EVALUATION CYCLES				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
2000	11	North American Green S350	0.62	86.78
1998	12	Landlok® BonTerra® CP2	0.64	78.98
1997	13	Earth-Lock	0.65	76.70
1997	14	Landlok® BonTerra® SFB™	0.67	78.79
1995	15	Miramat® TM8™	0.68	86.57
1996	16	North American Green S150	0.71	82.83
1997	17	Koirmat™ 700	0.72	72.49
1997	18	Landlok® BonTerra® C2	0.72	75.77
1996	19	Tensar® Erosion Blanket TB1000	0.72	73.10
2000	20	Xcel PP5	0.73	79.95
2000	21	Greenfix CFO 72RR	0.74	81.21
2000	22	Landlok TRM 1060	0.75	82.90
1996	23	verdyol® Excelsior High Velocity	0.78	68.84
1995	24	Curlex®II (Double Sided)	0.79	54.66
1998	25	North American Green® P350	0.79	80.85
2000	26	Curlex III® Stitched	0.79	78.52
2000	27	Curlex II® Stitched	0.81	81.54
PRODUCT PERFORMANCE - 1995 THROUGH 2000 EVALUATION CYCLES				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
1996	28	Enkamat® 7018	0.83	79.84
1999	29	North American Green SC150 BN	0.84	84.59
2000	30	Enkamat Composite NPK	0.85	79.82

PRODUCT PERFORMANCE – 1995 THRU 2000 EVALUATION CYCLE				
Cycle	No.	Product Name	Average Sediment Loss	Final Vegetation Density
1995	31	Greenstreak® PEC-MAT™	0.86	71.83
1996	32	Pyramat®	0.87	67.16
1998	33	Grass Mat	0.87	66.66
2000	34	Enviromat	0.88	78.64
1998	35	ECS High Velocity Straw Mat	0.90	82.55
1999	36	Greenfix CFO72RP	0.90	74.29
1999	37	Earth-Lock II	0.91	71.97
1998	38	Landlok™ TRM 435	0.92	72.11
1999	39	North American Green C125 BN	0.95	76.88
1999	40	Multimat 100	0.95	71.72
1995	41	Enkamat® 7020	0.97	82.39
1997	42	Pyramat®	0.98	72.14
1998	43	Landlok® BonTerra® EcoNet™ ENC2	1.00	89.50
1999	44	Landlok BonTerra C2	1.01	63.41
2000	45	Spraymat	1.07	48.39
1999	46	Landlok TRM 1050	1.08	83.67
1999	47	Enkamat Composite 30	1.10	71.20
1999	48	ECS Standard Excelsior	1.10	81.37
1998	49	Curlex® Channel Enforcer II	1.01	82.65
1998	50	Permamat 150F	1.04	68.02
1997	51	Miramat® TM8™	1.07	67.37
1997	52	BioD-Mat™ 90	1.13	63.11
1995	53	Permamat 200F	1.25	56.95

95-00	54	CONTROL	2.00	47.79
1996	55	Curlex® I	2.30	69.98

SHEAR STRESS RANGE = 0 - 192 PASCAL FLOWS (0 - 4 LBS / SQ FT)

PRODUCT PERFORMANCE - 2000 EVALUATION CYCLE ONLY				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
2000	1	Landlok TRM 1060	071	84.59
	2	Greenfix CFO72RR	0.74	81.21
	3	Curlex® II Stitched	0.79	81.54
	4	Enviromat	0.84	78.64
	5	Xcel PP5	0.84	79.95
	6	North American Green S350	0.85	86.78
	7	Curlex® III Stitched	0.85	78.52
	8	Enkamat Composite NPK	0.90	79.82
	9	Spraymat	1.05	48.39
PRODUCT PERFORMANCE - 1995 THROUGH 2000 EVALUATION CYCLES				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
1995	1	North American Green C350™ Three Phase™	0.46	79.98
1996	2	Landlok® BonTerra® SFB12™	0.52	72.63
1996	3	Earth-Lock	0.52	69.88
1996	4	KoirMat™ 740	0.57	65.64
1997	5	Curlex® Channel Enforcer I	0.58	73.70
1995	6	Tensar® Erosion Mat TM3000	0.58	92.85

1995	7	Geojute®Plus-Regular High Velocity	0.61	59.49
PRODUCT PERFORMANCE - 1995 THROUGH 2000 EVALUATION CYCLES				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
1996	8	Earth-Lock	0.65	76.70
1996	9	Tensar® Erosion Blanket TB1000	0.66	73.10
1996	10	Enkamat® 7018	0.66	79.83
2000	11	Landlok TRM 1060	0.71	84.59
1997	12	ECS High Impact Excelsior	0.71	82.44
2000	13	Greenfix CFO72RR	0.74	81.21
1996	14	erdyol® Excelsior High Velocity	0.74	68.84
1997	15	Koirmat™ 700	0.75	72.49
1995	16	Landlok® TRM 450	0.76	78.12
1995	17	Greenstreak® PEC-MAT™	0.76	71.83
2000	18	Curlex® II Stitched	0.79	81.54
1995	19	Miramat® TM8™	0.79	86.57
1997	20	Landlok® BonTerra® C2	0.80	75.77
1999	21	North American Green SC150 BN	0.80	84.59
1998	22	North American Green® P350	0.82	80.85
2000	23	Enviromat	0.84	78.64
2000	24	Xcel PP5	0.84	79.95
1996	25	Pyramat®	0.84	67.16
1998	26	BonTerra® CP2	0.85	78.98
2000	27	North American Green S350	0.85	86.78

PRODUCT PERFORMANCE - 1995 THROUGH 2000 EVALUATION CYCLES				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
2000	28	Curlex® III Stitched	0.85	78.52
1999	29	Landlok TRM 1050	0.85	83.67
1999	30	Earth-Lock II	0.86	71.97
1998	31	ECS High Velocity Straw Mat	0.86	82.55
PRODUCT PERFORMANCE - 1991 THROUGH 2000 EVALUATION CYCLES				
Cycle	No.	**Product Name**	Average Sediment Loss	Final Vegetative Density
1999	32	Enkamat Composite 30	0.86	71.20
1996	33	North American Green S150	0.87	82.83
1997	34	Miramat® TM8™	0.87	67.37
1999	35	Multimat 100	0.87	71.72
1997	36	Pyramat®	0.88	72.14
2000	37	Enkamat Composite NPK	0.90	79.82
1997	38	Landlok® BonTerra® SFB™	0.90	78.79
1998	39	Landlok® BonTerra® EcoNet™ ENC2	0.92	89.50
1999	40	North American Green C125 BN	0.92	76.88
1997	41	BioD-Mat™ 90	0.93	63.11
1999	42	ECS Standard Excelsior	0.94	81.37
1999	43	Greenfix CFO72RP	0.94	74.29
1998	44	Curlex® Channel Enforcer II	0.95	82.65
1998	45	Landlok® TRM 435	0.97	72.11
1999	46	Landlok BonTerra C2	0.97	63.41
1998	47	Permamat 150F	0.98	68.02

PRODUCT PERFORMANCE - 1991 THROUGH 2000 EVALUATION CYCLES				
Cycle	No.	**Product Name**	Average Sediment Loss	Final Vegetative Density
2000	48	Spraymat	1.05	48.39
1995	49	Permamat 200F	1.08	56.95
1995	50	Enkamat® 7020	1.09	82.39
1995	51	Curlex®II (Double Sided)	2.51	54.66
1996	52	Curlex® I	2.51	69.98
95-00	53	CONTROL	3.97	47.79

SHEAR STRESS RANGE = 0 - 287 PASCAL FLOWS (0 - 6 LBS / SQ FT)

PRODUCT PERFORMANCE - 2000 EVALUATION CYCLE ONLY				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
2000	1	Landlok TRM 1060	0.69	82.91
	2	Enkamat Composite NPK	0.80	79.82
	3	Curlex® III Stitched	0.83	78.52
	4	North American Green S350	0.87	86.78
	5	Xcel PP5	1.01	79.95
	6	Enviromat	1.04	78.64
PRODUCT PERFORMANCE - 1995 THROUGH 2000 EVALUATION CYCLES				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
1996	1	Landlok® BonTerra® SFB12™	0.53	72.63
1996	2	Earth-Lock	0.55	69.88
1995	3	Tensar® Erosion Mat TM3000	0.59	92.85
1995	4	North American Green C350™ Three Phase™	0.62	82.83
1996	5	Enkamat® 7018	0.66	79.84
2000	6	Landlok TRM 1060	0.69	82.91
1996	7	Tensar® Erosion Blanket TB1000	0.75	73.10
1995	8	Landlok® TRM 450	0.75	78.12
1998	9	Landlok® BonTerra® CP2	0.77	78.98
2000	10	Enkamat Composite NPK	0.80	79.82
1998	11	North American Green® P350	0.80	80.85
1998	12	Landlok™ TRM 435	0.81	72.11

2000	13	Curlex®III Stitched	0.83	78.52
PRODUCT PERFORMANCE - 1995 THROUGH 2000 EVALUATION CYCLES				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
1995	14	Greenstreak® PEC-MAT™	0.83	71.83
1997	15	Koirmat™ 700	0.84	72.49
1996	16	Pyramat®	0.86	67.16
2000	17	North American Green S350	0.87	86.78
1997	18	Earth-Lock	0.88	76.70
1999	19	Greenfix CFO72RP	0.88	74.29
1997	20	Pyramat®	0.89	72.14
1999	21	Landlok TRM 1050	0.89	83.67
1999	22	Earth-Lock II	0.90	71.97
1998	23	Permamat 150F	0.91	68.02
1999	24	Enkamat Composite 30	0.92	71.20
1997	25	Landlok® BonTerra® SFB™	0.93	78.79
1998	26	Curlex® Channel Enforcer II	0.97	82.65
1997	27	Miramat® TM8™	1.00	67.37
2000	28	Xcel PP5	1.01	79.95
1995	29	Miramat® TM8™	1.02	86.57
1999	30	Landlok BonTerra C2	1.03	63.41
PRODUCT PERFORMANCE - 1995 THROUGH 2000 EVALUATION CYCLES				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
2000	31	Enviromat	1.04	78.64
1996	32	Verdyol® Excelsior High Velocity	1.07	68.84
1995	33	Permamat 200F	1.10	56.95

1999	34	Multimat 100	1.10	71.72
PRODUCT PERFORMANCE - 1995 THROUGH 2000 EVALUATION CYCLES				
Cycle	No.	**Product Name**	Average Sediment Loss	Final Vegetative Density
1997	35	BioD-Mat™ 90	1.11	63.11
1995	36	Enkamat® 7020	1.28	82.39
95-00	37	CONTROL	Not Tested	47.79

SHEAR STRESS RANGE = 0 - 383 PASCAL FLOWS (0 - 8 LBS / SQ FT)

PRODUCT PERFORMANCE 2000 EVALUATION CYCLE ONLY				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
2000	1	Landlok TRM 1060	0.70	82.91
	2	Curlex® III Stitched	0.78	78.52
	3	North American Green S350	0.78	86.78
	4	Enkamat Composite NPK	0.81	79.82
	5	Enviromat	0.94	78.64
	6	Xcel PP5	1.00	79.95
PRODUCT PERFORMANCE - 1995 THROUGH 2000 EVALUATION CYCLES				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
1996	1	Landlok® BonTerra® SFB12™	0.59	72.63
1995	2	Tensar® Erosion Mat TM3000	0.59	92.85
1995	3	North American Green C350™ Three Phase™	0.63	79.98
1996	4	Earth-Lock	0.67	69.88
1995	5	Landlok® TRM 450	0.69	78.12
2000	6	Landlok TRM 1060	0.70	82.91
1998	7	Landlok® TRM 435	0.71	72.11
1999	8	Landlok TRM 1050	0.75	83.67
1996	9	Tensar® Erosion Blanket TB1000	0.76	73.10
1998	10	North American Green® P350	0.77	80.85
1996	11	Pyramat®	0.77	67.16
1997	12	Pyramat®	0.78	72.14

2000	13	Curlex® III Stitched	0.78	78.52
PRODUCT PERFORMANCE - 1995 THROUGH 2000 EVALUATION CYCLES				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
2000	14	North American Green S350	0.78	86.78
2000	15	Enkamat Composite NPK	0.81	79.82
1999	16	Greenfix CFO72RP	0.83	74.29
1998	17	Permamat 150F	0.84	68.02
1998	18	Landlok® BonTerra® CP2	0.84	78.98
1999	19	Earth-Lock II	0.84	71.97
1997	20	Earth-Lock	0.86	76.70
1998	21	Greenstreak® PEC-MAT®	0.88	70.85
1998	22	Curlex® Channel Enforcer II	0.90	82.65
1999	23	Enkamat Composite 30	0.91	71.20
1997	24	Koirmat™ 700	0.93	72.49
2000	25	Enviromat	0.94	78.64
2000	26	Xcel PP5	1.00	79.95
1995	27	Greenstreak® PEC-MAT™	1.00	71.83
1997	28	Landlok® BonTerra® SFB™	1.03	78.79
1999	29	Landlok BonTerra C2	1.04	63.41
1995	30	Miramat® TM8™	1.06	86.57
PRODUCT PERFORMANCE - 1995 THROUGH 2000 EVALUATION CYCLES				
Cycle	No	Product Name	Average Sediment Loss	Final Vegetative Density
1996	31	Verdyol® Excelsior High Velocity	1.08	68.84
1999	32	Multimat 100	1.08	71.72
1997	33	Miramat® TM8™	1.09	67.37

1996	34	Enkamat® 7018	1.10	79.84
PRODUCT PERFORMANCE - 1995 THROUGH 2000 EVALUATION CYCLES				
Cycle	No.	**Product Name**	Average Sediment Loss	Final Vegetative Density
1997	35	BioD-Mat™ 90	1.15	63.11
1995	36	Enkamat® 7020	1.33	82.39
95-00	37	CONTROL	Not Tested	47.79

Year	No	Product Evaluated	1:3 Clay	1:3 Sand
1991	No Cellulose Fiber Mulch Evaluations Performed			
1992	1	American Fiber Mulch	XXX	XXX
	2	Conwed® Hydro Mulch®	XXX	XXX
	3	Second Nature® Regenerated Paper Fiber	XXX	XXX
		Total Products Evaluated:	**3**	**3**
1993	Evaluation Cycle Canceled Due to Weather Damage			
1994	1	American Fiber Mulch (with Hydro-Stik)	XXX	
	2	American Fiber Mulch (with Fiber Plus)		XXX
	3	Pro Mat®	XXX	XXX
	4	Pro Mat® XL	XXX	XXX
	5	Pro Mat® (with RMBplus)	XXX	XXX
	6	Silva-Fiber Plus®	XXX	XXX
1995	1	Second Nature® Regenerated Paper Fiber	XXX	Destroyed*
	2	Excel Fibermulch® II	XXX	Destroyed*
		Total Products Evaluated:	**7**	**7**
	* Products destroyed by natural rainfall soon after installation. Products reinstalled but were subsequently destroyed by another natural rainfall. Products			

Year	No	Product Evaluated	1:3 Clay	1:3 Sand
	were not reinstalled.			
1996	1	Enviro-Gro	XXX	XXX
	2	Excel Fibermulch® II		XXX
	3	Second Nature® Regenerated Paper Fiber		XXX
		Total Products Evaluated:	**1**	**3**
1997	1	American Fiber Mulch	XXX	XXX
	2	American Fiber Mulch with Stick Plus		XXX
	3	Conwed® Hydro Mulch®		XXX
	4	Excel Fibermulch® II		XXX
	5	Pro Mat®		XXX
	6	Pro Mat® (with RMBplus)		XXX
	7	Pro Mat® XL		XXX
		Total Products Evaluated:	**1**	**7**
1998	1	Evercycle™ Hydro-Mulch	XXX	XXX
	2	Lay-Low Mulch	XXX	XXX
	3	Pennzsuppress®	XXX	XXX
		Total Products Evaluated:	**3**	**3**
1999	1	Agri-Fiber	XXX	XXX
	2	Oasis Fiber Mulch	XXX	XXX
		Total Products Evaluated:	**2**	**2**
2000		Cycle was lost due to weather		
		Total Products Evaluated:	**0**	**0**

Final Vegetative Density

PRODUCT PERFORMANCE - 2000 EVALUATION CYCLE ONLY					
No	Product Name	Year	Slope	Soil	Vegetation Density
1	Entire cycle was lost due to slope failure from inclement weather				
2					
PRODUCT PERFORMANCE - 1992 THROUGH 2000 EVALUATION CYCLES					
No	Product Name	Year	Slope	Soil	Vegetation Density
1	Excel Fibermulch® II	1995	1:3	Clay	96.33
2	Second Nature® Regenerated Paper Fiber	1995			95.08
3	Silva-Fiber Plus®	1994			91.98
4	Pro Mat® XL	1994			86.25
5	Evercycle™ Hydro-Mulch	1998			84.33
6	Pro Mat®	1994			84.15
7	American Fiber Mulch (with Fiber Plus)	1994			82.53
8	Pro Mat® (with RMBplus)	1994			82.96
9	American Fiber Mulch	1997			82.53
10	Conwed® Hydro Mulch®	1992			82.17
11	Pennzsuppress®	1998			81.91
12	Lay-Low Mulch	1998			81.34
13	Oasis Fiber Mulch	1999			80.50
14	Enviro-Gro	1996			79.53
15	Second Nature® Regenerated Paper Fiber	1992			77.97
16	Agri-Fiber	1999			73.50
17	American Fiber Mulch	1992			66.61
18	CONTROL	92-99			57.78

Final Vegetative Density

PRODUCT PERFORMANCE - 2000 EVALUATION CYCLE ONLY					
No	Product Name	Year	Slope	Soil	Vegetation Density
1	Entire cycle was lost due to slope failure from inclement weather				
2					
PRODUCT PERFORMANCE - 1992 THROUGH 2000 EVALUATION CYCLES					
No	Product Name	Year	Slope	Soil	Vegetation Density
1	Pro Mat® (with RMBplus)	1997	1:3	Sand	90.04
2	Pennzsuppress®	1998			89.60
3	Conwed® Hydro Mulch®	1997			86.75
4	American Fiber Mulch	1997			85.56
5	Pro Mat® XL	1997			85.29
6	Pro Mat®	1997			81.97
7	American Fiber Mulch (with Fiber Plus)	1997			81.25
8	Excel Fibermulch® II	1997			79.02
9	Oasis Fiber Mulch	1999			71.14
10	Lay-Low Mulch	1998			76.47
11	Enviro-Gro	1996			68.72
12	Second Nature® Regenerated Paper Fiber	1996			65.19
13	Evercycle™ Hydro-Mulch	1998			64.66
14	Agri-Fiber	1999			55.13
15	Excel Fibermulch® II	1996			54.37
16	CONTROL	92-99			47.60

PRODUCT PERFORMANCE - 1992 THROUGH 2000 EVALUATION CYCLES					
No	Product Name	Year	Slope	Soil	Vegetation Density
17	American Fiber Mulch	1992			40.99
18	Second Nature® Regenerated Paper Fiber	1992			40.27
19	Conwed® Hydro Mulch®	1992			31.55
20	Pro Mat®	1994			25.07
21	Silva-Fiber Plus®	1994			24.83
22	Pro Mat® XL	1994			24.62
23	Pro Mat® (with RMBplus)	1994			23.05
24	American Fiber Mulch (with Hydro-Stik)	1994			22.52