

# **Exhibit A - Plan of Work**

## **The Evaluation of Sixty-Day Drought Survival in San Antonio of Established Turfgrass Species and Cultivars**

**Prepared for:**

The San Antonio Water System and the Turfgrass Producers of Texas

**Principal Investigator:**

David R. Chalmers, Associate Professor & State Turfgrass Extension Specialist, Soil and Crop Sciences Department, Texas A&M University, College Station, TX 77843-2474

**Co-Principal Investigator:**

Guy Fipps, Professor and Extension Agricultural Engineer, Department of Biological and Agricultural Engineering, Texas A&M University, College Station, TX 77843-2117

**Cooperators:**

Roger Havlak - Extension Program Specialist, Turfgrass Water & Nutrient Management, Soil and Crop Sciences Department.

Richard White - Professor Turfgrass Physiology, Soil and Crop Sciences Department.

James Thomas - Senior Research Associate, Soil and Crop Sciences Department.

Karl McDonald - Extension Assistant, Irrigation Technology Center, Department of Biological and Agricultural Engineering.

**Industry Cooperators:**

Turfgrass Producers of Texas, Wharton, Texas.

Bladerunner Farms Poteet, Texas

Turfgrass America, Bay City, Texas

**Date:** June 20, 2005

**Project Duration:** July 15, 2005 through December 31, 2007

## **Project Description**

### **The Evaluation of Sixty-Day Drought Survival in San Antonio of Established Turfgrass Species and Cultivars**

The agronomic research component of this project has been divided into basic services comprising Tasks as listed below and additional services

#### **Overview**

The goal of this project is to determine grass species and varieties that can persist without irrigation in the event of a 60-day drought. Grasses will be evaluated for 60-day drought survival in four inches of soil media to provide information as to grasses that could persist in accordance with a city ordinance that requires a minimum 4-inch soil depth, as follows:

1. Turfgrasses will be established by September 1 in 2005 and exposed to a 60-day drought during July and August 2006.
2. Turfgrasses will be tested on both a four-inch soil depth and native soil depth.
3. The turfgrasses will be managed appropriate to the agronomic requirements for each species and variety, as they would be cared for as a lawn grass.
4. The study will be repeated for the 2007 growing season to validate the research results as being reproducible. This is an essential and accepted requirement for field based research in agronomy and horticulture.

The location for this study is City of San Antonio property, managed by SAWS and currently leased to Bladerunner Farms. It lies adjacent to the San Antonio Leon Creek Wastewater Treatment facility.

#### **Generalized timeline for the complete project**

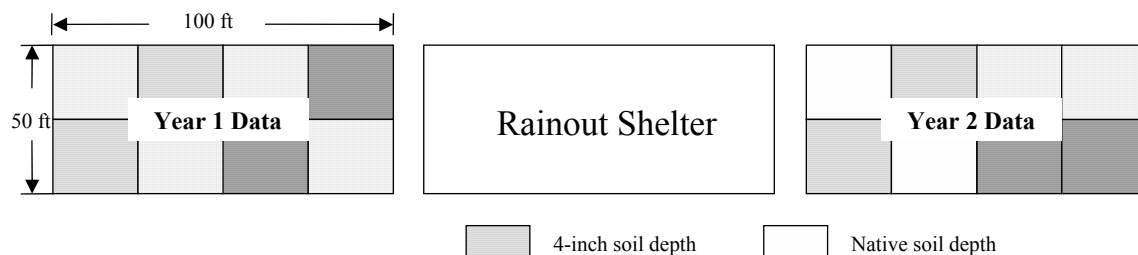
<b><u>Time Period</u></b>	<b><u>Task</u></b>
July 15-Aug 31, 2005	Construct perimeter fence, Install drainage and irrigation, systems, install 4" root barriers where needed, place soil on plots to uniform 4-inch depth where needed
Sept 2005	Plant Year 1 plots
Oct 1, 2005- June 30,2006	Maintain plots and take monthly turf quality ratings.
July 1 – Aug 31, 2006	Impose 60-day drought Take weekly turf quality ratings. Prep Year 2 plots.
Sept 2006	Plant Year 2 plots
Sept 1 – Oct 30, 2006	Take weekly ratings of recovery on Year 1 plots.

Nov 1 – Dec 20, 2006	Analyze year 1 data and prepare interim report.
Nov 1, 2006 – June 30, 2007	Maintain plots and take monthly turf quality ratings.
July 1 – Aug 31, 2007	Impose 60-day drought on Year 2 plots Take weekly turf quality ratings.
Sept 1 – Oct 30, 2007	Take weekly ratings of recovery on Year. 2 plots.
Nov 1 – Dec 31, 2007	Data analysis and prepare final report.

**Experimental Design**

Approximately 25 commonly marketed lawn grasses in the San Antonio area will be planted in a replicated field plot study. The plot area will be fenced to keep out unwanted animals and equipped with a rainout shelter capable of automatically covering the plots in the event of rainfall events thereby insuring that drought conditions can be imposed for the desired time period. Each lawn grass selected for inclusion in the study will be planted in plots that will be a maximum of 4.5 feet by 4.5 feet in size with four replications. Plots will be divided into two blocks, representing different soil conditions. One block of plots will establish a four (4) inch root zone. This block will be underlain with a high density polyethylene liner (or equivalent) to limit root depth to 4 inches to simulate grasses grown on lawns or other landscaped areas having shallow soils conforming to the minimum allowable soil depth as proposed in the Conservation Ordinance scheduled to take effect in 2007. The 4-inch root barrier will be constructed to slope in two directions to allow for drainage water to move out of the block under saturated flow. The second block will be grown on native soil with unrestricted root depth to serve as a comparison. All plots will be established from washed sod and will be maintained using irrigation and fertilization practices typical of well maintained lawn areas. Mowing will be done at 3.5” for tall-mowed grasses such as common bermudagrass, St. Augustinegrass, etc and 1.5” for grasses typically managed at lower mowing heights. The grasses will be established in Year 1 Plots from September 1, 2005 to June 30, 2006 (10 months) prior to imposing a 60-day drought. The same grasses will be established in Year 2 Plots from September 1, 2006 to June 30, 2007 (10 months) prior to imposing a 60-day drought. Turf quality of the plots will be evaluated monthly during the establishment phase and weekly during the drought period. An on-site weather station will be used to evaluate meteorological conditions throughout the study period.

**Specific Tasks for Rainout Shelter Construction, Maintenance and Management**



Schematic diagram of research area

**Task 1** - TCE, through the Irrigation Technology Center (ITC), will design and construct a rainout shelter for a cost not exceeding \$62,100. Estimated costs are as follows:

<b>Item</b>	<b>Cost (\$)</b>
Structure	12,500
Track/Rails	25,000
Control System	3,740
Drive System	2,780
Misc.	2,780
Labor*	7,000
<b>Subtotal</b>	<b>54,000</b>
Indirect costs (15%)	8,100
<b>Total</b>	<b>62,100</b>

\*Labor costs may include contractual services and travel expenses.

**Task 2** - The roof structure of the rainout shelter will be 50 feet by 100 feet, and rest on a metal and concrete track system.

**Task 3** - The shelter will be designed to automatically deploy during rain events and retract afterwards. The rainfall volume and/or rate triggering the deployment and the waiting period before retracting will be decided by mutual agreement.

**Task 4** - TCE agrees to maintain the rainout shelter for the duration of this project.

**Task 5** - Use, maintenance and financial support of the rainout shelter and associated facilities after this study will be subject of a separate MOU. Unless modified by a future MOU, the rainout shelter and associated facilities will remain under the authority of the ITC and Extension Biological and Agricultural Engineering

**Task 6** - TCE will not assume the costs of removing the concrete tracks if the shelter is relocated or dismantled in the future.

**Project Basic Tasks – 2005 though 2007**

**Key to notation of the collaborator responsibility in each task:**

**SCS** = Soil and Crop Science; **BAE** = Biological and Agricultural Engineering; **TPT** = Turfgrass Producers of Texas and/or its volunteers; **BRF** = Bladerunner Farms personnel; **SAWS** – San Antonio Water System; **TA**= Turfgrass America

**July 15, 2005 to September 1, 2005**

**Task 1 - Project Coordination Committee is formed to oversee research activity.  
SCS, BAE, SAWS, TPT, BRF, TA**

**Task 2 – Basic site preparation (Year 1 and Year 2 plots)**

- Prepare site for planting (fumigation, tillage, leveling grade) **BRF, SCS, TPT**
- Install irrigation main lines from existing mains to new experimental area **BRF, SCS**
- Install wire fence and gate around the perimeter of the research area. **SCS**
- Modify an on-site weather station to bring it on line with the Texas ET Network **BAE, SAWS**
- Relocation and use of the existing on-site storage shed for this project so that appropriate equipment may be kept secure on site. **SAWS**

**Task 3 – Determination of grasses to be tested (Year 1 and Year 2 plots)**

- TPT, SAWS and Soil and Crop Science cooperators develop protocol to select turfgrass entries for the test. The working limit on grass entries is 25. **TPT, SAWS, SCS**
- TPT will solicit sod producers for sod of grass cultivars to be tested. **TPT**
- Growers having entries in the trial will be notified of shipment dates and requirements associated with shipping grass entries to San Antonio. **TPT**

**Task 4 – Construction of research plots (Year 1 and Year 2 plots)**

- Grade research plots for surface and subsurface drainage (4-inch deep barrier plots) **SCS, TPT, BRF**
- Install drain lines on the outside edges and the center of the study. **SCS**
- Install research plot irrigation system. **SCS, BRF**
- Install root barrier layers on appropriate plots. **SCS**
- Install soil over plots with the liner barrier and encourage soil to settle to a 4-inch depth over the barrier liner. **SCS**
- Collect composite soil samples prior to plot establishment and have samples analyzed to guide fertility needs of the site. **SCS**

**Task 5 – Washing the soil from the sod prior to planting (Year 1 plots)**

- Sod is shipped to arrive at a predetermined time at the Turfgrass America facility designated to wash the soil from all sod entries. **TPT, TA**
- Sod is washed and transported to research site with minimum delay. **TPT, TA**

### **Task 6 – Planting sod on research site (Year 1 plots)**

- Sod is transplanted. **TPT, SCS**
- Sod establishment care maintenance. **SCS**

### **Research Plots: September 1, 2005 to December 2006**

#### **Task 7 - Plot Maintenance**

- Grasses will be maintained using mowing, irrigation, fertilization, pest control and other practices typical of well-maintained lawn areas suitable for each species. **SCS, BAE**
- Mowing will be at 3.5” for tall-mowed grasses such as common bermudagrass, St. Augustinegrass, etc and 1.5” for zoysiagrass and other grasses typically managed at lower mowing heights. **SCS**
- The grasses will be under normal maintenance from September 1 to June 30 (10 months) prior to imposing a 60-day drought July 1. **SCS**
- Mowing will continue into the drought period until a time when growth is suppressed by drought condition **SCS**
- Following the 60-day drought treatment, recovery from drought will be encouraged through appropriate irrigation and management. **SCS, BAE**
- Maintenance on year 1 plots will cease between November 1 and December 1.

#### **Task 8 - Data Measurements prior to imposed 60-day drought**

During the 10-month establishment period, the turf plots will be evaluated (**SCS**) on a monthly basis and will include:

- turf quality
- turfgrass density
- turfgrass color
- percent leaf firing
- percent dormancy
- percent green turf cover

#### **Task 9 – Impose 60-day drought treatment with the aid of the rainout shelter.**

- Monitor effectiveness and operation of the rainout shelter. **BAE, SCS**

#### **Task 10 - Data collection during the imposed 60-day drought imposed**

During the drought stress period, data will be collected weekly (**SCS**) and will include:

- turf quality
- turfgrass density
- turfgrass color
- percent leaf firing

- percent dormancy
- percent green turf cover

**Task 11 - Data collection during the drought recovery period (Sept 1 to October 30)**

During the post drought recovery period, data will be collected weekly (SCS) and will include:

- turf quality
- turfgrass density
- turfgrass color
- percent leaf firing
- percent dormancy
- percent green turf cover

**Task 12 – Washing the soil from the sod prior to planting (Year 2 plots)**

- Sod is shipped to arrive at a predetermined time at the Turfgrass America facility designated to wash the soil from all sod entries. **TPT, TA**
- Sod is washed and transported to research site with minimum delay. **TPT, TA**

**Task 13 – Planting sod on research site (Year 2 plots)**

- Sod is transplanted. **TPT, SCS**
- Sod establishment care maintenance. **SCS**

**Research Plots: September 1, 2006 through December 2007**

**Task 14 - Plot Maintenance**

- Grasses will be maintained using mowing, irrigation, fertilization, pest control and other practices typical of well-maintained lawn areas suitable for each species. **SCS, BAE**
- Mowing will be at 3.5” for tall-mowed grasses such as common bermudagrass, St. Augustinegrass, etc and 1.5” for zoysiagrass and other grasses typically managed at lower mowing heights. **SCS**
- The grasses will be under normal maintenance from September 1 to June 30 (10 months) prior to imposing a 60-day drought July 1. **SCS**
- Mowing will continue into the drought period until a time when growth is suppressed by drought condition **SCS**
- Following the 60-day drought treatment, recovery from drought will be encouraged through appropriate irrigation and management. **SCS, BAE**
- Maintenance on year 1 plots will cease between November 1 and December 1.

**Task 15 - Data Measurements prior to imposed 60-day drought**

During the 10-month establishment period, data will be collected weekly (SCS) and will include:

- turf quality
- turfgrass density
- turfgrass color
- percent leaf firing
- percent dormancy
- percent green turf cover

**Task 16 – Impose 60-day drought treatment with the aid of the rainout shelter.**

- Monitor effectiveness and operation of the rainout shelter. **BAE, SCS**

**Task 17 - Data collection during the imposed 60-day drought imposed**

During the drought stress period, data will be collected weekly (SCS) and will include:

- turf quality
- turfgrass density
- turfgrass color
- percent leaf firing
- percent dormancy
- percent green turf cover

**Task 18 - Data collection during the drought recovery period (Sept 1 to October 30)**

During the post drought recovery period, data collection will be done on a weekly (SCS) basis and will include:

- turf quality
- turfgrass density
- turfgrass color
- percent leaf firing
- percent dormancy
- percent green turf cover

**Task 19 – Reporting**

- Data will be entered and analyzed separately for each study year (year one and year 2). **SCS**
- 2005 activities and progress will be summarized by January 31, 2006. **SCS**
- Data from the first year study will be summarized and presented to SAWS by December 31, 2006. **SCS**
- Data from the second year study will be summarized and combined with year 1 data to produce a final report to SAWS by December 31, 2007. **SCS**