

**The Texas Department of Transportation - Texas Transportation Institute
Hydraulics, Sedimentation and Erosion Control Laboratory**

INTRODUCTION:

Starting with the 1993 edition of the Texas Department of Transportation (TxDOT) *Standard Specifications for Construction of Highways, Streets and Bridges*, TxDOT shifted from a material-type specification into an “approved product”-type specification for two classifications of erosion control and revegetation products. These two product classifications included rolled and spray-on products promoted by industry for either slope protection or flexible channel liner applications, (termed “Soil Retention Blankets within TxDOT’s Standard Specification Item 169), and standard hydraulic mulches (termed “cellulose fiber mulch” within TxDOT’s Standard Construction Item 164).

TxDOT’s current specifications for soil retention blankets and for cellulose fiber mulches are included as attachments to this document, and do not include any of the typical ASTM-type material requirements such as mass per unit area, water holding capacity, tensile strength, elongation, pH, etc. TxDOT has elected to base their approved product list (APL) upon the documented field performance of the products through a formal evaluation program conducted by the Environmental Management Program of the Texas Transportation Institute (TTI).

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 (termed “Class 1” applications within TxDOT’s Standard Specification Item 169), and
- products designed for concentrated water flows associated with typical highway drainage channels (termed “Class 2” applications within TxDOT’s Standard Specification Item 169).

By statistically analyzing the performance data produced through controlled 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 APL, 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 APL.

A review of the TxDOT testing program was conducted in 2000 in order to reduce the annual operating costs of the facility. Likewise, there was a desire to make the testing program more flexible so that the program can provide a better service to other agencies that have expressed interest in the potential for a cooperative program of testing and research

THE TESTING FACILITY:

The new facility was constructed to meet 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 will be used to establish vegetation in trays and flumes before and during the testing cycle on a year-a-round basis. The facility was constructed by the Environmental Management Program of The Texas Transportation Institute on Texas A&M University's Riverside Campus, located 6.5 km (4 miles) west of Bryan, Texas.



The greenhouses at the facility allow vegetation to be grown on a year-a-round basis. The greenhouse contains the nursery flats covered with the selected slope protection products to determine their effect on establishing perennial vegetation cover and trays to grow vegetation in the flumes covered with selected channel liners prior to flow simulation.



THE INDUSTRY ADVISORY COUNCIL

The Pooled Fund Advisory Committee recognized a need for a venue through which industry could make comments and suggestions regarding the evaluation program. The Industry Advisory Council (IAC) was formed to encourage dialogue between industry, participants, related associations and the Committee. IAC members call meetings at their convenience to discuss matters appropriate to the conduct of the Laboratory. Management and staff will be available to meet with the IAC to discuss and provide answers to questions or concerns raised by the IAC. Although the committee will remain sensitive to all matters voiced by the IAC, the final decision and authority regarding the conduct of the facility remains with the Pooled Fund Advisory Committee.

INITIAL EVALUATION FEES

Effective with all products evaluated within the 2001 evaluation cycle and beyond, initial evaluation fees shall be required of each product evaluated at the TxDOT/TTI Hydraulics and Erosion Control Laboratory. These fees shall be above and beyond any fees as necessary for TTI to provide for the installation of the products.

The initial evaluation fee schedule shall be as follows:

- Class 1 “Slope Protection” Applications: \$7,500 per evaluation set
- Class 2 “Flexible Channel Liner” Applications: \$7,500 per individual channel
- “Hydraulic Mulch” Applications: \$7,500 per evaluation set
- Sediment Retention Device \$7,500 per evaluation set

An “evaluation set” is defined as two individual evaluation plots – either a 3:1 clay and a 3:1 sand set, or a 2:1 clay and a 2:1 sand set.

Should initial evaluation fees not be received within TTI by the deadline established, the product will be removed from the evaluation waiting list schedule, and the evaluation slot offered to the next product in accordance with the existing procedures relating to the waiting list. The product must then submit a new “Request for Performance Evaluation” packet in order to place the product back on the waiting list for evaluation.

RECERTIFICATION FEES & LABORATORY REPORT OPTIONS

The intent of the recertification program is to insure quality control of products once approved, and insure that no significant revisions have been made to the product’s material characteristics, trade name, private label list, official contact representative, etc.

Recertification Schedule:

Recertification fees and laboratory reports shall be required of each product on TxDOT’s Approved Product List (APL) as follows:

Class 1 “Slope Protection” Application Products:

If the Product was Originally Approved for Class 1 Applications During an Evaluation Cycle Ending In . . .	Then Initial Recertification / Recording Fees and Laboratory Reports are Due by the Last Working Day of November, of . . .	And Subsequent Recertification Recording Fees and Laboratory Reports are Due by the Last Working Day of November of . . .
2001	2004	2008, 2011, 2014, 2017, etc.
2002	2005	2009, 2012, 2015, 2018, etc.
2003	2006	2010, 2013, 2016, 2019, etc.
2004	2007	2011, 2014, 2017, 2020, etc.
2005	2008	2012, 2015, 2018, 2021, etc.
2006	2009	2013,2016,2019,2022,etc.
2007	2010	2014,2017,2020,2023,etc.
2008	2011	2015,2018,2021,2024,etc.
2009	2012	2016,2019,2022,2025,etc
2010	2013	2017,2020,2023,2026,etc
2011	2014	2018,2021,2024,2027,etc

Class 2 “Flexible Channel Liner” Application Products:

If the Product was Originally Approved for Class 2 Applications During an Evaluation Cycle Ending In . . .	Then Initial Recertification / Recording Fees and Laboratory Reports are Due by the Last Working Day of November, of . . .	And Subsequent Recertification Recording Fees and Laboratory Reports are Due by the Last Working Day of November of . . .
2000	2003	2007, 2010, 2013, 2016, etc.
2001	2004	2008, 2011, 2014, 2017, etc.
2002	2005	2009,2012, 2015, 2018, etc.
2003	2006	2010, 2013, 2016, 2019, etc.
2004	2007	2011, 2014, 2017, 2020, etc.
2005	2008	2012,2015,2018,2021, etc.
2006	2009	2013,2016,2019,2022,etc.
2007	2010	2014,2017,2020,2023,etc
2008	2011	2015,2018,2021,2024,etc.
2009	2012	2016,2019,2022,2025,ect
2010	2013	2017,2020,2023,2026,etc
2011	2014	2018,2021,2024,2027,etc

RECERTIFICATION FEES & LABORATORY REPORT OPTIONS (cont.)

“Cellulose Fiber Mulch” Application Products:

If the Product was Originally Approved for Mulch Applications During an Evaluation Cycle Ending In . . .	Then Initial Recertification / Recording Fees and Laboratory Reports are Due by the Last Working Day of November, of . . .	And Subsequent Recertification Recording Fees and Laboratory Reports are Due by the Last Working Day of November of . . .
2000	2003	2007, 2010, 2013, 2016 etc.
2001	2004	2008, 2011, 2014, 2017, etc.
2002	2005	2009, 2012, 2015, 2018, etc.
2003	2006	2010, 2013, 2016, 2019, etc.
2004	2007	2011, 2014, 2017, 2020, etc.
2005	2008	2012, 2015, 2018, 2021, etc.
2006	2009	2013,2016,2019,2022, etc.
2007	2010	2014,2017,2020,2023,ect.
2008	2011	2015,2018,2021,2024,etc.
2009	2012	2016,2019,2022,2025,etc.
2010	2013	2017,2020,2023,2026,etc
2011	2014	2018,2021,2024,2027,etc

Recertification Fees and Options:

Manufacturers of products on TxDOT’s APL have the following options regarding recertification of their products:

Option	Procedures	Type of Product	Fee
1	Manufacturer has required physical property tests performed by an independent, accredited laboratory of their choice. Tests shall have been performed within a three-month period prior to the submission for recertification. Laboratories must be accredited by either the Geosynthetic Accreditation Institute, Laboratory Accreditation Program (GAI-LAP), or the American Association for Laboratory Accreditation (A2LA)	Class 1	\$100
		Class 2	\$100
		Cellulose Fiber Mulch	\$100
2	Manufacturer submits a physical sample of product of product to the Texas Transportation Institute who will perform the appropriate physical property tests.	Rolled Class 1 or 2	\$650
		Spray-On Class 1	\$250
		Cellulose Fiber Mulch	\$250

EVALUATION WAITING LIST:

Given the limited number of individual evaluation plots or channels, and given the numbers of products being developed and marketed by industry, it was necessary to implement a waiting-list procedure to provide the greatest degree of access to the facility to the greatest number of participants. The Laboratory Manager is required to maintain a waiting list of those products that desire to be evaluated during the next available test cycle. The final decision confirming whether a product will be tested at the Laboratory rests with the Laboratory Manager.

The waiting list shall be maintained based upon the postmarked date on an acceptable, complete “Request for Performance Evaluation” (RPE) as received within TTI. Personal memoranda, telephone calls, fax transmissions or individual letters to the Lab Manager will not be utilize to determine a product(s) position on the waiting list. Based upon space availability, the Laboratory Manager will offer an evaluation slot of the gradient and soil type requested by the participant for Slope Protection applications, or for the centerline gradient requested by Flexible Channel Liner participants, based upon the order of the postmarked date on the completed RPE. In the event a participant fails to commit to testing by the deadline established by TTI, the product will be removed from the waiting list and the evaluation slot offered to the next participant on the waiting list.

Management reserves the right to limit the number of products any single company, manufacturer or distributor may evaluate during any given evaluation cycle, and will treat requests for different gradients, soil types and/or channel gradients as separate requests.

INSTALLATION & EVALUATION PROCEDURES:

With respect to products being promoted for “Slope Protection” applications, participants must select the steepness of slope on which their product is to be evaluated. Participants have the option of having their product(s) evaluated on the 3:1 slopes only, the 2:1 slopes only, or on both 3:1 and 2:1 slopes.

With respect to products being tested for “Flexible Channel Liner” applications, participants have the option of specifying the shear-stress range most appropriate for their product. Generally, the 3% centerline-gradient channels are utilized to evaluate products designed for shear stresses up to 383 pascals (8 pounds per square foot).

All products, whether submitted for “Slope Protection” or for “Flexible Channel Liners” applications, are installed in strict accordance with the manufacturer’s published installation literature, as determined by the Laboratory Manager. Particular attention will be paid to edge and junction overlaps, staple size and staple pattern. Installation techniques which, in the Laboratory Manager’s opinion, is not supported by the product’s published installation literature, will not be permitted. The adopted installation techniques as taken from the product’s published installation literature and as agreed on between the participant and Laboratory Manager may be utilized by TxDOT to produce “Standard Installation Sheets” for the approved products as may be appropriate.

Currently, all hydraulic mulches are applied at the following rates only:

- Sandy Soils - 2.8 Mg/ha (2,500 lbs/ac); or
- Clay Soils - 2.3 Mg/ha (2,000 lbs/ac).

To be approved for use by TxDOT a material must demonstrate the ability to foster the development of an acceptable vegetation cover and demonstrate that it can reduce the sediment loss to an acceptable level compared to an unprotected surface.

Each nursery flat and channel flume receive the identical rate of the standard, rural area, warm season, permanent, perennial seed mix as specified for TxDOT’s Bryan District 17. Further, each flat and channel flume receive the same amount of fertilizer and simulated rainfall.

CLASS I – SLOPE PROTECTION

The procedure for testing Class 1 slope protection materials utilizes two slopes, 1:3 and 1:2 and two soil types, sand and clay. At the participants option, a material may be tested on 1:3, 1:2 or both. Regardless of slope, the material is tested on both sand and clay. Materials are evaluated for sediment loss from three different storm intensities. Vegetation cover is determined by taking video samples which are processed to determine the average surface cover of vegetation.

Sediment loss is measured independently of vegetation. Removing the vegetation from the test provides a better measure of a materials ability to protect the soil surface and prevent down hill migration of sediment and seed. The same soil for the sediment test will be used for the vegetation cover test. Soil (sand and clay) will be sterilized using steam. Soil is placed on steam pipes laid on a concrete base. Soil will be covered and raised to a temperature of 140°F (60°C) for 6 hours. They are placed in the test beds and nursery flats within 48 hours of treatment.

Test Beds

Test beds for sediment control tests are 30 ft. x 5 ft. x 0.7 ft. deep. Frames are steel and plywood with porous bottoms. A layer of filter fabric will control loss of material from the beds over the bottom grid.

Soils used in the tests are of two types, a loamy sand and a plastic clay. The soils are collected from on site sources, graded for texture, composition and organic content to insure uniformity. Soil moisture is controlled for all tests.

Once the soils have been stabilized in the test beds the slope protection material is applied according to manufacturer's literature.



Sediment Collection and Processing

All water and sediment is collected in a tank at the base of the sediment beds. The sediment is allowed to settle for a minimum of 12 hours. At that point the clear water will be drawn off. The remaining sediment and water is removed from the sediment tank and weighed. Weight is taken to the nearest 0.1 lb. Sediment is then agitated for two minutes and 10 samples are taken. Agitation continues until all samples are taken. Samples are transferred to a desiccating oven and dried at 130°F (58°) for 24 hours. Samples are then weighed on a scientific balance to the nearest 0.0004 oz.



Sediment loss is calculated by determining the water (w) to sediment (s) ratio (w/s) of the sediment samples by dividing the dry sample weight by the original sample weight. This ratio is applied to the full sediment sample to determine total sediment loss.

Rainfall Simulation



Rainfall simulation is done using a new simulator that more closely reproduces the more damaging precipitation drop sizes found in more intense storms. Uniformity of the coverage and precipitation rate are carefully controlled. Each test consist of three (3), repetitions of three, 30-minute storms of 3.5 in/hr. After each set of 3 rainfall events, the test bed is completely rebuilt with new soil and new Class 1 material.

Vegetation Cover

Vegetation cover is based on the average percent of surface cover achieved in three standard nursery flats (12 in x 18 in) covered with the selected Class 1 material. Flats are seeded with the seeding mixture, placed on 3:1 and 2:1 racks and allowed to grow for 90 days. Percent vegetation covered is determined using a digital camera and processed using the current VCAP technology.



CLASS II – FLEXIBLE CHANNEL LINERS

The procedure for testing Class II flexible channel liner material utilizes vegetated trays 30 ft long x 1.5 ft wide x 4.0 ft deep which are placed in a flume prior to the simulated flow event. The flume slope can be adjusted from 0% to 12%. A material may be tested on a 7% or 3% slope depending on the manufacturer's estimate of the material's working strength. Shear stress flows beginning at the 96 pascal (2 lb./sq. ft.) level and continuing on a 48 pascal (1 lb./sq. ft.) increments up to 383 pascal (8 lbs./sq. ft.).

Test Channel

Three test trays are prepared for each material to be tested. Trays are lined with a filter fabric and then filled with sterile soil. They are seeded manually and the channel liner is installed. Materials are fastened at the top and bottom in accordance with the manufacturer's published literature. Once prepared, the trays are watered and placed in the greenhouse for the initial 90 day resting period. During the rest period water is provided at the rate of 0.75 inch per week.

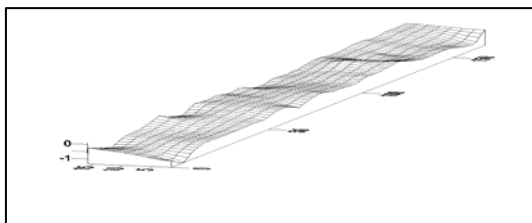


Flow Simulation

Flow simulation begins after the 90-day rest period. A tray is placed in the flume and brought to 75% field capacity. Test flows will then be run for 20 minutes. Two flows will be run on each tray successively at depths of 1 foot. After each increment of 1 foot, the material is allowed to rest for a minimum of 48 hours and the test repeated at the next stress. Test is continue in this manner until the material fails or survives a stress of >8 psf.

Sediment Data Collection

After each run, profiles are taken longitudinally. Two profiles 3 in from each side of the flume and the third along the centerline on 6 in increments are taken down the flume. This is accomplished with a computer operated instrument and the data is automatically recorded in a computer.



Sediment movement is taken as a gross measure of sediment deposited and lost. A second calculation of sediment loss is made using the average end area method from the longitudinal profiles.

Vegetation Cover

Vegetation cover remains a consideration in channel liner performance. In a channel the material relies to some degree on having some vegetation to help stabilize the blanket. Therefore, it is important that the material protect the seed bed and protect the young plants until the channel is stabilized.

At the end of the 90 day growing period, trays are checked for any foreign vegetation that could indicate that the product was contaminated with weed seed. If no weeds are present, trays are placed on a camera stand and photographed. The photographs are processed using the VCAP program to determine the percent of cover achieved.

The data reported are the arithmetic average of surface cover for the three sample trays for each soil type.

HYDRAULIC MULCHES

Cellulose and Bonded Fiber Mulches can be tested for sediment loss and vegetation growth using the same criteria as Class I slope protection for 3:1 and 2:1 clay and sand soils or they can be tested on 4:1 clay and sand soil to be listed in the Hydraulic Mulch category.

Test Beds

Soil used in the tests are of two types, a loamy sand and a plastic clay. The soils are collected from on site sources, graded for texture composition and organic content to insure uniformity. All soils are sterilized by steam. Soil moisture is controlled for all tests.

Once the soil have been stabilized in the test beds the “cellulose fiber mulch” is applied with commercial application equipment according to TxDOT’s guidelines:

- Sandy Soils – 2,500 lbs./acre
- Clay Soils – 2,000 lbs./acre

APPROVAL BY EXTENTION

Within TxDOT, “Approved by Extension” shall apply for “Slope Protection” applications only. Approval by Extension shall not apply to “Flexible Channel Liner” applications or to Hydraulic Mulch applications.

For Slope Protection applications products, if the participant elects to evaluate a product on the severe slope conditions (2:1) only, and the product successfully meets the current minimum or maximum performance established by TxDOT, the product will also be included as a approved product on the less severe (3:1) conditions within the same soil texture group. For example, if a product is evaluated on the 2:1 clay and sand beds, and successfully meets the adopted sediment and vegetation density standards for 2:1 clay only, the product will also be listed as an approved product for the more gentle 3:1 clay beds.

If a product elects, however, to test on the more gentle 1:3 beds, the product will not be added to the more severe (2:1) beds as an approved equal regardless of the performance of the material. If a product elects to be tested on both 3:1 and 3:1 beds, the product’s individual performance, as documented within each application, shall determine placement upon TxDOT’s Approved Product List (APL) and approval by extension shall not apply.

RELEASE OF PRODUCT PERFORMANCE DATA:

With the exception of the final research reports as published by the Texas Transportation Institute, all performance data will be released by TxDOT only. Performance data will be released only at the completion of an evaluation cycle, and all data, regardless of ranking, shall be published on all products by individual trade or brand name.

The Approved Product List for all products evaluated to date is available through TxDOT Internet Home Page without charge. TxDOT will maintain the latest complete performance data, including rankings, and make it available only to those states that are participating in the pooled research fund.

REVISION OF MINIMUM PERFORMANCE STANDARDS

Based upon statistical analysis of performance data as produced through the Lab, TxDOT reserves the right to revise the minimum performance standards. In the event that an individual products performance data no longer meet the revised minimum performance standards, the product representative will be notified in writing by TxDOT and provided the opportunity of retesting the identical product within the next available evaluation cycle as determined by the Lab Manager.

The product will remain on the APL pending the results of the retest. In the event that the product fails to meet any of the revised performance standards, the product will be removed from the APL during the next scheduled revision of the APL. In the event that the product's performance meets the newly adopted minimum performance standards, the product will remain on the APL.

CONTRACTOR'S OPTION

The APL will be maintained by TxDOT according to the classes and types as may be appropriate for the given products. It will be the Contractor's option of using any product, provided that product is on the current APL for the class and type specified within the plans. Installation of the product will be in strict accordance with any product installation sheets as may be issued by TxDOT.

PRIVATE LABELING:

Within TxDOT, private labeling shall apply, and private labels will be added to the APL if the original manufacturer of the product evaluated at the Lab certifies, to TxDOT's satisfaction, that the private label brand is identical to the product tested and only distributed under other (private labels) brand names. Additions or revisions to the APL due to private label name changes will be made only during the normally scheduled revision of the APL.

REQUIRED MANUFACTURER LITERATURE:

A product will not be accepted for evaluation at the Lab, nor placed on the waiting list for future evaluation at the Lab unless the participant furnishes evidence that the product is currently being marketed under a discrete trade or brand name, and unless the product can demonstrate published installation literature.

All "Request for Performance Analysis" packets for products which do not include complete manufacturer's literature, or for products which are under development only, shall not be accepted for evaluation through the Lab.

APPROVED PRODUCT LIST:

Based upon the performance data collected through the Lab, TxDOT will establish and maintain a current approved product list (APL). A revised APL will be issued only after data analysis has been completed.

The current APL will be maintained on TxDOT's Internet Home Page at:

http://www.txdot.gov/business/doing_business/product_evaluation/default.htm. Alternatively, the report may be accessed on the TxDOT Home Page through the "Search" facility, using the words "erosion control report" in the search dialogue box.

Hard copies of the current APL may also be secured through the Vegetation Management Section of the Maintenance Division, 125 E. 11th Street, Austin, TX 78701-2483, telephone (512)416-3081, fax (512)416-3044, e-mail John.Mason@txdot.gov.

PRODUCT BRAND OR TRADE NAME REVISIONS:

The manufacturer of a product evaluated at the Lab shall notify TxDOT should any revisions to the trade or brand name for the product be made. The manufacturer must provide the revised trade or brand name for the product and must further certify, to TxDOT's satisfaction, that the action reflects a revision to the trade or brand name only, and that no material properties were revised. The manufacturer must also notify TxDOT if any brand or trade name revisions are made to any of the product's private labels.

All revisions to the APL necessitated by revisions to brand or trade names will occur only within the normally scheduled revision of the APL which is typically released during February or March of each year.

WORLD WIDE WEB

This document, and the official Approved Product List, will be maintained on TxDOT's Internet Home Page at http://www.txdot.gov/business/doing_business/product_evaluation/default.htm. Hard copies of the document are also available to interested parties at no charge.

TTI also maintains an extensive Internet Web presence on the Lab. You may access this site through the Environmental Management Program, at: http://tti.tamu.edu/facilities/facility_detail.htm?cat_id=3218&fac_id=10.

SUMMARY:

The TxDOT/TTI Hydraulics and Erosion Control Laboratory is a unique facility which provides TxDOT and the specifying community data on the performance of a product's ability to protect the natural environment through controlled, formal performance evaluations.

The Lab provides industry with a timely, uniform and fair method through which their products are evaluated for possible usage within TxDOT's construction and maintenance activities. The evaluation program seeks to establish and maintain the greatest number of individual products on the APL possible, provided those products have demonstrated their ability to meet adopted minimum performance standards for the appropriate use applications.

FUTURE DIRECTIONS:

As the new protocol is installed and refined, TxDOT and TTI are planning to expand the research program to include analysis of runoff samples to test for contaminants, tenting evaluation, and laboratory methods to determine product longevity.

PROGRAM CONTACT PERSONNEL:

To discuss or request information on TxDOT's overall evaluation program for erosion control products or secure a hard copy of this report, contact John Mason, Texas Department of Transportation, Maintenance Division, Vegetation Management Section, 125 E. 11th Street, Austin, TX 78701-2483, phone (512)416-3081, fax (512)416-3044, or through e-mail to John.Mason@txdot.gov.

To secure a "Request for Performance Evaluation" packet, to inquire about waiting list or evaluation schedules or to arrange a visit to the evaluation facility, contact Jett McFalls, Lab Manager, Texas Transportation Institute Environmental Management Program, Texas Transportation Institute, 3135 TAMUS, College Station, TX 778943-3135, phone (979)847-8709, fax (979)862-1759, or through Email to mcfalls@ttimail.tamu.edu.