# APPENDIX B
# FORAGE INVENTORY SUMMARY REPORT

**PUBLIC DRAFT**

# Forage Inventory Summary Report

**November 2011**

# PUBLIC DRAFT

# FORAGE INVENTORY SUMMARY REPORT

---

**Contract No. W912G69-D-0067**
**Task Order No. 0010**

**Prepared for:**

Fort Hood Military Reservation
Killeen, Texas 776544-5028

**Prepared by:**

Gulf South Research Corporation
8081 GSRI Avenue
Baton Rouge, Louisiana 70820

**November 2011**

## TABLE OF CONTENTS

**1.0 BACKGROUND ..... 1**

**2.0 METHODS ..... 1**

2.1 Measuring Biomass ..... 1
2.2 Sampling Design ..... 3
2.3 Measuring Forage Availability ..... 8
2.4 Determination of Moderate Stocking Rates ..... 9
2.5 Implementation of change in stocking rates ..... 17

**3.0 RESULTS ..... 17**

**4.0 CONCLUSION ..... 19**

**5.0 REFERENCES ..... 20**

**6.0 LATIN NAMES OF PLANT SPECIES ..... 21**

## LIST OF FIGURES

Figure 1. Sample Plots in WMAN GMU ..... 4
Figure 2. Sample Plots in WMAS GMU ..... 5
Figure 3. Sample Plots in WFHN GMU ..... 6
Figure 4. Sample Plots in WFHS GMU ..... 7

## LIST OF TABLES

Table 1. Management Thresholds Based on Residual Forage Biomass ..... 10
Table 2. Residual Biomass by Species and Palatability and Stocking Rate Response by Plot for WMAN ..... 11
Table 3. Residual Biomass by Species and Palatability and Stocking Rate Response by Plot for WMAS ..... 12
Table 4. Residual Biomass by Species and Palatability and Stocking Rate Response by Plot for WFHN ..... 13
Table 5. Residual Biomass by Species and Palatability and Stocking Rate Response by Plot for WFHS ..... 14
Table 6. Frequency and Percent of Each Stocking Rate Response by GMU ..... 15
Table 7. Existing Stocking Rate, Balanced Response, and Adjusted Stocking Rate for Next Grazing Season ..... 19

## LIST OF APPENDICES

Appendix A. Data
Appendix B. Pictures

**THIS PAGE LEFT INTENTIONALLY BLANK**

## 1.0 BACKGROUND

To support the military mission and its associated training activities, United States (U.S.) Army is required to assess the impacts on the environment from all of its activities and programs and to avoid, minimize, or mitigate significant impacts. Gulf South Research Corporation was tasked by the U.S. Army Corps of Engineers (USACE) to the necessary information to support the preparation of an Environmental Assessment (EA) of a Grazing Management Plan (GMP) on Fort Hood, Texas (Contract Number W912G69-D-0067; Task Order No. 0010). This forage inventory summary report provides the methods, data, and analysis used to estimate future stocking rates under the Adaptive GMP (i.e, Proposed Action) addressed in the EA.

## 2.0 METHODS

Gulf South Research Corporation (GSRC) reviewed previous GMPs, forage inventories, and the 2003 Supplemental Environmental Assessment (SEA) for Grazing Outlease at Fort Hood. GSRC also reviewed methods for estimating biomass (i.e., dry weight of organic material per unit of area) using a Robel pole and methods for applying Robel pole biomass estimates to the management of rangelands (Ackerman 2001, Hanselka et al. 2001a, Hanselka et al. 2001b, Heitschmidt et al. 1998, Jackson and Paine 2006, Uresk and Benzon 2007, Vermier et al. 2002).

### 2.1 Measuring Biomass

**Using a Robel Pole to Measure Forage Biomass**

The Adaptive GMP would maintain moderate grazing levels in the Western Maneuver Area and West Fort Hood by adjusting stocking rates on the basis of data provided by annual forage inventories. At each plot, biomass of all vegetation would be measured using a Robel pole (Ackerman et al. 2001). Also at each sample plot, percent cover of dominant plant species would be measured by ocular estimation and pictures would be taken in each cardinal direction.

A Robel pole was used to measure visual obstruction (VO). A Robel pole consists of two poles, a string, and a viewing apparatus. The first pole was marked with alternating 2-centimeter-wide bands. The marked pole was attached to the second pole, the viewing pole, with a string exactly 4 meters long. A viewing apparatus was attached to the viewing pole at a height of 1 meter. The viewing apparatus used for this survey was a Zeiss monocular with a 4-times

magnification and a 16-millimeter objective. VO was measured by placing the viewing pole at a distance of 4 meters from the marked pole, observing the marked pole through the monocular, and recording the lowest band that was not obstructed from view by vegetation. At each sample location, four VO measurements were recorded by placing the viewing pole in each of the cardinal directions relative to the stationary, marked pole. The VO of that sample was then calculated as the average of the four readings.

VO was converted to Standing Biomass using the following linear equation proposed by Vermeire et al. (2002) for use in a variety of grasslands (i.e., short, mixed, and tall grass prairies): Standing Biomass = 183(VO) + 358

Standing Biomass is not a measure of forage availability, but a measure of the biomass of all plants present at the sample plot at the time of measurement. It was noted during sampling that plots with a higher proportion of forbs had a higher Standing Biomas than sample plots dominated by grasses. This is because of differences in growth form, with forbs having the majority of leaves and stems located near the top of the plant and grasses having the majority of leaves and stems located near the base of the plant.

For each plot, the percent cover of dominant species was measured using an ocular estimate. Relative percent cover of each species was then calculated as the percent cover divided by the total cover for a given plot. The relative percent cover of each species was then multiplied by the total residual biomass for a given plot to obtain residual biomass for each species. The residual forage biomass of each species was then multiplied by a palatability factor (i.e., good = 1.0, fair = 0.8, poor = 0.6, none = 0.0) depending on the desirability of maintaining the species on the landscape (Texas AgriLife Extension 2011). The total residual forage biomass of each plot was then calculated as the sum of the biomass of each species multiplied by its palatability factor. Using a palatability factor, as opposed to classifying species as consumable or non-consumable, provides greater weight to those species which are most desirable on the landscape. This emphasizes monitoring of, and management for, the residual biomass of key species.

**Comparison of Robel Pole to Clipping and Drying Methods**

Compared to clipping and drying methods of measuring biomass, the Robel pole allows a large number of measurements to be taken in a short time. Thus, a larger number of sample plots

can be evaluated for a given level of funding. The Robel pole technique is an acceptable, time-saving method for these circumstances. However, the correlation between visual obstruction and forage estimates are generally better in homogeneous vegetative communities than in heterogeneous rangeland vegetative communities. It is recommended that correlations be developed for each type of vegetation community sampled at the time of sampling to provide more accurate estimates of biomass. Ocular estimates can be insufficient to determine relative percent cover of each species present at a plot depending on the training and background of the personnel completing the action. Maintaining consistency in personnel completing this action will reduce variability when using the ocular estimation method. The estimated cost of implementing a forage inventory using the clipping and drying method conducted in 2006 (Appendix E) was $20,000 to $30,000, which is similar to the estimated cost of implementing a forage inventory using the Robel pole method conducted in 2010. The analysis of Robel pole data is also relatively rapid compared to clipping and drying. Biomass values can be calculated from Robel pole data within a few days after sampling, while final values of biomass obtained from dried plant specimens can take a month or more.

## 2.2 Sampling Design

### Stratified Random Sampling

The number and location of sample plots would be selected to capture the variation of vegetation communities, soil types, and history of disturbance and management within the grazeable area of each Grazing Management Unit (GMU). At least 75 plots would be sampled each year. The statistical significance provided by this number of samples has not been determined; however, this is the number of samples that can be reasonably recorded given current funding levels. Sample plots would be randomly distributed within the grazeable area of each GMU. Grazeable area would be delineated using aerial imagery and was identified as areas with less than 20 percent cover of trees and the slope was less than 10 percent. Sample locations would be then stratified by GMU and soil type. The number of sample plots placed in each GMU would be proportional to the area of each GMU relative to the total area of all GMUs sampled, while the number of samples placed within each soil type in a GMU would be proportional to the area of each soil type relative to the area of the GMU.

The sample plot locations are depicted in Figures 1 through 4, and the coordinates of each sample plot are provided in Appendix A. A total of 77 sample plots were first divided among the four GMUs, with 25 plots assigned to the Western Maneuver Area – North (WMAN), 24 plots

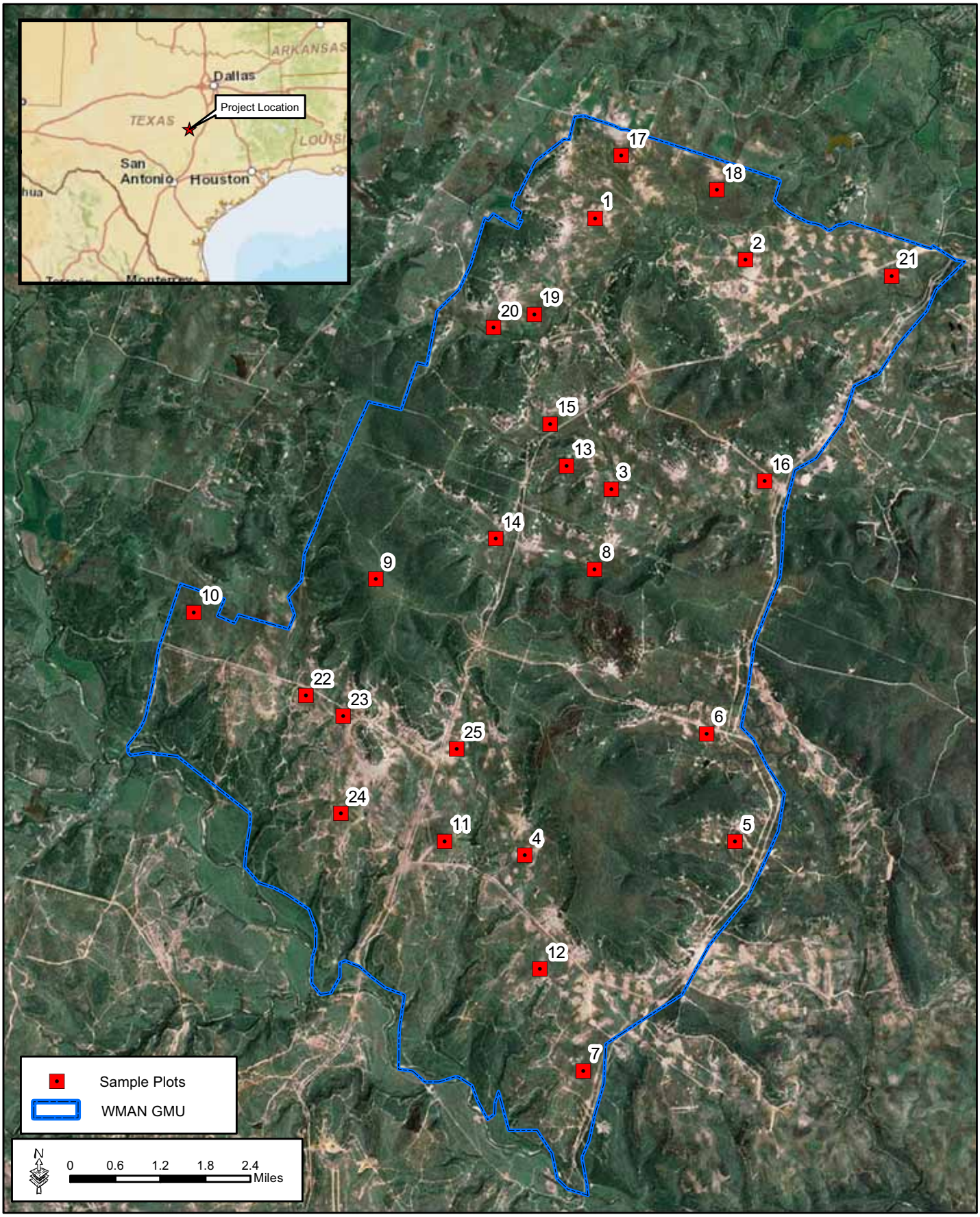



Figure 1: Sample Plots in WMAN GMU

GSRC

November 2010

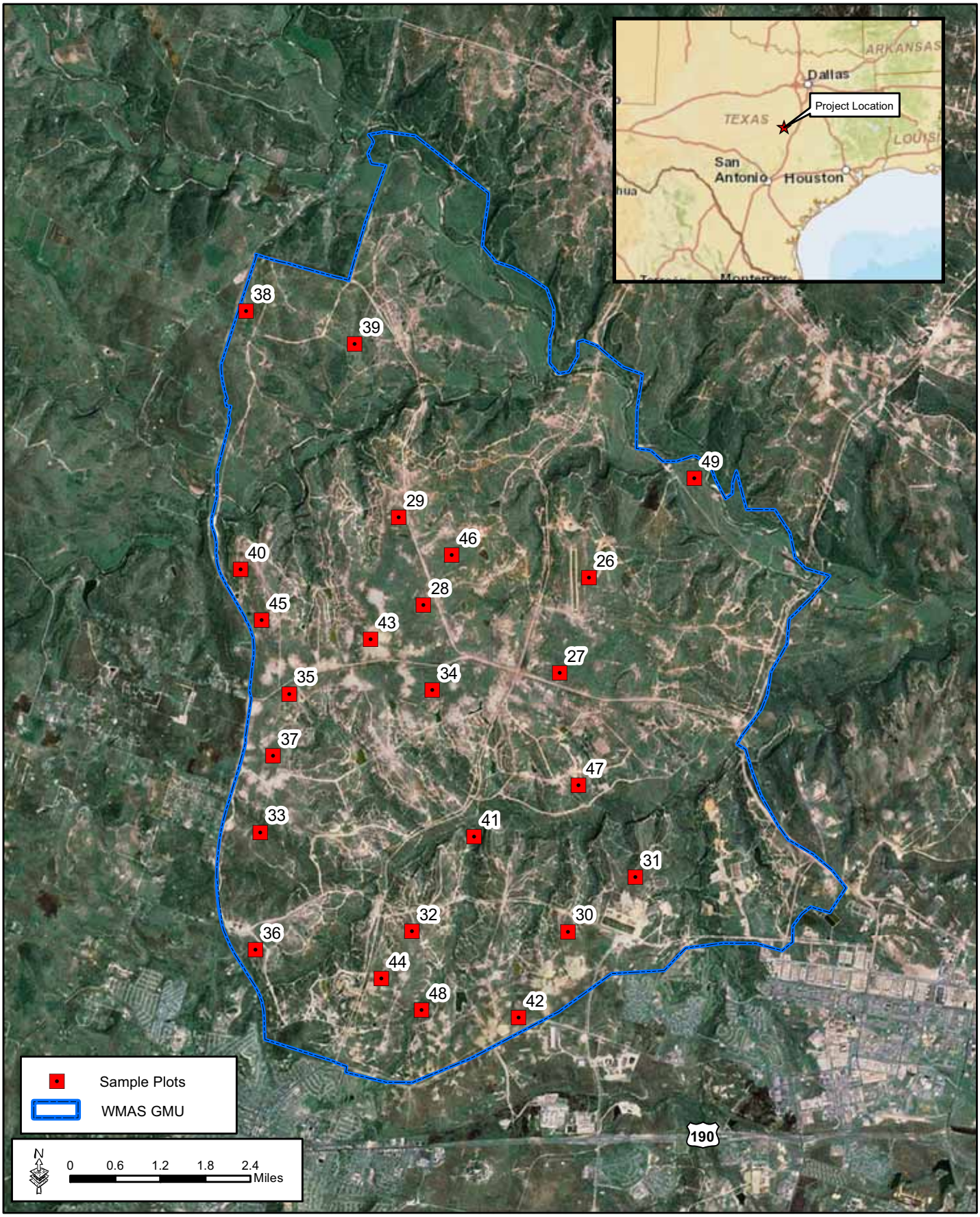



Figure 2: Sample Plots in WMAS GMU

GSRC

November 2010

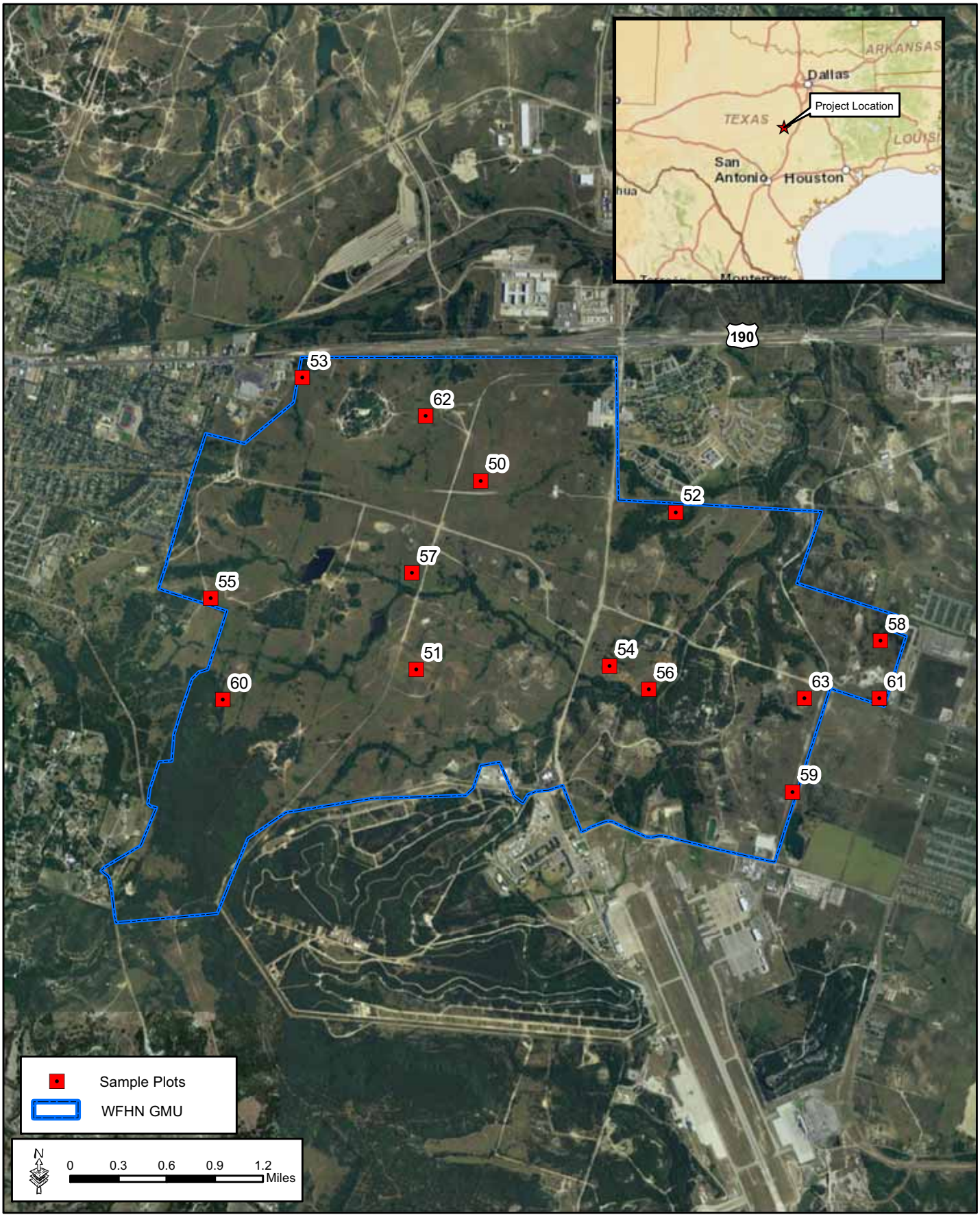



Figure 3: Sample Plots in WFHN GMU

GSRC

November 2010

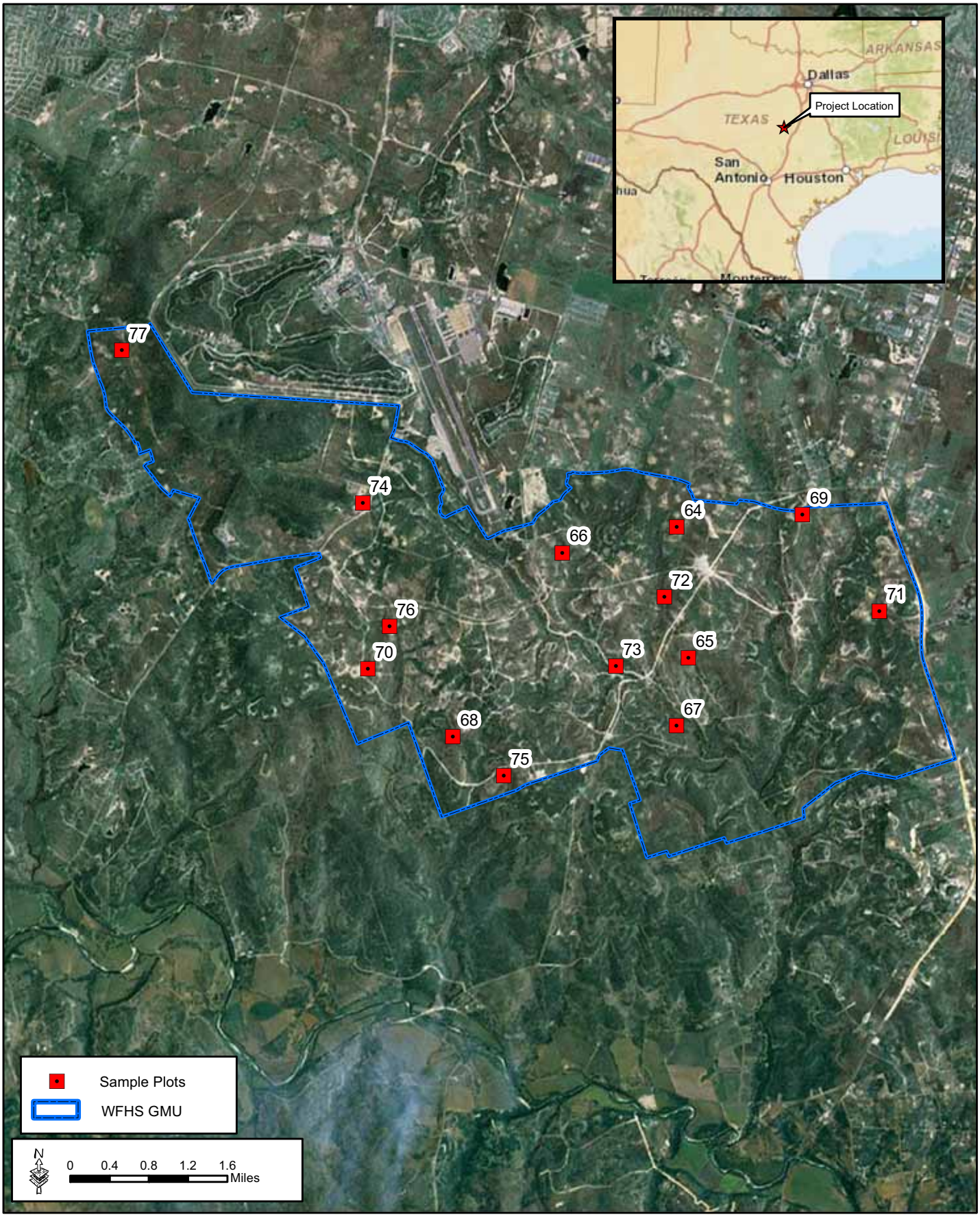



Figure 4: Sample Plots in WFHS GMU

GSRC

November 2010

assigned to the Western Maneuver Area – South (WMAS), 14 plots assigned to West Fort Hood – North (WFHN), and 14 plots assigned to West Fort Hood – South (WFHS). Then, plots were assigned to each soil type proportional to the soil type area within a given GMU. For example, if 50 percent of the grasslands in WMAN were mapped as soil type "A", then 50 percent of the sample plots were randomly located in soil type "A". There were some soil types which constituted less than 1 percent of the grasslands in a GMU. These soil types were not represented by a sample plot.

**Comparison of Stratified Random Design to Representative Plots**

Previous sample designs located one sample plot in each soil association within a GMU. The location of the sample plot was chosen as a representative location of the soil association based on professional judgment. Where sample data indicated a lack of forage availability, the entire soil association was removed from the grazeable area of the GMU. Randomly locating multiple samples within a soil type provides a more robust estimate of biomass. Although the representative sample locations may have provided an accurate measurement of biomass at that location, they do not provide any indication of forage levels in "non-representative" locations. By randomly locating multiple samples within a soil type, the data will be more representative of the variety of conditions present in a soil type as affected by varying intensity of grazing, training, and management in any given year. By excluding sample plots from locations lacking forage (i.e., forested areas) or presenting unsuitable conditions for cattle (i.e., slopes greater than 10 percent), the value of each sample is increased. In other words, by sampling in grazeable areas only, each sample will provide data that are used in the final analysis.

## 2.3 Measuring Forage Availability

**Residual Forage**

Under the Adaptive GMP proposed in this EA, the forage inventory would measure biomass of residual forage. Residual forage is the biomass of palatable plants left on the range at the end of the growing season. At Fort Hood, grazing is continuous year-round. Thus, residual forage would be measured at the end of the growing season (i.e., the frost-free period from spring through fall), which growing season typically extends from April 1 to November 1 (National Climate Data Center 2008).

**Comparison of Residual Forage to Forage Use**

Forage use (i.e., the amount of forage removed by grazing) and residual forage (i.e., the amount of forage remaining after grazing) are both measures of grazing intensity. Grazing intensity is the level of grazing relative to the productivity of a rangeland, such that a given stocking rate can represent different levels of grazing intensity depending on the productivity of the rangeland.

Forage use is commonly used to calculate stocking rates based on the estimated productivity (i.e., the amount of forage that will be available during the next grazing season) of a given rangeland. However, because of variations in precipitation, disturbance, and other factors, it is difficult to predict total annual production. Consequently, forage use cannot be accurately measured until the end of the growing season, and then only if annual production can be measured accurately. Measuring annual forage biomass production at Fort Hood would require the identification or establishment of numerous plots within each soil type that are isolated from the effects of grazing and training. This approach is impracticable on training lands where exclosures could impede movement and realism of training. Furthermore a single sampling event would not account for regrowth of plant material following repeated grazing throughout the grazing season.

Residual forage, or the forage remaining ungrazed at the end of the growing season, is a good indicator of a wide range of environmental conditions occurring throughout the year (i.e., climate, training, land management, wild fire, and grazing). Residual forage is a good indicator of how well rangeland health and sustainability, as well as other resource values, are being maintained. Range health is more directly related to the amount of forage ungrazed than the amount consumed; thus, a critical measure of rangeland health is the amount of residual forage left after grazing.

## 2.4 Determination of Moderate Stocking Rates

Stocking rates would be increased or decreased based on the proportion of sample plots within a GMU in which residual forage is above or below management thresholds (Table 1) (Menke 1992, Heitschmidt et al. 1998, Hanselka et al. 2001, Reinecke et al. 2011). Management thresholds represent points at which changing levels of biomass begin to affect other processes on the landscape. An ecological threshold is a point at which an irreversible change in the health and sustainability of rangeland may occur. There are a number of ecological thresholds

on rangelands. Examples of ecological thresholds are changes from healthy grassland to grassland invaded by other plants, and from natural erosion to accelerated erosion. Management thresholds are points at which management must be changed to avoid crossing an ecological threshold.

**Table 1. Management Thresholds Based on Residual Forage Biomass**

| Residual Forage Biomass | Grazing Intensity | Effect | Stocking Rate Adjustment |
|---|---|---|---|
| < 750 | Over Grazing | Erosion rates become unsustainable, perennial grasses replaced by annual grasses and forbs | Defer |
| 750 to 1,000 | Heavy | Short-grass species favored at the lower end of the range, mid-grass species favored at higher end | Decrease |
| 1,000 to 1,500 | Moderate | Effective fuel loads, limited woody encroachment | Maintain |
| > 1,500 | Light | Excessive fuel loads, increased woody encroachment | Increase |

In order to account for the adverse effects of open and continuous grazing on areas where cattle tend to graze repeatedly, the residual forage biomass of each plot would be compared to management thresholds and the appropriate adjustment of stocking rates would be identified for each sample plot (see Table 1). The percent cover of palatable species, the most common non-consumable species for each plot, the residual biomass, residual forage biomass, and the stocking rate response for each plot are provided in Tables 2 through 5. Species' latin names are provided in Section 6.0. The frequency of each stocking rate response by plot was then calculated (Table 6) and the following steps were taken to determine a balanced response:

1) Subtract the number of "defer" plots from the number of "increase" plots.
2) If the result of step 1 is negative, the balanced response is to defer grazing. If the result of step 1 is not negative, go to step 3.
3) Subtract the number of "decrease" plots from the remaining "increase" plots.
4) If the result of step 3 is 0, the balanced response is to maintain stocking rates. If the result of step 3 is not 0, go to step 5.
5) Calculate the degree of decrease or increase as the number derived from step 3 divided by the total number of plots.
6) The Installation will then determine the appropriate stocking rate based on the rates recommended by the Adaptive GMP and any other pertinent knowledge.

## Table 2. Residual Biomass by Species and Palatability and Stocking Rate Response by Plot for WMAN

| Plot # | Palatability | | | | | | | | | | | | | Residual Biomass (pounds per acre) | Residual Forage (pounds per acre) | Response |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fair | None | None | Poor | Fair | Fair | Good | Fair | Fair | Fair | Fair | Good | Fair | | | |
| | Kingranch Bluestem | Broomweed | Cuman Ragweed | Texas Grama | Silver Beardgrass | Dropseed | Little Bluestem | Hall's Panicum | Wrights three-awn | Texas Wintergrass | White Tridens | Sideoats Grama | Hairy Grama | | | |
| | (percent cover) | | | | | | | | | | | | | | | |
| 1 | 10 | 45 | 15 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 3,933 | 952 | decrease |
| 2 | 30 | 0 | 10 | 5 | 10 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 2,487 | 1,327 | maintain |
| 3 | 35 | 20 | 5 | 10 | 15 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 2,728 | 1,240 | maintain |
| 4 | 25 | 10 | 0 | 15 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,692 | 1,433 | maintain |
| 5 | 30 | 0 | 0 | 0 | 5 | 20 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 4,013 | 2,368 | increase |
| 6 | 95 | 5 | 5 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 4,816 | 3,445 | increase |
| 7 | 30 | 15 | 10 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 4,816 | 1,401 | maintain |
| 8 | 35 | 5 | 10 | 15 | 5 | 0 | 15 | 0 | 0 | 5 | 0 | 0 | 0 | 2,728 | 1,488 | maintain |
| 9 | 15 | 20 | 0 | 5 | 5 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 3,772 | 974 | decrease |
| 10 | 40 | 0 | 50 | 5 | 5 | 10 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 5,137 | 2,173 | increase |
| 11 | 55 | 40 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,655 | 1,463 | maintain |
| 12 | 15 | 55 | 15 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 6,020 | 946 | decrease |
| 13 | 15 | 0 | 0 | 40 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 2,568 | 1,208 | maintain |
| 14 | 50 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 5 | 15 | 0 | 0 | 0 | 5,057 | 2,574 | increase |
| 15 | 30 | 5 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2,158 | 942 | decrease |
| 16 | 80 | 10 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,583 | 3,121 | increase |
| 17 | 85 | 15 | 5 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,598 | 2,048 | increase |
| 18 | 90 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,495 | 2,942 | increase |
| 19 | 35 | 25 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3,933 | 1,468 | maintain |
| 20 | 25 | 5 | 10 | 20 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 3,371 | 1,798 | increase |
| 21 | 0 | 10 | 5 | 20 | 0 | 0 | 0 | 10 | 5 | 0 | 0 | 0 | 0 | 1,684 | 539 | defer |
| 22 | 10 | 45 | 25 | 20 | 5 | 10 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5,780 | 1,475 | maintain |
| 23 | 40 | 5 | 15 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 5 | 0 | 0 | 4,977 | 1,991 | increase |
| 24 | 30 | 70 | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,298 | 848 | decrease |
| 25 | 65 | 15 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,378 | 2,432 | increase |

## Table 3. Residual Biomass by Species and Palatability and Stocking Rate Response by Plot for WMAS

| Plot # | Palatability | | | | | | | | | | | | | Residual Biomass (pounds per acre) | Residual Forage (pounds per acre) | Response |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Fair | None | None | Good | Poor | Fair | Good | Fair | Fair | Fair | Fair | Fair | Good | | | |
| | Kingranch Bluestem | Cuman Ragweed | Broomweed | Little Bluestem | Texas Grama | Dropseed | Indian Grass | Silver Beardgrass | Hall's Panicum | Purple three-awn | Hiary Grama | White Tridens | Sideoats Grama | | | |
| | (percent cover) | | | | | | | | | | | | | | | |
| 26 | 85 | 25 | 5 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 5,539 | 2,954 | increase |
| 27 | 60 | 15 | 10 | 20 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,495 | 2,464 | increase |
| 28 | 75 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,977 | 1,659 | increase |
| 29 | 15 | 35 | 0 | 15 | 20 | 0 | 0 | 5 | 0 | 10 | 0 | 0 | 5 | 2,247 | 1,048 | maintain |
| 30 | 0 | 10 | 0 | 5 | 0 | 30 | 15 | 5 | 0 | 5 | 0 | 5 | 0 | 5,298 | 3,709 | increase |
| 31 | 80 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,458 | 3,465 | increase |
| 32 | 0 | 65 | 0 | 40 | 5 | 10 | 5 | 10 | 0 | 0 | 0 | 0 | 0 | 4,174 | 1,723 | increase |
| 33 | 80 | 15 | 0 | 10 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,061 | 3,733 | increase |
| 34 | 30 | 40 | 15 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,174 | 980 | decrease |
| 35 | 25 | 35 | 5 | 10 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 3,772 | 1,166 | maintain |
| 36 | 0 | 30 | 50 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,736 | 379 | defer |
| 37 | 40 | 0 | 5 | 30 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,334 | 2,966 | increase |
| 38 | 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,940 | 4,002 | increase |
| 39 | 0 | 5 | 5 | 0 | 15 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 1,122 | 468 | defer |
| 40 | 35 | 25 | 10 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,013 | 1,188 | maintain |
| 41 | 75 | 15 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,458 | 2,519 | increase |
| 42 | 0 | 30 | 0 | 0 | 10 | 5 | 10 | 5 | 0 | 0 | 5 | 0 | 0 | 3,692 | 985 | decrease |
| 43 | 5 | 20 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 1,604 | 321 | defer |
| 44 | 85 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 5,860 | 3,014 | increase |
| 45 | 75 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6,261 | 4,453 | increase |
| 46 | 20 | 10 | 60 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,093 | 598 | defer |
| 47 | 90 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,977 | 2,986 | increase |
| 48 | 45 | 10 | 0 | 15 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5,780 | 3,589 | increase |
| 49 | 5 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4,174 | 531 | defer |

## Table 4. Residual Biomass by Species and Palatability and Stocking Rate Response by Plot for WFHN

| Plot # | Palatability | | | | | | | | | | Residual Biomass (pounds per acre) | Residual Forage (pounds per acre) | Response |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | None | Good | Fair | Fair | Fair | None | Fair | Fair | Good | Fair | | | |
| | Cuman Ragweed | Little Bluestem | Texas Grama | Purple Three-awn | Kingranch Bluestem | Broomweed | Hiary Grama | Dropseed | Indian Grass | White Tridens | | | |
| | (percent cover) | | | | | | | | | | | | |
| 50 | 25 | 0 | 0 | 0 | 10 | 5 | 5 | 30 | 0 | 0 | 3,772 | 1,086 | maintain |
| 51 | 10 | 0 | 10 | 0 | 25 | 15 | 0 | 0 | 0 | 0 | 3,130 | 1,017 | maintain |
| 52 | 20 | 0 | 30 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 1,765 | 838 | decrease |
| 53 | 0 | 35 | 15 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 4,736 | 2,901 | increase |
| 54 | 5 | 0 | 50 | 10 | 5 | 0 | 0 | 0 | 0 | 5 | 1,323 | 695 | defer |
| 55 | 5 | 60 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 3,692 | 2,953 | increase |
| 56 | 45 | 0 | 5 | 5 | 5 | 0 | 15 | 0 | 0 | 0 | 1,925 | 521 | defer |
| 57 | 10 | 15 | 0 | 0 | 10 | 15 | 5 | 0 | 0 | 0 | 4,174 | 1,252 | maintain |
| 58 | 5 | 20 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 2,086 | 910 | decrease |
| 59 | 0 | 5 | 5 | 30 | 0 | 0 | 5 | 0 | 0 | 0 | 1,444 | 547 | defer |
| 60 | 0 | 0 | 15 | 5 | 5 | 0 | 5 | 0 | 0 | 0 | 2,969 | 1,134 | maintain |
| 61 | 30 | 0 | 0 | 0 | 25 | 20 | 0 | 0 | 0 | 0 | 3,531 | 785 | decrease |
| 62 | 15 | 5 | 5 | 0 | 5 | 10 | 0 | 0 | 10 | 0 | 4,415 | 1,214 | maintain |
| 63 | 0 | 5 | 10 | 20 | 5 | 5 | 0 | 5 | 0 | 0 | 1,363 | 530 | defer |

## Table 5. Residual Biomass by Species and Palatability and Stocking Rate Response by Plot for WFHS

| Plot # | Palatability | | | | | | | | | | | | Residual Biomass (pounds per acre) | Residual Forage (pounds per acre) | Response |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | None | None | Poor | Fair | Good | Fair | Fair | Fair | Fair | Fair | Fair | Fair | | | |
| | Cuman Ragweed | Broomweed | Texas Grama | Puprle Three-awn | Little Bluestem | Hiary Grama | Texas Wintergrass | Silver Beardgrass | Kingranch Bluestem | Halls Panicum | Dropseed | Wrights Three-awn | | | |
| | (percent cover) | | | | | | | | | | | | | | |
| 64 | 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 5,298 | 748 | defer |
| 65 | 45 | 10 | 0 | 5 | 5 | 10 | 5 | 5 | 0 | 5 | 5 | 0 | 3,371 | 890 | decrease |
| 66 | 25 | 5 | 0 | 0 | 15 | 10 | 5 | 5 | 5 | 0 | 0 | 0 | 2,728 | 1,273 | maintain |
| 67 | 10 | 5 | 0 | 0 | 15 | 0 | 0 | 0 | 5 | 0 | 0 | 10 | 2,487 | 1,221 | maintain |
| 68 | 15 | 5 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,604 | 275 | defer |
| 69 | 20 | 10 | 10 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 1,524 | 388 | defer |
| 70 | 55 | 10 | 0 | 5 | 0 | 0 | 15 | 0 | 5 | 0 | 0 | 0 | 5,940 | 1,033 | maintain |
| 71 | 45 | 5 | 0 | 20 | 0 | 10 | 15 | 10 | 0 | 5 | 0 | 0 | 3,451 | 1,380 | maintain |
| 72 | 50 | 5 | 20 | 5 | 0 | 0 | 5 | 5 | 0 | 5 | 0 | 5 | 3,852 | 1,072 | maintain |
| 73 | 5 | 5 | 5 | 15 | 5 | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 1,604 | 917 | decrease |
| 74 | 5 | 5 | 15 | 0 | 5 | 0 | 0 | 10 | 10 | 0 | 0 | 0 | 3,612 | 1,970 | increase |
| 75 | 40 | 5 | 0 | 10 | 5 | 5 | 0 | 5 | 5 | 0 | 0 | 0 | 2,926 | 975 | decrease |
| 76 | 10 | 5 | 5 | 5 | 20 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 3,049 | 1,719 | increase |
| 77 | 0 | 5 | 10 | 10 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 3,049 | 1,558 | increase |

**Table 6. Frequency and Percent of Each Stocking Rate Response by GMU**

| Residual Forage Biomass (pounds per acre) | Plot Response | WMAN | | WMAS | | WFHN | | WFHS | |
|---|---|---|---|---|---|---|---|---|---|
| | | Frequency | Percent | Frequency | Percent | Frequency | Percent | Frequency | Percent |
| < 750 | defer | 1 | 4 | 5 | 20 | 4 | 29 | 3 | 21 |
| 750 to 1000 | decrease | 5 | 20 | 2 | 8 | 3 | 21 | 3 | 21 |
| 1000 to 1500 | maintain | 9 | 36 | 3 | 12 | 5 | 36 | 5 | 36 |
| > 2000 | increase | 10 | 40 | 15 | 60 | 2 | 14 | 3 | 21 |

**Comparison**

Previous stocking rate calculations were based on measurement of rangeland productivity (i.e., dry weight of palatable plants measured in July), estimation of future training impacts on biomass production, and conservation thresholds established to moderate grazing pressure. Rangeland productivity was measured at a single location chosen to represent each ecological site and the total productivity of a GMU was calculated as the area-weighted average of ecological site productivity. The volume of available forage was then reduced by a factor representing the estimated impacts of the next year's training. The adjusted forage volume was then used to calculate stocking rates using three methods: the 25 percent Harvest Efficiency method (i.e., 50 percent residual biomass), by subtracting 750 pounds per acre of biomass as residual forage and grazing the remaining forage, and by subtracting 1,000 pound per acre as residual forage and grazing remaining forage. The stocking rate calculation method was then selected for each GMU based on rangeland conditions and estimated erosion conditions.

These methods were revised to account for differences in the timing of sampling, the relative imprecision of Robel pole estimates, and to mimic other management plans which rely on rapid assessment of rangeland health using a Robel pole. Robel pole measurements were recorded at the end of the growing season and represent residual forage. The Adaptive GMP would adjust stocking rates in response to the measured effects of a past growing season and the estimated response of grasslands to future grazing pressure and disturbance (i.e., climate, fire, and training). This approach also allows the CTCA time to remove or introduce cattle for the next growing season during which the adjusted stocking rates would apply.

Residual biomass is not used to predict the volume of forage that will be available in the next season, but is an indicator of the rangeland's ability to respond to favorable or unfavorable changes in disturbance or climate. Residual biomass could be used to estimate productivity based on assumed conditions of disturbance and climate; however, this step increases the separation between decision thresholds and actual conditions. Furthermore, residual biomass estimates for each plot are based on an imprecise formula for converting VO to dry weight of plant material. Using the proposed methods, estimated residual biomass is used as an indicator of the resilience of each plot and the status of each plot within a GMU is considered when determining the stocking rate to be applied to a GMU. Previous methods based stocking rate decisions on an average value of biomass measured at a single plot in each ecological site. This average value is a mathematical artifact and does not approximate actual conditions

observed in the field. In other words, this method adjusts stocking rates assuming the measured condition occurs everywhere within the ecological site.

### 2.5 Implementation of change in stocking rates

Currently, the CTCA provides AU stocked on a monthly basis. This practice will be continued; in addition, the CTCA will provide total AUs by GMU that is verified by Fort Hood during spring working (or not later than April 1), and at fall weaning/ shipping (or no later than November 1). It is also recommended that any stocking rate adjustments for the next growing season that recommend a deferral or reduction would be implemented between October 15 and November 1 of the current growing season. Maintaining stock densities for 2 to 5 months beyond a recommended deferral or reduction could lead to accelerated erosion, spring weed flush, and favor cool-season annual grasses over warm-season perennial grasses. This timing would also correspond with fall weaning/shipping which would make it easier on the cattle producers to make reductions as they would already have their cattle gathered. This timing would also facilitate verification of stocking rates by personnel at Fort Hood.

A recommended stocking rate increase should be allowed no earlier than April 1 of the next growing season. This time period corresponds with the beginning of the growing season and would also accommodate verification of stocking rates. At this time, spring calving herds would be in the middle of or finishing calving. The cattle producers should be monitoring their herds more closely during this time of year.

## 3.0 RESULTS

Measured VO, estimated residual biomass, and estimated residual forage biomass for each sample plot are provided in Appendix A. Representative pictures of each site taken from the location of the banded pole and facing each cardinal direction are provided in Appendix B. In 2010, estimated biomass by plot was between 1,100 and 6,600 pounds per acre and the plot average was 3,800 pounds per acre. By comparison, the 2005 forage inventory estimated biomass by plot to be between 27 and 6,200 pounds per acre and the plot average was 1,900 pounds per acre. Estimated residual forage biomass by plot, modified by the palatability index, was between 275 and 4,450 pounds per acre and the plot average was 1,600 pounds per acre. By comparison, the total consumable forage by plot measured in 2005 was between 13 and 3,350 pounds per acre and the plot average was 631. While the two surveys are not directly

comparable due to differences in methods, timing, and extent of the surveyed area, these differences suggest a decrease in the number of plots with relatively low biomass.

In the Western Maneuver Area, the majority (i.e., 76 percent) of residual forage biomass values were greater than 1,000 pounds per acre. However, Kingranch bluestem was the dominant species in WMAN and WMAS, and the majority of residual forage biomass is derived from this species. The next two most abundant species in these GMUs were Cuman ragweed and broomweed, which were generally dominant in plots where Kingranch bluestem was less abundant. Little bluestem, a highly desirable species, was nearly absent from WMAN and was occasionally present in relatively low abundance in the WMAS, especially where Kingranch bluestem was less abundant. Kingranch bluestem is only palatable for a short period during the growing season (personal communication with Tim Buchanan 2011), and likely biomass values for this species could represent a greater availability of forage than actually occurs. The predominant influence of Kingranch bluestem on residual forage biomass values can be illustrated by changing the palatability index for this species. If Kingranch bluestem were assigned a palatability index of 0.2 or 0.0, 25 or 27 of 49 plots would have been classified as defer, respectively. If Kingranch bluestem were coded as poor, just 8 of 49 plots in the Western Maneuver area would have been classified as defer.

The next two most abundant species in the Western Maneuver Area GMUs were Cuman ragweed and broomweed, which were generally dominant in plots where Kingranch bluestem was less abundant. These species are indicators of disturbance or overgrazing and one of these species was present in nearly every plot, with some plots having up to 70 percent cover of just one of these species.

In West Fort Hood, residual forage biomass values were nearly evenly split between values less than or greater than 1,000 pounds per acre, or 13 and 15, respectively. However, approximately half of plots with less than 1,000 pounds per acre were classified as defer, and approximately two-thirds of plots with greater than 1,000 pounds per acre were classified as maintain. In the West Fort Hood GMUs, Cuman ragweed was the most common and abundant species, while Kingranch bluestem was less common and, when present, was less abundant when compared to the Western Maneuver Area GMUs. In WFHN, little bluestem was nearly as abundant as Cuman ragweed, but had a cover greater than 5 percent in just four plots. Little bluestem was equally as common, but less abundant in WMAS plots. The grama grasses,

three-awns, and silver beardgrass were relatively more common in the West Fort Hood plots when compared to the Western Maneuver Area Plots.

## 4.0 CONCLUSION

In each GMU there was at least one plot in which low residual forage biomass values necessitate deferrals to prevent long-term adverse effects and the need for remedial measures to establish climax plant communities. The uneven distribution of residual forage biomass values indicates that some areas are being overgrazed while other areas are not being utilized to their full potential. The uneven distribution of biomass reflects the lack of spatiotemporal herd management on Fort Hood. Using the steps outlined in Section 2.3 of this report, the balanced response to observed residual forage biomass is an increase in stocking rates for the Western Maneuver Area GMUs, deferral of grazing in WMAN, and a decrease of stocking rates in WFHS (Table 7).

**Table 7. Existing Stocking Rate, Balanced Response, and Adjusted Stocking Rate for Next Grazing Season**

| GMU | Existing Stocking Rate (AU) | Balanced Response | Rate (percent) | Adjusted Stocking Rate (AU) |
|---|---|---|---|---|
| WMAN | 320 | increase | 16 | 371 |
| WMAS | 394 | increase | 33 | 524 |
| WFHN | 73 | defer | 100 | 0 |
| WFHS | 109 | decrease | 21 | 86 |

## 5.0 REFERENCES


Ackerman, C.J., J. Sumner, and T.R. Shirley. Estimation of Forage Mass Using a Visual Obstruction Technique. Proceedings, Western Section, American Society of Animal Science, Vol. 52, 2001.

Hanselka, C.W., L.D. White, and J.L. Holechek. 2001a. Using Forage Harvest Efficiency to Determine Stocking Rate. Texas A&M System Extension, AgriLife Communications and Marketing. Publication E-128. Available at: AgriLifebookstore.org

Hanselka, C.W., L.D. White, and J.L. Holechek. 2001a. Managing Residual Forage for Rangeland Health. Texas A&M System Extension, Rangeland Risk Management for Texans. Publication E-127. Available at: AgriLifebookstore.org

Heitschmidt,R., K.D. Sanders, E.L. Smith, W.A. Laycock, G.A. Rasmussen, Q.D. Skinner, F.C. Hall, R. Lindenmuth, L.W. Van Tassell, J.W. Richardson, R.R. Fletcher, G.W. Borden, T.R. Harris, D.T. Taylor, B.R. Moline, and W.C. Krueger. 1998. Stubble Height and Utilization Measurements: Uses and Misuses. SB 682-E. Western Regional Resarch. Albany, California.

Jackson, R.D., and L.K. Paine. 2006. Revisiting Robel's visual obstruction method for estimation of standing crop in grasslands. Online. Forage and Grazinglands: doi: 10.1094/FG-2006-1213-01-RS.

Texas AgriLife Extension. 2011. Know Your Grasses. Texas A&M

Uresk, D.W., and T.A. Benzon. 2007. Monitoring with a modified Robel pole on meadows in the Central Black Hills of South Dakota. Western North American Naturalist 76(1): 46-50.

Vermeire, L.T., A.C. Gangull, and R.L. Gillen. 2002. A robust model for estimating standing crop across vegetation types. *Journal of Range Management* 55: 494-497.

## 6.0 LATIN NAMES OF PLANT SPECIES

| | |
|---|---|
| Ambrosia | *Ambrosia* sp. |
| Blackfoot Daisy | *Melampodium leucanthum* |
| Broomweed | *Amphiachyris dracunculoides* |
| Croton | *Croton* sp. |
| Cuman Ragweed | *Ambrosia psilostachya* |
| Desmanthus | *Desmanthus* spp. |
| Dropseed | *Sporobolus* spp. |
| Goldenrod | *Solidago* spp. |
| Gumweed | *Grindelia squarrosa* |
| Hairy Grama | *Bouteloua hirsuta* |
| Halls Panicum | *Panicum hallii* |
| Kingranch Bluestem | *Bothriochloa ischaemum* |
| Leavenworth's Eryngo | *Eryngium leavenworthii* |
| Liatris | *Liatris* spp. |
| Little Bluestem | *Schizachyrium scoparium* |
| Mesquite | *Prosopis* spp. |
| Monarda | *Monarda* spp. |
| Pink Aster | *Unknown* |
| Puprle Three-awn | *Aristida purpurea* |
| Rudebeckia | *Rudebeckia* spp. |
| Salvia | *Salvia* spp. |
| Seep Muhly | *Muhlenbergia reverchonii* |
| Sideoats Grama | *Bouteloua curtipendula* |
| Silver Beardgrass | *Bothriochloa laguroides* |
| Sumac | *Rhus* spp. |
| Sunflower | *Helianthus* |
| Texas Fogfruit | *Phyla nodiflora* |
| Texas Grama | *Bouteloua rigidiseta* |
| Texas Wintergrass | *Nassella leucotricha* |
| White Heath Aster | *Symphyotrichum ericoides* |
| White Tridens | *Tridens albescens* |
| Wright's Three-awn | *Aristida purpurea* var. *wrightii* |
| Yucca | *Yucca sp.* |

**THIS PAGE LEFT INTENTIONALLY BLANK**

# APPENDIX A
# DATA

| Plot # | Visual Obstruction Reading (centimeters) | | | | | Biomass (pounds per |
|---|---|---|---|---|---|---|
| | South | West | North | East | Average | |
| 1 | 22 | 26 | 26 | 16 | 22.5 | 3,933 |
| 2 | 16 | 12 | 16 | 10 | 13.5 | 2,487 |
| 3 | 16 | 18 | 16 | 10 | 15.0 | 2,728 |
| 4 | 18 | 22 | 22 | 22 | 21.0 | 3,692 |
| 5 | 20 | 24 | 22 | 26 | 23.0 | 4,013 |
| 6 | 20 | 24 | 36 | 32 | 28.0 | 4,816 |
| 7 | 28 | 24 | 28 | 32 | 28.0 | 4,816 |
| 8 | 10 | 24 | 10 | 16 | 15.0 | 2,728 |
| 9 | 22 | 20 | 24 | 20 | 21.5 | 3,772 |
| 10 | 28 | 32 | 38 | 22 | 30.0 | 5,137 |
| 11 | 32 | 26 | 28 | 22 | 27.0 | 4,655 |
| 12 | 34 | 36 | 34 | 38 | 35.5 | 6,020 |
| 13 | 12 | 12 | 22 | 10 | 14.0 | 2,568 |
| 14 | 20 | 28 | 32 | 38 | 29.5 | 5,057 |
| 15 | 10 | 12 | 8 | 10 | 10.0 | 1,925 |
| 16 | 42 | 42 | 38 | 34 | 39.0 | 6,583 |
| 17 | 18 | 20 | 22 | 12 | 18.0 | 3,210 |
| 18 | 26 | 36 | 32 | 10 | 26.0 | 4,495 |
| 19 | 20 | 20 | 24 | 26 | 22.5 | 3,933 |
| 20 | 18 | 22 | 20 | 16 | 19.0 | 3,371 |
| 21 | 10 | 10 | 4 | 10 | 8.5 | 1,684 |
| 22 | 30 | 40 | 36 | 30 | 34.0 | 5,780 |
| 23 | 28 | 32 | 36 | 20 | 29.0 | 4,977 |
| 24 | 34 | 20 | 32 | 38 | 31.0 | 5,298 |
| 25 | 30 | 30 | 32 | 34 | 31.5 | 5,378 |
| 26 | 34 | 30 | 32 | 34 | 32.5 | 5,539 |
| 27 | 24 | 32 | 28 | 20 | 26.0 | 4,495 |
| 28 | 22 | 28 | 32 | 34 | 29.0 | 4,977 |
| 29 | 12 | 10 | 10 | 16 | 12.0 | 2,247 |
| 30 | 34 | 32 | 26 | 32 | 31.0 | 5,298 |
| 31 | 36 | 34 | 28 | 30 | 32.0 | 5,458 |
| 32 | 20 | 24 | 32 | 20 | 24.0 | 4,174 |
| 33 | 39 | 36 | 36 | 32 | 35.8 | 6,061 |
| 34 | 20 | 32 | 24 | 20 | 24.0 | 4,174 |
| 35 | 22 | 26 | 18 | 20 | 21.5 | 3,772 |
| 36 | 32 | 28 | 22 | 28 | 27.5 | 4,736 |
| 37 | 22 | 24 | 26 | 28 | 25.0 | 4,334 |
| 38 | 34 | 32 | 38 | 36 | 35.0 | 5,940 |
| 39 | 7 | 5 | 5 | 3 | 5.0 | 1,122 |
| 40 | 22 | 26 | 24 | 20 | 23.0 | 4,013 |
| 41 | 32 | 38 | 26 | 32 | 32.0 | 5,458 |
| 42 | 18 | 22 | 26 | 18 | 21.0 | 3,692 |
| 43 | 10 | 8 | 4 | 10 | 8.0 | 1,604 |
| 44 | 34 | 34 | 38 | 32 | 34.5 | 5,860 |
| 45 | 36 | 34 | 36 | 42 | 37.0 | 6,261 |
| 46 | 24 | 20 | 24 | 26 | 23.5 | 4,093 |
| 47 | 36 | 28 | 20 | 32 | 29.0 | 4,977 |

| Plot # | Visual Obstruction Reading (centimeters) | | | | | Biomass (pounds per |
|---|---|---|---|---|---|---|
| | South | West | North | East | Average | |
| 48 | 34 | 36 | 36 | 30 | 34.0 | 5,780 |
| 49 | 24 | 20 | 24 | 28 | 24.0 | 4,174 |
| 50 | 24 | 22 | 18 | 22 | 21.5 | 3,772 |
| 51 | 14 | 10 | 20 | 26 | 17.5 | 3,130 |
| 52 | 12 | 10 | 4 | 10 | 9.0 | 1,765 |
| 53 | 32 | 26 | 28 | 24 | 27.5 | 4,736 |
| 54 | 3 | 10 | 8 | 4 | 6.3 | 1,323 |
| 55 | 16 | 18 | 26 | 24 | 21.0 | 3,692 |
| 56 | 12 | 10 | 10 | 8 | 10.0 | 1,925 |
| 57 | 26 | 22 | 24 | 24 | 24.0 | 4,174 |
| 58 | 8 | 10 | 16 | 10 | 11.0 | 2,086 |
| 59 | 8 | 6 | 6 | 8 | 7.0 | 1,444 |
| 60 | 22 | 14 | 16 | 14 | 16.5 | 2,969 |
| 61 | 18 | 14 | 26 | 22 | 20.0 | 3,531 |
| 62 | 28 | 24 | 26 | 24 | 25.5 | 4,415 |
| 63 | 10 | 4 | 4 | 8 | 6.5 | 1,363 |
| 64 | 28 | 24 | 38 | 34 | 31.0 | 5,298 |
| 65 | 18 | 16 | 20 | 22 | 19.0 | 3,371 |
| 66 | 18 | 16 | 14 | 12 | 15.0 | 2,728 |
| 67 | 16 | 12 | 10 | 16 | 13.5 | 2,487 |
| 68 | 10 | 6 | 4 | 12 | 8.0 | 1,604 |
| 69 | 12 | 10 | 4 | 4 | 7.5 | 1,524 |
| 70 | 34 | 30 | 40 | 36 | 35.0 | 5,940 |
| 71 | 22 | 24 | 18 | 14 | 19.5 | 3,451 |
| 72 | 26 | 18 | 24 | 20 | 22.0 | 3,852 |
| 73 | 8 | 10 | 8 | 6 | 8.0 | 1,604 |
| 74 | 22 | 18 | 20 | 22 | 20.5 | 3,612 |
| 75 | 22 | 16 | 10 | 18 | 16.5 | 2,969 |
| 76 | 10 | 22 | 20 | 16 | 17.0 | 3,049 |
| 77 | 14 | 8 | 18 | 16 | 14.0 | 2,568 |

Percent Cover by Species for WMAN

| Plot # | Kingranch Bluestem | Broomweed | Cuman Ragweed | Hall's Panicum | Little bluestem | Gumweed | Croton | Liatris | Monarda | Pink Aster | White Heath Aster | Leavenworth's Eryngo | Texas Grama | Silver Beardgrass | Mesquite | Blackfoot daisy | Salvia | Ambrosia | Goldenrod | Sumac | Sideoats Grama | Yucca | Desmanthus | Texas Frogfruit | Hairy Grama | white Tridens | Wright's Three-awn | Helianthus | Dropseed | Texas Winter | Rudebeckia | Total Cover |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 10 | 45 | 15 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 95 |
| 2 | 30 | 0 | 10 | 0 | 5 | 0 | 0 |  | 5 | 0 | 0 | 5 | 5 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 75 |
| 3 | 35 | 20 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 10 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 10 | 0 | 0 | 0 | 110 |
| 4 | 25 | 10 | 0 | 0 | 0 | 15 | 5 | 0 | 5 | 0 | 5 | 0 | 15 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 85 |
| 5 | 30 | 0 | 0 | 0 | 15 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 5 | 10 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 20 | 0 | 0 | 100 |
| 6 | 95 | 5 | 5 | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 130 |
| 7 | 30 | 15 | 10 | 0 | 0 | 0 | 10 | 0 | 0 | 5 | 15 | 5 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 110 |
| 8 | 35 | 5 | 10 | 0 | 15 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 5 | 0 | 5 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 110 |
| 9 | 15 | 20 | 0 | 15 | 0 | 30 | 5 | 0 | 0 | 5 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 120 |
| 10 | 40 | 0 | 50 | 10 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 130 |
| 11 | 55 | 40 | 20 | 0 | 0 | 5 | 0 | 5 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 140 |
| 12 | 15 | 55 | 15 | 0 | 5 | 5 | 5 | 0 | 5 | 0 | 5 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 5 | 140 |
| 13 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 5 | 0 | 40 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 85 |
| 14 | 50 | 0 | 10 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 15 | 0 | 110 |
| 15 | 30 | 5 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 |
| 16 | 80 | 10 | 20 | 0 | 0 | 10 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 135 |
| 17 | 85 | 15 | 5 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 10 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 130 |
| 18 | 90 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 110 |
| 19 | 35 | 25 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 75 |
| 20 | 25 | 5 | 10 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 20 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 75 |
| 21 | 0 | 10 | 5 | 10 | 0 | 5 | 5 | 0 | 0 | 5 | 5 | 0 | 20 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 75 |
| 22 | 10 | 45 | 25 | 0 | 5 | 0 | 5 | 5 | 5 | 5 | 5 | 0 | 20 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 145 |
| 23 | 40 | 5 | 15 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 10 | 20 | 0 | 0 | 0 | 110 |
| 24 | 30 | 70 | 30 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 150 |
| 25 | 65 | 15 | 5 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 5 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 115 |
| Average | 38.8 | 16.8 | 11.6 | 1.4 | 1.8 | 3.8 | 1.8 | 2.1 | 1.8 | 1.4 | 3.0 | 1.4 | 6.8 | 2.6 | 1.0 | 0.8 | 0.4 | 0.6 | 0.6 | 0.4 | 0.2 | 0.2 | 0.2 | 0.2 | 0.4 | 0.8 | 1.0 | 3.0 | 2.2 | 1.0 | 0.2 | 108.7 |

Percent Cover by Species for WMAS

| Plot # | Kingranch Bluestem | Little Bluestem | Cuman Ragweed | Broomweed | Texas Grama | Croton | Silver Beardgrass | Hall's Panicum | Purple Three-awn | Sideoats Grama | Gumweed | Monarda | White heath aster | Liatris | Pink Aster | Sumac | Leavenworth's Eryngo | Desmanthus | Mesquite | Seep muhly | Yucca | Blackfoot Daisy | Goldenrod | Hairy Grama | White Tridens | Dropseed | Sunflower | Total Cover |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | 85 | 0 | 25 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135 |
| 27 | 60 | 20 | 15 | 10 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 135 |
| 28 | 75 | 0 | 0 | 20 | 0 | 15 | 0 | 0 | 0 | 0 | 20 | 15 | 0 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 180 |
| 29 | 15 | 15 | 35 | 0 | 20 | 5 | 5 | 0 | 10 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120 |
| 30 | 0 | 5 | 10 | 0 | 0 | 0 | 5 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 30 | 0 | 80 |
| 31 | 80 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 115 |
| 32 | 0 | 40 | 65 | 0 | 5 | 5 | 10 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 155 |
| 33 | 80 | 10 | 15 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 125 |
| 34 | 30 | 0 | 40 | 15 | 5 | 5 | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 115 |
| 35 | 25 | 10 | 35 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 5 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 110 |
| 36 | 0 | 5 | 30 | 50 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 |
| 37 | 40 | 30 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 95 |
| 38 | 80 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 95 |
| 39 | 0 | 0 | 5 | 5 | 15 | 5 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 60 |
| 40 | 35 | 0 | 25 | 10 | 15 | 5 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 15 | 125 |
| 41 | 75 | 0 | 15 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 130 |
| 42 | 0 | 0 | 30 | 0 | 10 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 15 | 0 | 10 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 5 | 15 | 105 |
| 43 | 5 | 0 | 20 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 60 |
| 44 | 85 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 5 | 5 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 10 | 140 |
| 45 | 75 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 90 |
| 46 | 20 | 0 | 10 | 60 | 5 | 10 | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 130 |
| 47 | 90 | 0 | 5 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 120 |
| 48 | 45 | 15 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 95 |
| 49 | 5 | 0 | 0 | 5 | 5 | 20 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 55 |
| Average | 41.9 | 6.3 | 16.3 | 9.6 | 5.0 | 3.1 | 1.0 | 1.0 | 1.0 | 0.2 | 3.8 | 2.9 | 3.3 | 2.3 | 1.9 | 1.3 | 1.0 | 0.8 | 0.4 | 0.4 | 0.4 | 0.2 | 0.2 | 0.4 | 0.4 | 2.5 | 3.5 | 107.7 |

Percent Cover by Species in WFHN

| Plot # | Little Bluestem | Cuman Ragweed | Kingranch Bluestem | White Heath Aster | Broomweed | Silver Beardgrass | Solidago | Gumweed | Liatris | Pink Aster | Monarda | Blackfoot Daisy | Seep muhly | Croton | Leavenworth's Eryngo | Yucca | Desmanthus | Hall's Panicum | Puprle Three-awn | Texas Winter | Sideoats Grama | Hiary Grama | White Tridens | Texas Grama | Wright's Three-awn | Dropseed | Sunflower | Sumac | Total Cover |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | 0 | 25 | 10 | 5 | 5 | 0 | 5 | 10 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 30 | 10 | 10 | 125 |
| 51 | 0 | 10 | 25 | 10 | 15 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 5 | 0 | 80 |
| 52 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 |  | 25 | 0 | 0 | 0 | 0 | 30 | 0 | 0 | 0 | 0 | 80 |
| 53 | 35 | 0 | 0 | 5 | 0 | 0 | 0 | 10 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 15 | 0 | 0 | 0 | 0 | 80 |
| 54 | 0 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 50 | 0 | 0 | 0 | 0 | 80 |
| 55 | 60 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 80 |
| 56 | 0 | 45 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 15 | 0 | 5 | 0 | 0 | 0 | 0 | 85 |
| 57 | 15 | 10 | 10 | 5 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 20 | 90 |
| 58 | 20 | 5 | 0 | 5 | 0 | 0 | 10 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 55 |
| 59 | 5 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 35 | 30 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 95 |
| 60 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 5 | 0 | 15 | 0 | 0 | 0 | 0 | 55 |
| 61 | 0 | 30 | 25 | 5 | 20 | 0 | 0 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 90 |
| 62 | 5 | 15 | 5 | 15 | 10 | 0 | 0 | 0 | 0 | 0 | 10 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 5 | 0 | 0 | 0 | 0 | 80 |
| 63 | 5 | 0 | 5 | 10 | 5 | 0 | 5 | 0 | 5 | 0 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 10 | 20 | 0 | 0 | 0 | 0 | 10 | 0 | 5 | 0 | 0 | 90 |
| Average | 10.4 | 12.1 | 6.8 | 5.4 | 5.0 | 0.0 | 2.1 | 1.8 | 2.5 | 1.8 | 1.1 | 1.1 | 0.4 | 0.7 | 0.7 | 0.7 | 0.4 | 3.5 | 7.1 | 0.0 | 0.0 | 2.9 | 1.1 | 10.4 | 0.0 | 2.5 | 1.1 | 2.1 | 83.5 |

| Percent Cover by Species for WMAS | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plot # | Little bluestem | Cuman Ragweed | Kingranch Bluestem | Broomweed | Silver Beardgrass | White heath aster | Blackfoot Daisy | Croton | Monarda | Leavenworth's Eryngo | Goldenrod | Gumweed | Liatris | Pink Aster | Dropseed | Hall's Panicum | Desmanthus | Puprle Three-awn | Texas Winter | Hiary Grama | Texas Grama | Wright's Three-awn | Total Cover |
| 64 | 0 | 65 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 85 |
| 65 | 5 | 45 | 0 | 10 | 5 | 20 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 5 | 5 | 0 | 5 | 5 | 10 | 0 | 0 | 125 |
| 66 | 15 | 25 | 5 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 10 | 0 | 0 | 75 |
| 67 | 15 | 10 | 5 | 5 | 0 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 55 |
| 68 | 0 | 15 | 0 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 35 |
| 69 | 0 | 20 | 5 | 10 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 10 | 0 | 55 |
| 70 | 0 | 55 | 5 | 10 | 0 | 5 | 0 | 5 | 5 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 15 | 0 | 0 | 0 | 115 |
| 71 | 0 | 45 | 0 | 5 | 10 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 20 | 15 | 10 | 0 | 0 | 120 |
| 72 | 0 | 50 | 0 | 5 | 5 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 5 | 0 | 5 | 5 | 0 | 20 | 5 | 115 |
| 73 | 5 | 5 | 0 | 5 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 15 | 0 | 25 | 5 | 0 | 70 |
| 74 | 5 | 5 | 10 | 5 | 10 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 55 |
| 75 | 5 | 40 | 5 | 5 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 5 | 0 | 0 | 75 |
| 76 | 20 | 10 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 5 | 0 | 5 | 0 | 0 | 5 | 0 | 55 |
| 77 | 5 | 0 | 0 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 10 | 5 | 45 |
| Average | 5.4 | 27.9 | 2.5 | 5.7 | 2.9 | 3.2 | 1.4 | 1.1 | 1.1 | 0.7 | 1.1 | 0.4 | 0.4 | 0.4 | 1.4 | 1.4 | 0.4 | 5.4 | 3.2 | 4.6 | 5.4 | 1.4 | 77.1 |

# APPENDIX B
# PICTURES

**Picture 1 Plot 1 Facing South**

**Picture 2 Plot 1 Facing West**

**Picture 3 Plot 1 Facing North**

**Picture 4 Plot 1 Facing East**

**Picture 5 Plot 2 Facing South**

**Picture 6 Plot 2 Facing West**

**Picture 7 Plot 2 Facing North**

**Picture 8 Plot 2 Facing East**

**Picture 9 Plot 3 Facing South**

**Picture 10 Plot 3 Facing West**

**Picture 11 Plot 3 Facing North**

**Picture 12 Plot 3 Facing East**

**Picture 13 Plot 4 Facing South**

**Picture 14 Plot 4 Facing West**

**Picture 15 Plot 4 Facing North**

**Picture 16 Plot 4 Facing East**

**Picture 17 Plot 5 Facing South**

**Picture 18 Plot 5 Facing West**

**Picture 19 Plot 5 Facing North**

**Picture 20 Plot 5 Facing East**

**Picture 21 Plot 6 Facing South**

**Picture 22 Plot 6 Facing West**

**Picture 23 Plot 6 Facing North**

**Picture 24 Plot 6 Facing East**

**Picture 25 Plot 7 Facing South**

**Picture 26 Plot 7 Facing West**

**Picture 27 Plot 7 Facing North**

**Picture 28 Plot 7 Facing East**

**Picture 29 Plot 8 Facing South**

**Picture 30 Plot 8 Facing West**

**Picture 31 Plot 8 Facing North**

**Picture 32 Plot 8 Facing East**

**Picture 33 Plot 9-1 Facing South**

**Picture 34 Plot 9-1 Facing West**

**Picture 35 Plot 9-1 Facing North**

**Picture 36 Plot 9-1 Facing East**

Picture 37 Plot 9-2 Facing South

Picture 38 Plot 9-2 Facing West

Picture 39 Plot 9-2 Facing North

Picture 40 Plot 9-2 Facing East

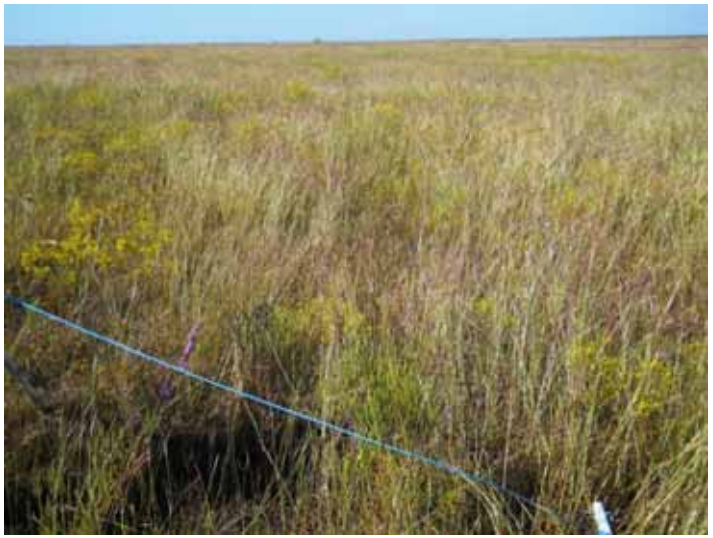
**Picture 41 Plot 10 Facing South**

**Picture 42 Plot 10 Facing West**

**Picture 43 Plot 10 Facing North**

**Picture 44 Plot 10 Facing East**

**Picture 45 Plot 11 Facing South**



**Picture 46 Plot 11 Facing West**

**Picture 47 Plot 11 Facing North**

**Picture 48 Plot 11 Facing East**

**Picture 49 Plot 12 Facing South**

**Picture 50 Plot 12 Facing West**

**Picture 51 Plot 12 Facing North**

**Picture 52 Plot 12 Facing East**

**Picture 53 Plot 13 Facing South**

**Picture 54 Plot 13 Facing West**

**Picture 55 Plot 13 Facing North**

**Picture 56 Plot 13 Facing East**

**Picture 57 Plot 14 Facing South**

**Picture 58 Plot 14 Facing West**

**Picture 59 Plot 14 Facing North**

**Picture 60 Plot 6 Facing East**

**Picture 61 Plot 15 Facing South**

**Picture 62 Plot 15 Facing West**

**Picture 63 Plot 15 Facing North**

**Picture 64 Plot 15 Facing East**

**Picture 65 Plot 16 Facing South**

**Picture 66 Plot 16 Facing West**

**Picture 67 Plot 16 Facing North**

**Picture 68 Plot 16 Facing East**

**Picture 69 Plot 17 Facing South**

**Picture 70 Plot 17 Facing West**

**Picture 71 Plot 17 Facing North**

**Picture 72 Plot 17 Facing East**

**Picture 73 Plot 18 Facing South**

**Picture 74 Plot 18 Facing West**

**Picture 75 Plot 18 Facing North**

**Picture 76 Plot 18 Facing East**

**Picture 77 Plot 19 Facing South**

**Picture 78 Plot 19 Facing West**

**Picture 79 Plot 19 Facing North**

**Picture 80 Plot 19 Facing East**

**Picture 81 Plot 20 Facing South**

**Picture 82 Plot 20 Facing West**

**Picture 83 Plot 20 Facing North**

**Picture 84 Plot 20 Facing East**

**Picture 85 Plot 21 Facing South**

**Picture 86 Plot 21 Facing West**

**Picture 87 Plot 21 Facing North**

**Picture 88 Plot 21 Facing East**

**Picture 89 Plot 22 Facing South**

**Picture 90 Plot 22 Facing West**

**Picture 91 Plot 22 Facing North**

**Picture 92 Plot 22 Facing East**

**Picture 93 Plot 23 Facing South**

**Picture 94 Plot 23 Facing West**

**Picture 95 Plot 23 Facing North**

**Picture 96 Plot 23 Facing East**

**Picture 97 Plot 24 Facing South**

**Picture 98 Plot 24 Facing West**

**Picture 99 Plot 24 Facing North**

**Picture 100 Plot 24 Facing East**

**Picture 101 Plot 25 Facing South**

**Picture 102 Plot 25 Facing West**

**Picture 103 Plot 25 Facing North**

**Picture 104 Plot 25 Facing East**

**Picture 105 Plot 26 Facing South**

**Picture 106 Plot 26 Facing West**

**Picture 107 Plot 26 Facing North**

**Picture 108 Plot 26 Facing East**

Picture 109 Plot 27 Facing South

Picture 110 Plot 27 Facing West

Picture 111 Plot 27 Facing North

Picture 112 Plot 27 Facing East

**Picture 113 Plot 28 Facing South**

**Picture 114 Plot 28 Facing West**

**Picture 115 Plot 28 Facing North**

**Picture 116 Plot 28 Facing East**

**Picture 117 Plot 29 Facing South**

**Picture 118 Plot 29 Facing West**

**Picture 119 Plot 29 Facing North**

**Picture 120 Plot 29 Facing East**

**Picture 121 Plot 30 Facing South**

**Picture 122 Plot 30 Facing West**

**Picture 123 Plot 30 Facing North**

**Picture 124 Plot 30 Facing East**

**Picture 125 Plot 31 Facing South**

**Picture 126 Plot 31 Facing West**

**Picture 127 Plot 31 Facing North**

**Picture 128 Plot 31 Facing East**

**Picture 129 Plot 32 Facing South**

**Picture 130 Plot 32 Facing West**

**Picture 131 Plot 32 Facing North**

**Picture 132 Plot 32 Facing East**

**Picture 133 Plot 33 Facing South**

**Picture 134 Plot 33 Facing West**

**Picture 135 Plot 33 Facing North**

**Picture 136 Plot 33 Facing East**

**Picture 137 Plot 34 Facing South**

**Picture 138 Plot 34 Facing West**

**Picture 139 Plot 34 Facing North**

**Picture 140 Plot 34 Facing East**

**Picture 141 Plot 35 Facing South**

**Picture 142 Plot 35 Facing West**

**Picture 143 Plot 35 Facing North**

**Picture 144 Plot 35 Facing East**

Picture 145 Plot 36 Facing South

Picture 146 Plot 36 Facing West

Picture 147 Plot 36 Facing North

Picture 148 Plot 36 Facing East

**Picture 149 Plot 37 Facing South**

**Picture 150 Plot 37 Facing West**

**Picture 151 Plot 37 Facing North**

**Picture 152 Plot 37 Facing East**

Picture 153 Plot 38 Facing South

Picture 154 Plot 38 Facing West

Picture 155 Plot 38 Facing North

Picture 156 Plot 38 Facing East

Picture 157 Plot 39 Facing South

Picture 158 Plot 39 Facing West

Picture 159 Plot 39 Facing North

Picture 160 Plot 39 Facing East

**Picture 161 Plot 40 Facing South**

**Picture 162 Plot 40 Facing West**

**Picture 163 Plot 40 Facing North**

**Picture 164 Plot 40 Facing East**

**Picture 165 Plot 41 Facing South**

**Picture 166 Plot 41 Facing West**

**Picture 167 Plot 41 Facing North**

**Picture 168 Plot 41 Facing East**

**Picture 169 Plot 42 Facing South**

**Picture 170 Plot 42 Facing West**

**Picture 171 Plot 42 Facing North**

**Picture 172 Plot 42 Facing East**

**Picture 173 Plot 43 Facing South**

**Picture 174 Plot 43 Facing West**

**Picture 175 Plot 43 Facing North**

**Picture 176 Plot 43 Facing East**

**Picture 177 Plot 44 Facing South**

**Picture 178 Plot 44 Facing West**

**Picture 179 Plot 44 Facing North**

**Picture 180 Plot 44 Facing East**

**Picture 181 Plot 45 Facing South**

**Picture 182 Plot 45 Facing West**

**Picture 183 Plot 45 Facing North**

**Picture 184 Plot 45 Facing East**

**Picture 185 Plot 46 Facing South**

**Picture 186 Plot 46 Facing West**

**Picture 187 Plot 46 Facing North**

**Picture 188 Plot 46 Facing East**

**Picture 189 Plot 47 Facing South**

**Picture 190 Plot 47 Facing West**

**Picture 191 Plot 47 Facing North**

**Picture 192 Plot 47 Facing East**

Picture 193 Plot 48 Facing South

Picture 194 Plot 48 Facing West

Picture 195 Plot 48 Facing North

Picture 196 Plot 48 Facing East

**Picture 197 Plot 49 Facing South**

**Picture 198 Plot 49 Facing West**

**Picture 199 Plot 49 Facing North**

**Picture 200 Plot 49 Facing East**

**Picture 201 Plot 50 Facing South**

**Picture 202 Plot 50 Facing West**

**Picture 203 Plot 50 Facing North**

**Picture 204 Plot 50 Facing East**

**Picture 205 Plot 51 Facing South**

**Picture 206 Plot 51 Facing West**

**Picture 207 Plot 51 Facing North**

**Picture 208 Plot 51 Facing East**

**Picture 209 Plot 52 Facing South**

**Picture 210 Plot 52 Facing West**

**Picture 211 Plot 52 Facing North**

**Picture 212 Plot 52 Facing East**

**Picture 213 Plot 53 Facing South**

**Picture 214 Plot 53 Facing West**

**Picture 215 Plot 53 Facing North**

**Picture 216 Plot 53  Facing East**

**Picture 217 Plot 54 Facing South**

**Picture 218 Plot 54 Facing West**

**Picture 219 Plot 54 Facing North**

**Picture 220 Plot 54 Facing East**

**Picture 221 Plot 55 Facing South**

**Picture 222 Plot 55 Facing West**

**Picture 223 Plot 55  Facing North**

**Picture 224 Plot 55  Facing East**

**Picture 225 Plot 56 Facing South**

**Picture 226 Plot 56 Facing West**

**Picture 227 Plot 56 Facing North**

**Picture 228 Plot 56 Facing East**

**Picture 229 Plot 57 Facing South**

**Picture 230 Plot 57 Facing West**

**Picture 231 Plot 57 Facing North**

**Picture 232 Plot 57 Facing East**

**Picture 233 Plot58 Facing South**

**Picture 234 Plot 58 Facing West**

**Picture 235 Plot 58 Facing North**

**Picture 236 Plot 58 Facing East**

**Picture 237 Plot 59 Facing South**

**Picture 238 Plot 59 Facing West**

**Picture 239 Plot 59 Facing North**

**Picture 240 Plot 59 Facing East**

**Picture 241 Plot 60 Facing South**

**Picture 242 Plot 60 Facing West**

**Picture 243 Plot 60 Facing North**

**Picture 244 Plot 60 Facing East**

**Picture 245 Plot 61 Facing South**

**Picture 246 Plot 61 Facing West**

**Picture 247 Plot 61 Facing North**

**Picture 248 Plot 61 Facing East**

**Picture 249 Plot 62 Facing South**

**Picture 250 Plot 62 Facing West**

**Picture 251 Plot 62 Facing North**

**Picture 252 Plot 62 Facing East**

**Picture 253 Plot 63 Facing South**

**Picture 254 Plot 63 Facing West**

**Picture 255 Plot 63 Facing North**

Picture 256 Plot 64 Facing South

Picture 257 Plot 64 Facing West

Picture 258 Plot 64 Facing North

Picture 259 Plot 64 Facing East

Picture 260 Plot 65 Facing South

Picture 261 Plot 65 Facing West

Picture 262 Plot 65 Facing North

Picture 263 Plot 65 Facing East

**Picture 264 Plot 66 Facing South**

**Picture 265 Plot 66 Facing West**

**Picture 266 Plot 66 Facing North**

**Picture 267 Plot 67 Facing South**

**Picture 268 Plot 67 Facing West**

**Picture 269 Plot 67 Facing North**

**Picture 270 Plot 67 Facing East**

**Picture 271 Plot 68 Facing South**

**Picture 272 Plot 68 Facing West**

**Picture 273 Plot 68 Facing North**

**Picture 274 Plot 68 Facing East**

**Picture 275 Plot 69 Facing South**

**Picture 276 Plot 69 Facing West**

**Picture 277 Plot 69 Facing North**

**Picture 278 Plot 69 Facing East**

**Picture 279 Plot 70 Facing South**

**Picture 280 Plot 70 Facing West**

**Picture 281 Plot 70 Facing North**

**Picture 282 Plot 70 Facing East**

**Picture 283 Plot 71 Facing South**

**Picture 284 Plot 71 Facing West**

**Picture 285 Plot 71 Facing North**

**Picture 286 Plot 71 Facing East**

**Picture 287 Plot 72 Facing South**

**Picture 288 Plot 72 Facing West**

**Picture 289 Plot 72 Facing North**

**Picture 290 Plot 72 Facing East**

**Picture 291 Plot 73 Facing South**

**Picture 292 Plot 73 Facing West**

**Picture 293 Plot 73 Facing North**

**Picture 294 Plot 73 Facing East**

**Picture 295 Plot 74 Facing South**

**Picture 296 Plot 74 Facing West**

**Picture 297 Plot 74 Facing North**

**Picture 298 Plot 74 Facing East**

**Picture 299 Plot 75 Facing South**

**Picture 300 Plot 75 Facing West**

**Picture 301 Plot 75 Facing North**

**Picture 302 Plot 75 Facing East**

**Picture 303 Plot 76 Facing South**

**Picture 304 Plot 76 Facing West**

**Picture 305 Plot 76 Facing North**

**Picture 306 Plot 76 Facing East**

Picture 307 Plot 77 Facing South

Picture 308 Plot 77 Facing West

Picture 309 Plot 77 Facing North

Picture 310 Plot 77 Facing East

# APPENDIX C
# SPECIAL STATUS SPECIES LISTS

# BELL COUNTY

## AMPHIBIANS

| | | Federal Status | State Status |
|---|---|---|---|
| **Salado Springs salamander** | *Eurycea chisholmensis* | C | |

endemic; surface springs and subterranean waters of the Salado Springs system along Salado Creek

## BIRDS

| | | Federal Status | State Status |
|---|---|---|---|
| **American Peregrine Falcon** | *Falco peregrinus anatum* | DL | T |

year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

| | | | |
|---|---|---|---|
| **Arctic Peregrine Falcon** | *Falco peregrinus tundrius* | DL | |

migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

| | | | |
|---|---|---|---|
| **Bald Eagle** | *Haliaeetus leucocephalus* | DL | T |

found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds

| | | | |
|---|---|---|---|
| **Black-capped Vireo** | *Vireo atricapilla* | LE | E |

oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous and broad-leaved shrubs and trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nesting season March-late summer

| | | | |
|---|---|---|---|
| **Golden-cheeked Warbler** | *Dendroica chrysoparia* | LE | E |

juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs; nesting late March-early summer

| | | | |
|---|---|---|---|
| **Henslow's Sparrow** | *Ammodramus henslowii* | | |

wintering individuals (not flocks) found in weedy fields or cut-over areas where lots of bunch grasses occur along with vines and brambles; a key component is bare ground for running/walking

| | | | |
|---|---|---|---|
| **Interior Least Tern** | *Sterna antillarum athalassos* | LE | E |

subspecies is listed only when inland (more than 50 miles from a coastline); nests along sand and gravel bars within braided streams, rivers; also know to nest on man-made structures (inland beaches, wastewater treatment plants, gravel mines, etc); eats small fish and crustaceans, when breeding forages within a few hundred feet of colony

# BELL COUNTY

## BIRDS

| | | Federal Status | State Status |
|---|---|---|---|
| **Mountain Plover** | *Charadrius montanus* | PT | |

breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous

| | | | |
|---|---|---|---|
| **Peregrine Falcon** | *Falco peregrinus* | DL | T |

both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.

**Western Burrowing Owl** *Athene cunicularia hypugaea*

open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows

| | | | |
|---|---|---|---|
| **Whooping Crane** | *Grus americana* | LE | E |

potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties

## FISHES

| | | Federal Status | State Status |
|---|---|---|---|
| **Guadalupe bass** | *Micropterus treculii* | | |

endemic to perennial streams of the Edward's Plateau region; introduced in Nueces River system

| | | | |
|---|---|---|---|
| **Smalleye shiner** | *Notropis buccula* | C | |

endemic to upper Brazos River system and its tributaries (Clear Fork and Bosque); apparently introduced into adjacent Colorado River drainage; medium to large prairie streams with sandy substrate and turbid to clear warm water; presumably eats small aquatic invertebrates

## MAMMALS

| | | Federal Status | State Status |
|---|---|---|---|
| **Cave myotis bat** | *Myotis velifer* | | |

colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (Hirundo pyrrhonota) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore

**Plains spotted skunk** *Spilogale putorius interrupta*

catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie

| | | | |
|---|---|---|---|
| **Red wolf** | *Canis rufus* | LE | E |

extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies

# BELL COUNTY

## MOLLUSKS

| | | Federal Status | State Status |
|---|---|---|---|
| **False spike mussel** | *Quadrula mitchelli* | | T |

possibly extirpated in Texas; probably medium to large rivers; substrates varying from mud through mixtures of sand, gravel and cobble; one study indicated water lilies were present at the site; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins

| | | | |
|---|---|---|---|
| **Smooth pimpleback** | *Quadrula houstonensis* | | T |

small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins

| | | | |
|---|---|---|---|
| **Texas fawnsfoot** | *Truncilla macrodon* | | T |

little known; possibly rivers and larger streams, and intolerant of impoundment; flowing rice irrigation canals, possibly sand, gravel, and perhaps sandy-mud bottoms in moderate flows; Brazos and Colorado River basins

## REPTILES

| | | Federal Status | State Status |
|---|---|---|---|
| **Texas garter snake** | *Thamnophis sirtalis annectens* | | |

wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August

| | | | |
|---|---|---|---|
| **Texas horned lizard** | *Phrynosoma cornutum* | | T |

open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September

## PLANTS

| | | Federal Status | State Status |
|---|---|---|---|
| **Texabama croton** | *Croton alabamensis var texensis* | | |

Texas endemic; in duff-covered loamy clay soils on rocky slopes in forested, mesic limestone canyons; locally abundant on deeper soils on small terraces in canyon bottoms, often forming large colonies and dominating the shrub layer; scattered individuals are occasionally on sunny margins of such forests; also found in contrasting habitat of deep, friable soils of limestone uplands, mostly in the shade of evergreen woodland mottes; flowering late February-March; fruit maturing and dehiscing by early June

# CORYELL COUNTY

## BIRDS

| | | Federal Status | State Status |
|---|---|---|---|
| **American Peregrine Falcon** | *Falco peregrinus anatum* | DL | T |

year-round resident and local breeder in west Texas, nests in tall cliff eyries; also, migrant across state from more northern breeding areas in US and Canada, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

| | | | |
|---|---|---|---|
| **Arctic Peregrine Falcon** | *Falco peregrinus tundrius* | DL | |

migrant throughout state from subspecies' far northern breeding range, winters along coast and farther south; occupies wide range of habitats during migration, including urban, concentrations along coast and barrier islands; low-altitude migrant, stopovers at leading landscape edges such as lake shores, coastlines, and barrier islands.

| | | | |
|---|---|---|---|
| **Bald Eagle** | *Haliaeetus leucocephalus* | DL | T |

found primarily near rivers and large lakes; nests in tall trees or on cliffs near water; communally roosts, especially in winter; hunts live prey, scavenges, and pirates food from other birds

| | | | |
|---|---|---|---|
| **Black-capped Vireo** | *Vireo atricapilla* | LE | E |

oak-juniper woodlands with distinctive patchy, two-layered aspect; shrub and tree layer with open, grassy spaces; requires foliage reaching to ground level for nesting cover; return to same territory, or one nearby, year after year; deciduous and broad-leaved shrubs and trees provide insects for feeding; species composition less important than presence of adequate broad-leaved shrubs, foliage to ground level, and required structure; nesting season March-late summer

| | | | |
|---|---|---|---|
| **Golden-cheeked Warbler** | *Dendroica chrysoparia* | LE | E |

juniper-oak woodlands; dependent on Ashe juniper (also known as cedar) for long fine bark strips, only available from mature trees, used in nest construction; nests are placed in various trees other than Ashe juniper; only a few mature junipers or nearby cedar brakes can provide the necessary nest material; forage for insects in broad-leaved trees and shrubs; nesting late March-early summer

| | | | |
|---|---|---|---|
| **Mountain Plover** | *Charadrius montanus* | PT | |

breeding: nests on high plains or shortgrass prairie, on ground in shallow depression; nonbreeding: shortgrass plains and bare, dirt (plowed) fields; primarily insectivorous

| | | | |
|---|---|---|---|
| **Peregrine Falcon** | *Falco peregrinus* | DL | T |

both subspecies migrate across the state from more northern breeding areas in US and Canada to winter along coast and farther south; subspecies (F. p. anatum) is also a resident breeder in west Texas; the two subspecies' listing statuses differ, F.p. tundrius is no longer listed in Texas; but because the subspecies are not easily distinguishable at a distance, reference is generally made only to the species level; see subspecies for habitat.

| | | | |
|---|---|---|---|
| **Western Burrowing Owl** | *Athene cunicularia hypugaea* | | |

open grasslands, especially prairie, plains, and savanna, sometimes in open areas such as vacant lots near human habitation or airports; nests and roosts in abandoned burrows

# CORYELL COUNTY

## BIRDS

| | | Federal Status | State Status |
|---|---|---|---|
| **Whooping Crane** | *Grus americana* | LE | E |

potential migrant via plains throughout most of state to coast; winters in coastal marshes of Aransas, Calhoun, and Refugio counties

## FISHES

| | | Federal Status | State Status |
|---|---|---|---|
| **Guadalupe bass** | *Micropterus treculii* | | |

endemic to perennial streams of the Edward's Plateau region; introduced in Nueces River system

| | | | |
|---|---|---|---|
| **Smalleye shiner** | *Notropis buccula* | C | |

endemic to upper Brazos River system and its tributaries (Clear Fork and Bosque); apparently introduced into adjacent Colorado River drainage; medium to large prairie streams with sandy substrate and turbid to clear warm water; presumably eats small aquatic invertebrates

## INSECTS

| | | Federal Status | State Status |
|---|---|---|---|
| **Leon River winter stonefly** | *Taeniopteryx starki* | | |

habitat not described in detail, but apparently breeds in rivers; several members of this genus are known to use warm lotic environments, while others use cold lotic environments

## MAMMALS

| | | Federal Status | State Status |
|---|---|---|---|
| **Cave myotis bat** | *Myotis velifer* | | |

colonial and cave-dwelling; also roosts in rock crevices, old buildings, carports, under bridges, and even in abandoned Cliff Swallow (Hirundo pyrrhonota) nests; roosts in clusters of up to thousands of individuals; hibernates in limestone caves of Edwards Plateau and gypsum cave of Panhandle during winter; opportunistic insectivore

**Plains spotted skunk** *Spilogale putorius interrupta*

catholic; open fields, prairies, croplands, fence rows, farmyards, forest edges, and woodlands; prefers wooded, brushy areas and tallgrass prairie

| | | | |
|---|---|---|---|
| **Red wolf** | *Canis rufus* | LE | E |

extirpated; formerly known throughout eastern half of Texas in brushy and forested areas, as well as coastal prairies

## MOLLUSKS

| | | Federal Status | State Status |
|---|---|---|---|
| **False spike mussel** | *Quadrula mitchelli* | | T |

possibly extirpated in Texas; probably medium to large rivers; substrates varying from mud through mixtures of sand, gravel and cobble; one study indicated water lilies were present at the site; Rio Grande, Brazos, Colorado, and Guadalupe (historic) river basins

| | | | |
|---|---|---|---|
| **Smooth pimpleback** | *Quadrula houstonensis* | | T |

# CORYELL COUNTY

## MOLLUSKS

| | | Federal Status | State Status |
|---|---|---|---|

small to moderate streams and rivers as well as moderate size reservoirs; mixed mud, sand, and fine gravel, tolerates very slow to moderate flow rates, appears not to tolerate dramatic water level fluctuations, scoured bedrock substrates, or shifting sand bottoms, lower Trinity (questionable), Brazos, and Colorado River basins

| | | | |
|---|---|---|---|
| **Texas fawnsfoot** | *Truncilla macrodon* | | T |

little known; possibly rivers and larger streams, and intolerant of impoundment; flowing rice irrigation canals, possibly sand, gravel, and perhaps sandy-mud bottoms in moderate flows; Brazos and Colorado River basins

## REPTILES

| | | Federal Status | State Status |
|---|---|---|---|
| **Texas garter snake** | *Thamnophis sirtalis annectens* | | |

wet or moist microhabitats are conducive to the species occurrence, but is not necessarily restricted to them; hibernates underground or in or under surface cover; breeds March-August

| | | | |
|---|---|---|---|
| **Texas horned lizard** | *Phrynosoma cornutum* | | T |

open, arid and semi-arid regions with sparse vegetation, including grass, cactus, scattered brush or scrubby trees; soil may vary in texture from sandy to rocky; burrows into soil, enters rodent burrows, or hides under rock when inactive; breeds March-September

| | | | |
|---|---|---|---|
| **Timber/Canebrake rattlesnake** | *Crotalus horridus* | | T |

swamps, floodplains, upland pine and deciduous woodlands, riparian zones, abandoned farmland; limestone bluffs, sandy soil or black clay; prefers dense ground cover, i.e. grapevines or palmetto

## PLANTS

| | | Federal Status | State Status |
|---|---|---|---|
| **Texabama croton** | *Croton alabamensis var texensis* | | |

Texas endemic; in duff-covered loamy clay soils on rocky slopes in forested, mesic limestone canyons; locally abundant on deeper soils on small terraces in canyon bottoms, often forming large colonies and dominating the shrub layer; scattered individuals are occasionally on sunny margins of such forests; also found in contrasting habitat of deep, friable soils of limestone uplands, mostly in the shade of evergreen woodland mottes; flowering late February-March; fruit maturing and dehiscing by early June

U.S. Fish & Wildlife Service

# Endangered Species List

Back to Start

## List of species by county for Texas:

**Counties Selected: Bell, Coryell**

**Select one or more counties from the following list to view a county list:**

Anderson
Andrews
Angelina
Aransas
Archer

View County List

## Bell County

| Common Name | Scientific Name | Species Group | Listing Status | Species Image | Species Distribution Map | Critical Habitat | More Info |
|---|---|---|---|---|---|---|---|
| bald eagle | *Haliaeetus leucocephalus* | Birds | DM | | | | P |
| black-capped Vireo | *Vireo atricapilla* | Birds | E | | | | P |
| golden-cheeked warbler (=wood) | *Dendroica chrysoparia* | Birds | E | | | | P |
| Jollyville Plateau Salamander | *Eurycea tonkawae* | Amphibians | C | | | | P |
| Salado Salamander | *Eurycea chisholmensis* | Amphibians | C | No Image | | | P |
| smalleye Shiner | *Notropis buccula* | Fishes | C | No Image | | | P |
| whooping crane | *Grus americana* | Birds | E, EXPN | | | | P |

## Coryell County

| Common Name | Scientific Name | Species Group | Listing Status | Species Image | Species Distribution Map | Critical Habitat | More Info |
|---|---|---|---|---|---|---|---|
| bald eagle | *Haliaeetus leucocephalus* | Birds | DM | | | | P |
| black-capped Vireo | *Vireo atricapilla* | Birds | E | | | | P |
| golden-cheeked warbler (=wood) | *Dendroica chrysoparia* | Birds | E | | | | P |
| whooping crane | *Grus americana* | Birds | E, EXPN | | | | P |

# APPENDIX D
# ESTIMATED EROSION RATES SUMMARY REPORT

**PUBLIC DRAFT**

# Estimated Erosion Rates Summary Report Fort Hood, Texas

November 2011

# PUBLIC DRAFT

# ESTIMATED EROSION RATES SUMMARY REPORT FORT HOOD, TEXAS

---

**Contract No. W9126G-09-D-0067**
**Task Order No. 0010**

**Prepared for:**

Fort Hood Military Reservation
Killeen, Texas 776544-5028

**Prepared by:**

Gulf South Research Corporation
8081 GSRI Avenue
Baton Rouge, Louisiana 70820

**November 2011**

## TABLE OF CONTENTS

**1.0 INTRODUCTION** ..... **1**
**2.0 METHODS** ..... **1**
**3.0 RESULTS** ..... **2**
**4.0 CONCLUSION** ..... **3**

## LIST OF TABLES

Table 1. Maximum and Average Sediment Yield and Erosion Index by GMU under the No Action Alternative ..... 3
Table 2. Maximum and Average Sediment Yield and Erosion Index by GMU under the Proposed Action ..... 3

## LIST OF APPENDICES

Appendix A. RUSLE Data

**THIS PAGE LEFT INTENTIONALLY BLANK**

## 1.0 INTRODUCTION

The Revised Universal Soil Loss Equation (RUSLE) Version 1.06 program was used to estimate average annual sediment yield (i.e., erosion rates). The RUSLE model requires the input of factors influencing the five variables used to calculate sediment yield: climate (R), soil (K), topography (LS), management (C), and supporting practices (P). There are no supporting practices proposed or currently in place at Fort Hood; thus, this variable was omitted from the calculations. The time-invariant version of the model was used to estimate average annual sediment yield occurring at each sample plot. Data values entered for each sample plot and estimated sediment yield are presented in Appendix A.

## 2.0 METHODS

Climate, soil, and topography factors were the same for the No Action Alternative, Limited Range Grazing Management Plan (GMP) Alternative, and Proposed Action (i.e., Adaptive GMP). The climate factor was selected by choosing the nearest city on the list available in the model. This city was Waco, Texas, with a corresponding R value of 300. National Resources Conservation Service (NRCS) soil survey data was used to identify soil factors for each soil type including K, hydrologic group, and surface texture. Percent rock cover was input using ocular estimates recorded in the field. The number of years to consolidate was calculated by RUSLE based on the annual rainfall. The topography variable is affected by land use, slope length, and average slope steepness. Rangeland was selected as the land use factor from a dropdown list built into the model. Slope length and average slope steepness were measured at each sample plot using a Geographic Information System (GIS) and a Digital Elevation Model (DEM) derived from Light Detection and Range (LiDAR) data provided by Fort Hood. The steepest path tool in the Esri 3D Analyst GIS tool was used to determine slope length based on the congruence of flow paths from the sample plot location. Slope length and slope steepness as measured using these methods averaged 190 feet and 1.34 percent, respectively.

Setting the management factor in RUSLE requires the selection or input of the following factors: plant community, production potential, percent canopy cover, average fall height, roughness, mechanical disturbance, and percent cover of surface residue. The plant community was selected as southern mixed prairie from a dropdown list. Percent canopy cover was calculated using a linear regression analysis of total biomass and percent cover calculated for a subset of

sample plot data. Average fall height was input as 0.75 feet for sites with greater than 2,500 pounds per acre total biomass and as 0.25 feet for sites with less than 2,500 pounds per acre total biomass. Roughness was selected from a dropdown list as 1.0, which corresponds to typical roughness values found in mixed grass prairie. Mechanical disturbance was input as 1, to represent a lack of mechanical disturbance such as disking or tilling. Percent cover of surface residue was calculated as 10 percent of the cover value.

For the No Action Alternative, the site production potential was entered as the residual biomass value estimated in the field using a Robel pole. For the Proposed Action, the change in site production potential was based on the proposed change in stocking rates relative to the No Action Alternative. The percent change in stocking rates was multiplied by the residual forage biomass, and this change was added or subtracted from the total residual biomass and entered as the site production potential. For sites at which deferral of grazing was proposed, it is assumed that sediment yields will decrease relative to the No Action Alternative. The same assumption was made for all sites under the Limited Range GMP Alternative. It is assumed that the effects of training on site production potential would be similar to those which occurred prior to sampling in 2010. Although changes in either training intensity or climate could have substantial effects on site production potential, these two factors are difficult to predict and can change substantially in any given year.

The average sediment yield for each Grazing Management Unit (GMU) was calculated as the average of sediment yields estimated for each plot in the GMU. Because sample plots were locations proportional to the soil types found within the grazeable area of each GMU, there is no need to apply an area-weighted average. Sediment yields were compared to the sustainable sediment yield value (T) listed in the soil survey for each soil type. An erosion index was calculated as the ratio of estimated sediment yield to sustainable sediment yield. An erosion index greater than 1.0 indicates unsustainable conditions and would result in significant adverse impacts.

## 3.0 RESULTS

Estimated sediment yields were less than the sustainable sediment yield for each sample plot under both the No Action Alternative (Table 1) and the Proposed Action (Table 2). It is assumed that sediment yields under the Limited Range Alternative would be less than those

estimated for the No Action Alternative. Relative to the No Action Alternative, the Proposed Action Alternative would result in increased sediment yields in the Western Maneuver Area GMUs, and decreased sediments yields West Fort Hood GMUs.

**Table 1. Maximum and Average Sediment Yield and Erosion Index by GMU under the No Action Alternative**

| GMU | Maximum Sediment Yield by Plot (tons/acre/year) | Average Sediment Yield by GMU (tons/acre/year) | Maximum Erosion Index by Plot | Average Erosion Index by GMU |
|---|---|---|---|---|
| Western Maneuver Area North | 0.57 | 0.11 | 0.13 | 0.04 |
| Western Maneuver Area South | 0.58 | 0.13 | 0.29 | 0.04 |
| West Fort Hood North | 0.62 | 0.24 | 0.14 | 0.07 |
| West Fort Hood South | 0.35 | 0.18 | 0.35 | 0.08 |

**Table 2. Maximum and Average Sediment Yield and Erosion Index by GMU under the Proposed Action**

| GMU | Maximum Sediment Yield by Plot (tons/acre/year) | Average Sediment Yield by GMU (tons/acre/year) | Maximum Erosion Index by Plot | Average Erosion Index by GMU |
|---|---|---|---|---|
| Western Maneuver Area North | 0.65 | 0.15 | 0.14 | 0.05 |
| Western Maneuver Area South | 0.65 | 0.20 | 0.33 | 0.06 |
| West Fort Hood North | <0.62 | <0.24 | <0.14 | <0.07 |
| West Fort Hood South | 0.33 | 0.17 | 0.33 | 0.07 |

## 4.0 CONCLUSION

Erosion rates would have a less than significant effect on soils, vegetation, water quality, and aesthetics under the No Action Alternative. Under the Proposed Action, erosion rates would slightly increase in the Western Maneuver Area and West Fort Hood South GMUs, and slightly decrease in the West Fort Hood North GMU; however, these changes in erosion rates would also be less than significant. Under the Limited Range GMP Alternative, erosion rates would likely decrease in the Western Maneuver Area and West Fort Hood GMUs.

**THIS PAGE LEFT INTENTIONALLY BLANK**

# APPENDIX A
# RUSLE Data

| | R | K | | | | | | LS | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Plot # | Waco, TX | Soil | K | % Rock | # Years to Consolidate | Hydrologic Group | Surface Texture | Land Use | Gradient (%) | Length (ft) |
| 1WMAN | 300 | Topsey | 0.32 | 5 | 7 | 3 | 8 | 5 | 0.96 | 104 |
| 2WMAN | 300 | Topsey | 0.32 | 0 | 7 | 3 | 8 | 5 | 1.94 | 98 |
| 3WMAN | 300 | Nuff | 0.37 | 0 | 7 | 3 | 9 | 5 | 0.88 | 137 |
| 4WMAN | 300 | Topsey | 0.32 | 30 | 7 | 3 | 8 | 5 | 0.77 | 261 |
| 5WMAN | 300 | Topsey | 0.32 | 5 | 7 | 3 | 8 | 5 | 1.16 | 52 |
| 6WMAN | 300 | Topsey | 0.32 | 10 | 7 | 3 | 8 | 5 | 0.65 | 153 |
| 7WMAN | 300 | Cho | 0.32 | 5 | 7 | 4 | 8 | 5 | 0.45 | 22 |
| 8WMAN | 300 | Doss-Real complex | 0.37 | 5 | 7 | 4 | 8 | 5 | 0.53 | 75 |
| 9WMAN | 300 | Eckrant-Rock outcrop complex | 0.32 | 30 | 7 | 4 | 11 | 5 | 0.99 | 202 |
| 10WMAN | 300 | Nuff | 0.37 | 5 | 7 | 3 | 9 | 5 | 1.09 | 460 |
| 11WMAN | 300 | Nuff | 0.37 | 5 | 7 | 3 | 9 | 5 | 0.79 | 253 |
| 12WMAN | 300 | Nuff | 0.37 | 0 | 7 | 3 | 9 | 5 | 0.88 | 193 |
| 13WMAN | 300 | Real-Rock outcrop complex | 0.28 | 0 | 7 | 4 | 9 | 5 | 0.79 | 51 |
| 14WMAN | 300 | Slidell | 0.32 | 0 | 7 | 4 | 11 | 5 | 0.37 | 189 |
| 15WMAN | 300 | Slidell | 0.32 | 0 | 7 | 4 | 11 | 5 | 0.41 | 122 |
| 16WMAN | 300 | Slidell | 0.32 | 0 | 7 | 4 | 11 | 5 | 0.59 | 338 |
| 17WMAN | 300 | Tarrant-Purves association | 0.32 | 5 | 7 | 4 | 11 | 5 | 0.17 | 58 |
| 18WMAN | 300 | Tarrant-Purves association | 0.32 | 0 | 7 | 4 | 11 | 5 | 0.58 | 607 |
| 19WMAN | 300 | Slidell | 0.32 | 0 | 7 | 4 | 11 | 5 | 0.94 | 32 |
| 20WMAN | 300 | Topsey | 0.32 | 0 | 7 | 3 | 8 | 5 | 1.09 | 128 |
| 21WMAN | 300 | Cho | 0.32 | 35 | 7 | 4 | 8 | 5 | 0.68 | 190 |
| 22WMAN | 300 | Nuff | 0.37 | 35 | 7 | 3 | 9 | 5 | 1.55 | 90 |
| 23WMAN | 300 | Topsey | 0.32 | 5 | 7 | 3 | 8 | 5 | 1.75 | 29 |
| 24WMAN | 300 | Nuff | 0.37 | 35 | 7 | 3 | 9 | 5 | 1.17 | 597 |
| 25WMAN | 300 | Slidell | 0.32 | 10 | 7 | 4 | 11 | 5 | 2.72 | 52 |

| Plot # | C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plant Community | Annual Site Production Potential | | | | | % Canopy Cover | Average Fall Height (in) | Roughness (in) | Mechanical Disturbance | % Residue Surface Cover |
| | | 2010 RB (lb/ac) | 2010 RFB (lb/ac) | % Change | RFB Change (lb/ac) | Adjusted RB (lb/ac) | | | | | |
| 1WMAN | 1 | 3933 | 952 | 16 | 152 | 3780 | 73 | 0.75 | 1 | 1 | 7 |
| 2WMAN | 1 | 2487 | 1327 | 16 | 212 | 2275 | 62 | 0.25 | 1 | 1 | 6 |
| 3WMAN | 1 | 2728 | 1240 | 16 | 198 | 2530 | 64 | 0.75 | 1 | 1 | 6 |
| 4WMAN | 1 | 3692 | 1433 | 16 | 229 | 3463 | 71 | 0.75 | 1 | 1 | 7 |
| 5WMAN | 1 | 4013 | 2368 | 16 | 379 | 3634 | 72 | 0.75 | 1 | 1 | 7 |
| 6WMAN | 1 | 4816 | 3445 | 16 | 551 | 4265 | 77 | 0.75 | 1 | 1 | 8 |
| 7WMAN | 1 | 4816 | 1401 | 16 | 224 | 4592 | 80 | 0.75 | 1 | 1 | 8 |
| 8WMAN | 1 | 2728 | 1488 | 16 | 238 | 2490 | 63 | 0.25 | 1 | 1 | 6 |
| 9WMAN | 1 | 3772 | 974 | 16 | 156 | 3616 | 72 | 0.75 | 1 | 1 | 7 |
| 10WMAN | 1 | 5137 | 2173 | 16 | 348 | 4789 | 81 | 0.75 | 1 | 1 | 8 |
| 11WMAN | 1 | 4655 | 1463 | 16 | 234 | 4421 | 78 | 0.75 | 1 | 1 | 8 |
| 12WMAN | 1 | 6020 | 946 | 16 | 151 | 5869 | 90 | 0.75 | 1 | 1 | 9 |
| 13WMAN | 1 | 2568 | 1208 | 16 | 193 | 2374 | 62 | 0.25 | 1 | 1 | 6 |
| 14WMAN | 1 | 5057 | 2574 | 16 | 412 | 4645 | 80 | 0.75 | 1 | 1 | 8 |
| 15WMAN | 1 | 2158 | 942 | 16 | 151 | 2007 | 60 | 0.25 | 1 | 1 | 6 |
| 16WMAN | 1 | 6583 | 3121 | 16 | 499 | 6083 | 91 | 0.75 | 1 | 1 | 9 |
| 17WMAN | 1 | 3598 | 2048 | 16 | 328 | 3270 | 69 | 0.75 | 1 | 1 | 7 |
| 18WMAN | 1 | 4495 | 2942 | 16 | 471 | 4024 | 75 | 0.75 | 1 | 1 | 8 |
| 19WMAN | 1 | 3933 | 1468 | 16 | 235 | 3698 | 73 | 0.75 | 1 | 1 | 7 |
| 20WMAN | 1 | 3371 | 1798 | 16 | 288 | 3083 | 68 | 0.75 | 1 | 1 | 7 |
| 21WMAN | 1 | 1684 | 539 | 16 | 86 | 1598 | 56 | 0.25 | 1 | 1 | 6 |
| 22WMAN | 1 | 5780 | 1475 | 16 | 236 | 5544 | 87 | 0.75 | 1 | 1 | 9 |
| 23WMAN | 1 | 4977 | 1991 | 16 | 319 | 4658 | 80 | 0.75 | 1 | 1 | 8 |
| 24WMAN | 1 | 5298 | 848 | 16 | 136 | 5162 | 84 | 0.75 | 1 | 1 | 8 |
| 25WMAN | 1 | 5378 | 2432 | 16 | 389 | 4989 | 83 | 0.75 | 1 | 1 | 8 |

RB = Residual Biomass; RFB = Residual Forage Biomass

| Plot # | Sediment Yield Proposed Action (t/ac/yr) | Sediment Yield No Action (t/ac/yr) | T-Factor (t/ac/yr) | Erosion Index Proposed Action | Erosion Index No Action |
|---|---|---|---|---|---|
| 1WMAN | 0.13 | 0.12 | 5 | 0.03 | 0.02 |
| 2WMAN | 0.65 | 0.57 | 5 | 0.13 | 0.11 |
| 3WMAN | 0.35 | 0.31 | 5 | 0.07 | 0.06 |
| 4WMAN | 0.10 | 0.09 | 5 | 0.02 | 0.02 |
| 5WMAN | 0.16 | 0.04 | 5 | 0.03 | 0.01 |
| 6WMAN | 0.07 | 0.05 | 5 | 0.01 | 0.01 |
| 7WMAN | 0.04 | 0.04 | 2 | 0.02 | 0.02 |
| 8WMAN | 0.22 | 0.05 | 2 | 0.11 | 0.03 |
| 9WMAN | 0.11 | 0.08 | 1 | 0.11 | 0.08 |
| 10WMAN | 0.08 | 0.07 | 5 | 0.02 | 0.01 |
| 11WMAN | 0.08 | 0.07 | 5 | 0.02 | 0.01 |
| 12WMAN | 0.03 | 0.03 | 5 | 0.01 | 0.01 |
| 13WMAN | 0.25 | 0.23 | 2 | 0.13 | 0.12 |
| 14WMAN | 0.04 | 0.04 | 5 | 0.01 | 0.01 |
| 15WMAN | 0.24 | 0.22 | 5 | 0.05 | 0.04 |
| 16WMAN | 0.02 | 0.01 | 5 | 0.00 | 0.00 |
| 17WMAN | 0.07 | 0.05 | 1 | 0.07 | 0.05 |
| 18WMAN | 0.08 | 0.06 | 1 | 0.08 | 0.06 |
| 19WMAN | 0.13 | 0.11 | 5 | 0.03 | 0.02 |
| 20WMAN | 0.24 | 0.04 | 6 | 0.04 | 0.01 |
| 21WMAN | 0.27 | 0.26 | 2 | 0.14 | 0.13 |
| 22WMAN | 0.05 | 0.05 | 5 | 0.01 | 0.01 |
| 23WMAN | 0.10 | 0.09 | 5 | 0.02 | 0.02 |
| 24WMAN | 0.05 | 0.05 | 5 | 0.01 | 0.01 |
| 25WMAN | 0.12 | 0.10 | 5 | 0.02 | 0.02 |

| | R | K | | | | | | LS | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Plot # | Waco, TX | Soil | K | % Rock | # Years to Consolidate | Hydrologic Group | Surface Texture | Land Use | Gradient (%) | Length (ft) |
| 26WMAS | 300 | Nuff | 0.37 | 5 | 7 | 3 | 9 | 5 | 0.68 | 512 |
| 27WMAS | 300 | Nuff | 0.37 | 0 | 7 | 3 | 9 | 5 | 0.73 | 165 |
| 28WMAS | 300 | Nuff | 0.37 | 0 | 7 | 3 | 9 | 5 | 0.73 | 204 |
| 29WMAS | 300 | Nuff | 0.37 | 15 | 7 | 3 | 9 | 5 | 0.66 | 15 |
| 30WMAS | 300 | Topsey | 0.32 | 0 | 7 | 3 | 8 | 5 | 1.51 | 398 |
| 31WMAS | 300 | Nuff | 0.37 | 10 | 7 | 3 | 9 | 5 | 2.92 | 342 |
| 32WMAS | 300 | Nuff | 0.37 | 10 | 7 | 3 | 9 | 5 | 1.29 | 12 |
| 33WMAS | 300 | Doss-Real complex | 0.37 | 0 | 7 | 4 | 8 | 5 | 0.48 | 6 |
| 34WMAS | 300 | Nuff | 0.37 | 5 | 7 | 3 | 9 | 5 | 1.11 | 3 |
| 35WMAS | 300 | Nuff | 0.37 | 5 | 7 | 3 | 9 | 5 | 0.54 | 370 |
| 36WMAS | 300 | Nuff | 0.37 | 0 | 7 | 3 | 9 | 5 | 0.20 | 50 |
| 37WMAS | 300 | Nuff | 0.37 | 0 | 7 | 3 | 9 | 5 | 0.47 | 127 |
| 38WMAS | 300 | Doss-Real complex | 0.37 | 0 | 7 | 4 | 8 | 5 | 1.13 | 533 |
| 39WMAS | 300 | Doss-Real complex | 0.37 | 65 | 7 | 4 | 8 | 5 | 1.86 | 306 |
| 40WMAS | 300 | Doss-Real complex | 0.37 | 5 | 7 | 4 | 8 | 5 | 1.04 | 290 |
| 41WMAS | 300 | Bosque | 0.28 | 20 | 7 | 2 | 8 | 5 | 1.14 | 35 |
| 42WMAS | 300 | Topsey | 0.32 | 0 | 7 | 3 | 8 | 5 | 1.12 | 143 |
| 43WMAS | 300 | Topsey | 0.32 | 60 | 7 | 3 | 8 | 5 | 2.61 | 38 |
| 44WMAS | 300 | Cho | 0.32 | 0 | 7 | 4 | 8 | 5 | 1.37 | 256 |
| 45WMAS | 300 | Cisco fine sandy loam | 0.37 | 0 | 7 | 2 | 3 | 5 | 1.82 | 165 |
| 46WMAS | 300 | Slidell | 0.32 | 0 | 7 | 4 | 11 | 5 | 0.89 | 675 |
| 47WMAS | 300 | Doss-Real complex | 0.37 | 10 | 7 | 4 | 8 | 5 | 1.27 | 126 |
| 48WMAS | 300 | Krum | 0.32 | 0 | 7 | 3 | 11 | 5 | 1.13 | 142 |
| 49WMAS | 300 | Bosque | 0.28 | 0 | 7 | 2 | 8 | 5 | 0.13 | 32 |

| | C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Annual Site Production Potential | | | | | | | | | |
| Plot # | Plant Community | 2010 RB (lb/ac) | 2010 RFB (lb/ac) | % Change | RFB Change (lb/ac) | Adjusted RB (lb/ac) | % Canopy Cover | Average Fall Height (in) | Roughness (in) | Mechanical Disturbance | % Residue Surface Cover |
| 26WMAS | 1 | 5539 | 2954 | 33 | 975 | 4564 | 80 | 0.75 | 1 | 1 | 8 |
| 27WMAS | 1 | 4495 | 2464 | 34 | 838 | 3657 | 72 | 0.75 | 1 | 1 | 7 |
| 28WMAS | 1 | 4977 | 1659 | 35 | 581 | 4396 | 78 | 0.75 | 1 | 1 | 8 |
| 29WMAS | 1 | 2247 | 1048 | 36 | 377 | 1869 | 59 | 0.25 | 1 | 1 | 6 |
| 30WMAS | 1 | 5298 | 3709 | 37 | 1372 | 3926 | 75 | 0.75 | 1 | 1 | 7 |
| 31WMAS | 1 | 5458 | 3465 | 38 | 1317 | 4142 | 76 | 0.75 | 1 | 1 | 8 |
| 32WMAS | 1 | 4174 | 1723 | 39 | 672 | 3502 | 71 | 0.75 | 1 | 1 | 7 |
| 33WMAS | 1 | 6061 | 3733 | 40 | 1493 | 4567 | 80 | 0.75 | 1 | 1 | 8 |
| 34WMAS | 1 | 4174 | 980 | 41 | 402 | 3772 | 73 | 0.75 | 1 | 1 | 7 |
| 35WMAS | 1 | 3772 | 1166 | 42 | 490 | 3282 | 70 | 0.75 | 1 | 1 | 7 |
| 36WMAS | 1 | 4736 | 379 | 43 | 163 | 4573 | 80 | 0.75 | 1 | 1 | 8 |
| 37WMAS | 1 | 4334 | 2966 | 44 | 1305 | 3029 | 68 | 0.75 | 1 | 1 | 7 |
| 38WMAS | 1 | 5940 | 4002 | 45 | 1801 | 4139 | 76 | 0.75 | 1 | 1 | 8 |
| 39WMAS | 1 | 1122 | 468 | 46 | 215 | 907 | 51 | 0.25 | 1 | 1 | 5 |
| 40WMAS | 1 | 4013 | 1188 | 47 | 558 | 3455 | 71 | 0.75 | 1 | 1 | 7 |
| 41WMAS | 1 | 5458 | 2519 | 48 | 1209 | 4249 | 77 | 0.75 | 1 | 1 | 8 |
| 42WMAS | 1 | 3692 | 985 | 49 | 482 | 3210 | 69 | 0.75 | 1 | 1 | 7 |
| 43WMAS | 1 | 1604 | 321 | 50 | 160 | 1444 | 55 | 0.25 | 1 | 1 | 6 |
| 44WMAS | 1 | 5860 | 3014 | 51 | 1537 | 4323 | 78 | 0.75 | 1 | 1 | 8 |
| 45WMAS | 1 | 6261 | 4453 | 52 | 2315 | 3946 | 75 | 0.75 | 1 | 1 | 7 |
| 46WMAS | 1 | 4093 | 598 | 53 | 317 | 3776 | 73 | 0.75 | 1 | 1 | 7 |
| 47WMAS | 1 | 4977 | 2986 | 54 | 1612 | 3364 | 70 | 0.75 | 1 | 1 | 7 |
| 48WMAS | 1 | 5780 | 3589 | 55 | 1974 | 3805 | 74 | 0.75 | 1 | 1 | 7 |
| 49WMAS | 1 | 4174 | 531 | 56 | 297 | 3876 | 74 | 0.75 | 1 | 1 | 7 |

RB = Residual Biomass; RFB = Residual Forage Biomass

| Plot # | Sediment Yield Proposed Action (t/ac/yr) | Sediment Yield No Action (t/ac/yr) | T-Factor (t/ac/yr) | Erosion Index Proposed Action | Erosion Index No Action |
|---|---|---|---|---|---|
| 26WMAS | 0.07 | 0.04 | 5 | 0.01 | 0.01 |
| 27WMAS | 0.25 | 0.08 | 5 | 0.05 | 0.02 |
| 28WMAS | 0.08 | 0.06 | 5 | 0.02 | 0.01 |
| 29WMAS | 0.33 | 0.26 | 5 | 0.07 | 0.05 |
| 30WMAS | 0.18 | 0.08 | 5 | 0.04 | 0.02 |
| 31WMAS | 0.31 | 0.15 | 5 | 0.06 | 0.03 |
| 32WMAS | 0.20 | 0.14 | 5 | 0.04 | 0.03 |
| 33WMAS | 0.05 | 0.02 | 2 | 0.03 | 0.01 |
| 34WMAS | 0.15 | 0.12 | 5 | 0.03 | 0.02 |
| 35WMAS | 0.14 | 0.11 | 5 | 0.03 | 0.02 |
| 36WMAS | 0.03 | 0.03 | 5 | 0.01 | 0.01 |
| 37WMAS | 0.16 | 0.08 | 5 | 0.03 | 0.02 |
| 38WMAS | 0.14 | 0.05 | 2 | 0.07 | 0.03 |
| 39WMAS | 0.65 | 0.58 | 2 | 0.33 | 0.29 |
| 40WMAS | 0.20 | 0.15 | 2 | 0.10 | 0.08 |
| 41WMAS | 0.08 | 0.04 | 5 | 0.02 | 0.01 |
| 42WMAS | 0.23 | 0.17 | 5 | 0.05 | 0.03 |
| 43WMAS | 0.56 | 0.51 | 5 | 0.11 | 0.10 |
| 44WMAS | 0.12 | 0.05 | 2 | 0.06 | 0.03 |
| 45WMAS | 0.23 | 0.07 | 5 | 0.05 | 0.01 |
| 46WMAS | 0.13 | 0.11 | 5 | 0.03 | 0.02 |
| 47WMAS | 0.24 | 0.10 | 2 | 0.12 | 0.05 |
| 48WMAS | 0.15 | 0.05 | 5 | 0.03 | 0.01 |
| 49WMAS | 0.03 | 0.03 | 5 | 0.01 | 0.01 |

| | R | K | | | | | | LS | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Plot # | Waco, TX | Soil | K | % Rock | # Years to Consolidate | Hydrologic Group | Surface Texture | Land Use | Gradient (%) | Length (ft) |
| 50WFHN | 300 | Topsey | 0.32 | 0 | 7 | 3 | 8 | 5 | 0.72 | 690 |
| 51WFHN | 300 | Topsey | 0.32 | 0 | 7 | 3 | 8 | 5 | 0.59 | 591 |
| 52WFHN | 300 | Cho | 0.32 | 85 | 7 | 4 | 8 | 5 | 0.96 | 83 |
| 53WFHN | 300 | Crawford | 0.32 | 0 | 7 | 4 | 11 | 5 | 0.75 | 53 |
| 54WFHN | 300 | Denton | 0.32 | 25 | 7 | 3 | 11 | 5 | 0.79 | 89 |
| 55WFHN | 300 | Doss-Real complex | 0.37 | 0 | 7 | 4 | 8 | 5 | 1.12 | 27 |
| 56WFHN | 300 | Frio | 0.32 | 5 | 7 | 3 | 11 | 5 | 0.51 | 79 |
| 57WFHN | 300 | Krum | 0.32 | 0 | 7 | 3 | 11 | 5 | 0.74 | 135 |
| 58WFHN | 300 | Lewisville | 0.32 | 20 | 7 | 2 | 11 | 5 | 2.07 | 126 |
| 59WFHN | 300 | Purves | 0.32 | 75 | 7 | 4 | 11 | 5 | 0.35 | 57 |
| 60WFHN | 300 | Real-Rock outcrop complex | 0.28 | 40 | 7 | 4 | 8 | 5 | 1.46 | 34 |
| 61WFHN | 300 | Denton | 0.32 | 60 | 7 | 3 | 11 | 5 | 3.54 | 743 |
| 62WFHN | 300 | Slidell | 0.32 | 5 | 7 | 4 | 11 | 5 | 1.21 | 83 |
| 63WFHN | 300 | Topsey | 0.32 | 60 | 7 | 3 | 8 | 5 | 1.67 | 359 |

| Plot # | C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plant Community | Annual Site Production Potential | | | | | % Canopy Cover | Average Fall Height (in) | Roughness (in) | Mechanical Disturbance | % Residue Surface Cover |
| | | 2010 RB (lb/ac) | 2010 RFB (lb/ac) | % Change | RFB Change (lb/ac) | Adjusted RB (lb/ac) | | | | | |
| 50WFHN | 1 | 3772 | 1086 | 0 | 0 | 3772 | 73 | 0.75 | 1 | 1 | 7 |
| 51WFHN | 1 | 3130 | 1017 | 0 | 0 | 3130 | 68 | 0.75 | 1 | 1 | 7 |
| 52WFHN | 1 | 1765 | 838 | 0 | 0 | 1765 | 58 | 0.25 | 1 | 1 | 6 |
| 53WFHN | 1 | 4736 | 2901 | 0 | 0 | 4736 | 81 | 0.75 | 1 | 1 | 8 |
| 54WFHN | 1 | 1323 | 695 | 0 | 0 | 1323 | 54 | 0.25 | 1 | 1 | 5 |
| 55WFHN | 1 | 3692 | 2953 | 0 | 0 | 3692 | 73 | 0.75 | 1 | 1 | 7 |
| 56WFHN | 1 | 1925 | 521 | 0 | 0 | 1925 | 59 | 0.25 | 1 | 1 | 6 |
| 57WFHN | 1 | 4174 | 1252 | 0 | 0 | 4174 | 76 | 0.75 | 1 | 1 | 8 |
| 58WFHN | 1 | 2086 | 910 | 0 | 0 | 2086 | 60 | 0.25 | 1 | 1 | 6 |
| 59WFHN | 1 | 1444 | 547 | 0 | 0 | 1444 | 55 | 0.25 | 1 | 1 | 6 |
| 60WFHN | 1 | 2969 | 1134 | 0 | 0 | 2969 | 67 | 0.75 | 1 | 1 | 7 |
| 61WFHN | 1 | 3531 | 785 | 0 | 0 | 3531 | 71 | 0.75 | 1 | 1 | 7 |
| 62WFHN | 1 | 4415 | 1214 | 0 | 0 | 4415 | 78 | 0.75 | 1 | 1 | 8 |
| 63WFHN | 1 | 1363 | 530 | 0 | 0 | 1363 | 55 | 0.25 | 1 | 1 | 5 |

RB = Residual Biomass; RFB = Residual Forage Biomass

| Plot # | Sediment Yield Proposed Action (t/ac/yr) | Sediment Yield No Action (t/ac/yr) | T-Factor (t/ac/yr) | Erosion Index Proposed Action | Erosion Index No Action |
|---|---|---|---|---|---|
| 50WFHN | 0.11 | 0.11 | 5 | 0.02 | 0.02 |
| 51WFHN | 0.15 | 0.15 | 5 | 0.03 | 0.03 |
| 52WFHN | 0.14 | 0.14 | 2 | 0.07 | 0.07 |
| 53WFHN | 0.05 | 0.05 | 2 | 0.03 | 0.03 |
| 54WFHN | 0.42 | 0.42 | 3 | 0.14 | 0.14 |
| 55WFHN | 0.17 | 0.17 | 2 | 0.09 | 0.09 |
| 56WFHN | 0.54 | 0.54 | 5 | 0.11 | 0.11 |
| 57WFHN | 0.08 | 0.08 | 5 | 0.02 | 0.02 |
| 58WFHN | 0.62 | 0.62 | 5 | 0.12 | 0.12 |
| 59WFHN | 0.10 | 0.10 | 1 | 0.10 | 0.10 |
| 60WFHN | 0.17 | 0.17 | 2 | 0.09 | 0.09 |
| 61WFHN | 0.24 | 0.24 | 3 | 0.08 | 0.08 |
| 62WFHN | 0.10 | 0.10 | 5 | 0.02 | 0.02 |
| 63WFHN | 0.42 | 0.42 | 5 | 0.08 | 0.08 |

| | R | K | | | | | | LS | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Plot # | Waco, TX | Soil | K | % Rock | # Years to Consolidate | Hydrologic Group | Surface Texture | Land Use | Gradient (%) | Length (ft) |
| 64WFHS | 300 | Topsey | 0.32 | 0 | 7 | 3 | 8 | 5 | 0.82 | 490 |
| 65WFHS | 300 | Denton | 0.32 | 5 | 7 | 3 | 11 | 5 | 0.46 | 65 |
| 66WFHS | 300 | Doss-Real complex | 0.37 | 0 | 7 | 4 | 8 | 5 | 1.36 | 88 |
| 67WFHS | 300 | Bosque | 0.28 | 0 | 7 | 2 | 8 | 5 | 1.39 | 7 |
| 68WFHS | 300 | Topsey | 0.32 | 30 | 7 | 3 | 8 | 5 | 0.14 | 7 |
| 69WFHS | 300 | Denton | 0.32 | 0 | 7 | 3 | 11 | 5 | 1.70 | 470 |
| 70WFHS | 300 | Doss-Real complex | 0.37 | 0 | 7 | 4 | 8 | 5 | 1.80 | 139 |
| 71WFHS | 300 | Topsey | 0.32 | 0 | 7 | 3 | 8 | 5 | 1.03 | 88 |
| 72WFHS | 300 | Krum | 0.32 | 0 | 7 | 3 | 11 | 5 | 0.91 | 220 |
| 73WFHS | 300 | Krum | 0.32 | 0 | 7 | 3 | 11 | 5 | 0.48 | 62 |
| 74WFHS | 300 | Real-Rock outcrop complex | 0.28 | 25 | 7 | 4 | 8 | 5 | 2.11 | 14 |
| 75WFHS | 300 | Topsey-Pidcoke assocation | 0.32 | 5 | 7 | 3 | 8 | 5 | 1.83 | 11 |
| 76WFHS | 300 | Topsey-Pidcoke assocation | 0.32 | 50 | 7 | 3 | 8 | 5 | 1.71 | 281 |
| 77WFHS | 300 | Topsey | 0.32 | 50 | 7 | 3 | 8 | 5 | 1.41 | 120 |

| | C | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Annual Site Production Potential | | | | | | | | | |
| Plot # | Plant Community | 2010 RB (lb/ac) | 2010 RFB (lb/ac) | % Change | RFB Change (lb/ac) | Adjusted RB (lb/ac) | % Canopy Cover | Average Fall Height (in) | Roughness (in) | Mechanical Disturbance | % Residue Surface Cover |
| 64WFHS | 1 | 5298 | 748 | -21 | -157 | 5455 | 86 | 0.75 | 1 | 1 | 9 |
| 65WFHS | 1 | 3371 | 890 | -20 | -178 | 3549 | 72 | 0.75 | 1 | 1 | 7 |
| 66WFHS | 1 | 2728 | 1273 | -19 | -242 | 2970 | 67 | 0.75 | 1 | 1 | 7 |
| 67WFHS | 1 | 2487 | 1221 | -18 | -220 | 2707 | 65 | 0.75 | 1 | 1 | 7 |
| 68WFHS | 1 | 1604 | 275 | -17 | -47 | 1651 | 57 | 0.25 | 1 | 1 | 6 |
| 69WFHS | 1 | 1524 | 388 | -16 | -62 | 1586 | 56 | 0.25 | 1 | 1 | 6 |
| 70WFHS | 1 | 5940 | 1033 | -15 | -155 | 6095 | 91 | 0.75 | 1 | 1 | 9 |
| 71WFHS | 1 | 3451 | 1380 | -14 | -193 | 3644 | 72 | 0.75 | 1 | 1 | 7 |
| 72WFHS | 1 | 3852 | 1072 | -13 | -139 | 3992 | 75 | 0.75 | 1 | 1 | 8 |
| 73WFHS | 1 | 1604 | 917 | -12 | -110 | 1714 | 57 | 0.25 | 1 | 1 | 6 |
| 74WFHS | 1 | 3612 | 1970 | -11 | -217 | 3829 | 74 | 0.75 | 1 | 1 | 7 |
| 75WFHS | 1 | 2926 | 975 | -10 | -98 | 3024 | 68 | 0.75 | 1 | 1 | 7 |
| 76WFHS | 1 | 3049 | 1719 | -9 | -155 | 3204 | 69 | 0.75 | 1 | 1 | 7 |
| 77WFHS | 1 | 3049 | 1558 | -8 | -125 | 3174 | 69 | 0.75 | 1 | 1 | 7 |

RB = Residual Biomass; RFB = Residual Forage Biomass

| Plot # | Sediment Yield Proposed Action (t/ac/yr) | Sediment Yield No Action (t/ac/yr) | T-Factor (t/ac/yr) | Erosion Index Proposed Action | Erosion Index No Action |
|---|---|---|---|---|---|
| 64WFHS | 0.03 | 0.04 | 5 | 0.01 | 0.01 |
| 65WFHS | 0.09 | 0.10 | 3 | 0.03 | 0.03 |
| 66WFHS | 0.06 | 0.08 | 2 | 0.03 | 0.04 |
| 67WFHS | 0.31 | 0.35 | 5 | 0.06 | 0.07 |
| 68WFHS | 0.12 | 0.12 | 5 | 0.02 | 0.02 |
| 69WFHS | 0.24 | 0.30 | 3 | 0.08 | 0.10 |
| 70WFHS | 0.04 | 0.05 | 2 | 0.02 | 0.03 |
| 71WFHS | 0.15 | 0.17 | 5 | 0.03 | 0.03 |
| 72WFHS | 0.14 | 0.11 | 5 | 0.03 | 0.02 |
| 73WFHS | 0.33 | 0.35 | 5 | 0.07 | 0.07 |
| 74WFHS | 0.15 | 0.17 | 3 | 0.05 | 0.06 |
| 75WFHS | 0.33 | 0.35 | 1 | 0.33 | 0.35 |
| 76WFHS | 0.17 | 0.19 | 1 | 0.17 | 0.19 |
| 77WFHS | 0.15 | 0.16 | 5 | 0.03 | 0.03 |

# APPENDIX E
# 2006 GRAZING MANAGEMENT PLAN

# Fort Hood Military Installation
# Killeen, Texas

*Draft*

# Cattle Grazing Management Plan
## May 2006

**Prepared For Fort Hood & U.S. Army Corps of Engineers – Fort Worth District**
**Under Contract No. DACA63-03-D-0008, Delivery Order Numbers 11 & 31**

## TABLE OF CONTENTS

**1.0 INTRODUCTION ..... 1**
1.1 Background ..... 1
1.2 Purpose ..... 3

**2.0 CATTLE STOCKING RATE CALCULATION PROCESS ..... 4**
2.1 Selection of Stocking Rate Calculation Method ..... 4
2.2 Grazing Use Methodology ..... 6
2.3 Live-Fire/Impact Area Stocking Rate Calculation Approach ..... 8
2.4 Forage Inventories ..... 9
2.5 Soil Erosion Rate Estimation ..... 10
2.6 Final Stocking Rate Selection ..... 10

**3.0 CONTINGENCY PLANS ..... 11**

**4.0 FUTURE IMPLEMENTATION OF PHYGROW MODEL ..... 12**

**5.0 REFERENCES ..... 13**

### List of Figures

Figure 1 Fort Hood Grazing Management Units ..... 2
Figure 2 Stocking Rate Calculation Process ..... 5

### List of Tables

Table 1 Animal-Unit Equivalents ..... 6
Table 2 Grazing Use Methodology Model Training Utilization Scale ..... 8

### List of Appendices

Appendix A Grazing Use Methodology Calculations
Appendix B Forage Inventory

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AU | Animal-Unit |
| CTCA | Central Texas Cattleman's Association |
| EA | Environmental Assessment |
| FNSI | Finding of No Significant Impact |
| FRF | Training-Related Forage Reduction Factor |
| FY | Fiscal Year |
| GIS | Geographic Information System |
| GMP | Grazing Management Plan |
| GMU | Grazing Management Unit |
| GUM | Grazing Use Methodology |
| ITAM | Integrated Training Area Management |
| NRCS | Natural Resource Conservation Service |
| RUSLE | Revised Universal Soil Loss Equation |
| SEA | Supplemental Environmental Assessment |
| U.S. | United States |
| USACE | U.S. Army Corps of Engineers |

*Note: The Grazing Use Methodology relevant to this plan appears in Appendix A at the end of the document. This organizational approach for the GMP was used to facilitate annual updates of the GMP with the least disruption to the body of the document to minimize the effort required for future updates.*

# 1.0 INTRODUCTION

Fort Hood was established in 1942 by acquiring over 160,000 acres of land from 1,500 private landowners (Army 2000). Primarily through condemnation, the United States (U.S.) government acquired this land which was used historically for farming and grazing. In 1950, it became a permanent Army installation.

At the time of acquisition, the landowners received fair market value for their land and each were granted 5-year leases to allow continued livestock grazing. The Central Texas Cattlemen's Association (CTCA) was later formed by these landowners to manage their cattle grazing rights on Fort Hood. The Army (through the U.S. Army Corps of Engineers [USACE], Fort Worth District) has renewed the CTCA cattle grazing lease continuously since the original lease(s) expired.

The Installation contains five primary grazing management units (GMUs) as shown on Figure 1. These units are North Fort Hood, South Fort Hood (North and South subunits), the Western Maneuver Area (North and South subunits), the Eastern Training Areas (North and South subunits), and the Live-Fire/Impact Area.

## 1.1 Background

In 2000, the Army prepared an Environmental Assessment (EA) for proposed renewal of the lease through 2004. In that EA, the Army determined that grazing could occur on the Installation but only at a reduced stocking rate and with deferral of grazing on certain portions. The EA concluded that ecological conditions at Fort Hood had deteriorated since issuance of the original grazing lease in the 1940s due to a variety of factors including livestock overgrazing, drought, and training activities (USACE 2003a).

Upon review of the EA, numerous agencies (including Texas Parks and Wildlife Department) felt that Fort Hood proposed overly complicated grazing management strategies and that stocking rate calculations performed at that time employed inadequate data (USACE 2003a). As a result, the Army agreed to revise the 2000 EA to include the results from a forage inventory conducted on the Installation by the Natural Resources Conservation Service (NRCS) (USACE 2003a).

A Supplemental EA (SEA) for the Grazing Outlease at Fort Hood, Texas was completed in December 2003 by the USACE (2003a). The SEA evaluated several alternatives involving various grazing strategies and methods for calculating stocking rates for potential implementation during a new 5-year grazing lease between the Army and the CTCA. This EA incorporated the results of a forage inventory conducted by the NRCS in May 2002 (USACE 2003b). The SEA process identified a preferred alternative that maximizes grazing opportunities while minimizing potential impacts to environmental resources and military training activities. The Army issued a Finding of No Significant Impact (FNSI) for

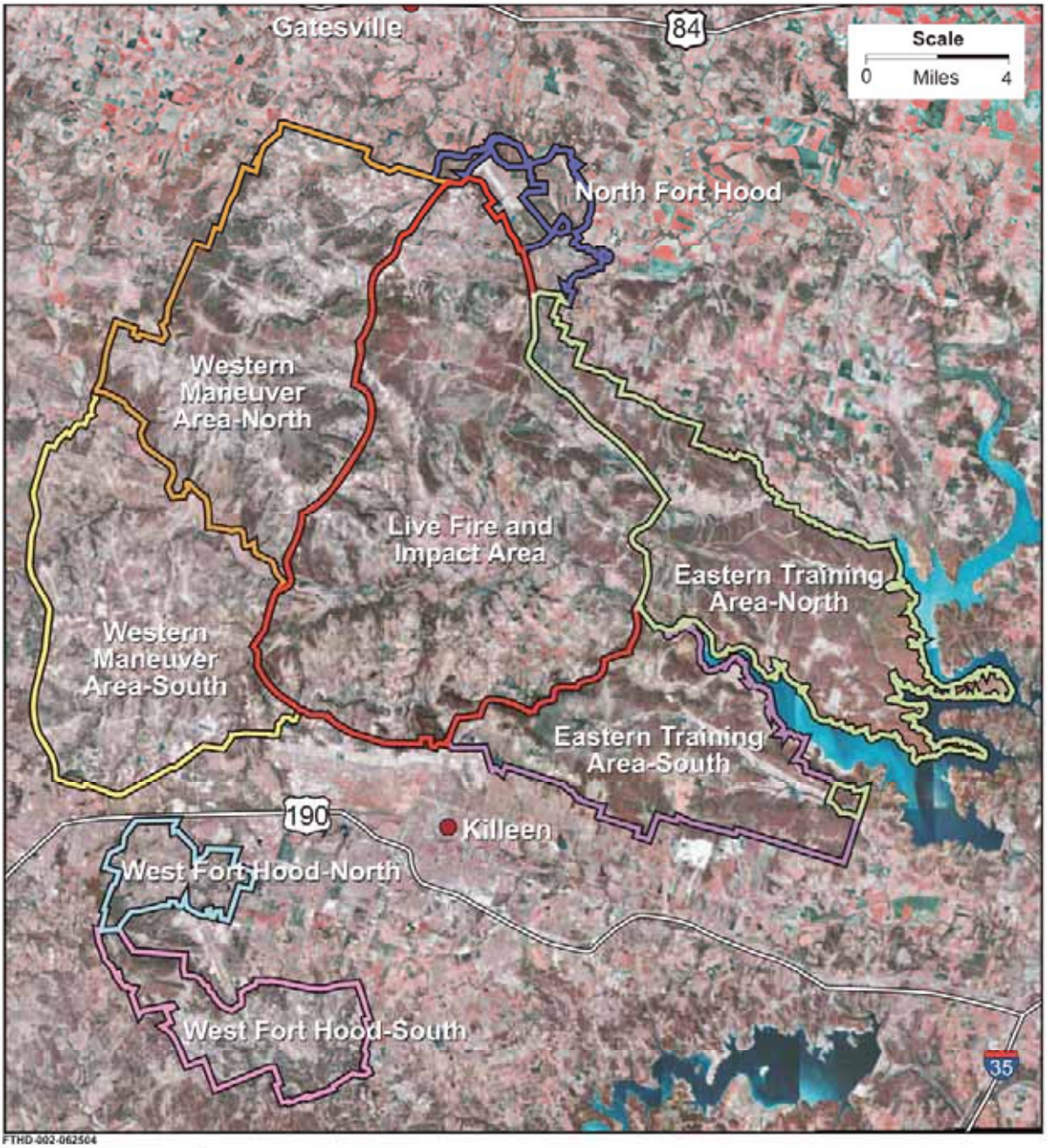



**Figure 1**
**Fort Hood Grazing Management Units**

the proposed grazing strategy on January 4, 2004 (Army 2004). The FNSI included provisions that the Installation would develop a Grazing Management Plan (GMP) to implement the methods described in the SEA for determining stocking rates.

Efforts to develop a GMP were initiated by the Installation in 2004 with the assistance of the USACE. As part of this process, a second forage inventory was completed in August 2004 by Texas A&M University's Center for Grazinglands and Ranch Management (Texas A&M 2004). Data collected during field surveys (completed in June 2004) were used to estimate consumable perennial vegetation, total grazeable acres, and potential soil erosion rates using the Revised Universal Soil Loss Equation (RUSLE) (Texas A&M 2004).

Upon review of the results of the 2004 Forage Inventory and preliminary drafts of the GMP, The CTCA expressed concerns that stocking rate calculation methods prescribed in the EA did not allow for adequate flexibility for cattle grazing if ecological conditions improved due to changes in military training intensity, reduction in grazing impacts, or improved climate conditions (i.e., adequate rainfall). To address these concerns, representatives of the Army and CTCA met to discuss these issues and potential methods by which the GMP could allow more flexibility in determining stocking rates while complying with the intent of the SEA and FNSI. These discussions resulted in the development of a document entitled *Points of Agreement Regarding Methodology for Calculating Animal Units (AUs) for Grazing at Fort Hood, Texas*. The Points of Agreement document was signed by all parties on February 22, 2005.

## 1.2 Purpose

Fort Hood's military mission takes priority over all other land uses at the Installation. Secondary land uses, such as livestock grazing, recreational activities (hunting and fishing), and wildlife management must be conducted in a manner that results in minimal interference with the military mission of training combat-ready forces.

The goal of this GMP is to outline a process to calculate cattle stocking rates for the Installation on an annual basis in a manner that maximizes cattle grazing opportunities while keeping subsequent impacts to military training and rangeland ecological condition at acceptable levels. This GMP complies with the intent of the SEA and the Points of Agreement established in February 2005.

Stocking rate calculations conducted as prescribed in this GMP will be incorporated into the annual grazing lease agreements between the Army and the CTCA.

## 2.0 CATTLE STOCKING RATE CALCULATION PROCESS

The flow chart presented as Figure 2 in this GMP documents the process by which cattle stocking rates are established on Fort Hood. The process contains three major steps:

1. Selection of stocking rate calculation method and training-related forage reduction factor,
2. Annual forage inventory, and
3. Soil erosion rate estimation.

### 2.1 Selection of Stocking Rate Calculation Method

There are three distinct stocking rate calculation methods that could be used to establish stocking rates for GMUs on Fort Hood. Each of these methods were fully evaluated and described in the SEA (USACE 2003a):

- ***25 Percent Harvest Efficiency*** – The NRCS commonly uses this standard method to determine stocking rates on privately-owned rangeland. This method is based on the premise that 50 percent of the forage present in a pasture shall be left ungrazed to provide adequate soil cover and keep the vegetation stand healthy. Of the remaining 50 percent, cattle consume only 25 percent and drop about half (25 percent) of the grazed forage which is returned to the soil as litter. This method only considers livestock grazing as a consumer of forage; it does not take into account vegetation loss from other activities such as military training. Additionally, this method fails to establish a minimum amount of vegetation that should be left to protect rangeland. Data demonstrate the consistency of this method with historical stocking determinations used on Fort Hood. Ranchers implementing this approach on privately-owned rangeland typically utilize rotational grazing methods which allow pastures periods of rest from grazing or other disturbance.

- ***Maintenance Threshold (750 pounds of ungrazed forage residue per acre)*** – The Texas Cooperative Extension Service states that optimal amounts of ungrazed forage for midgrass rangeland should range from 750 to 1,000 pounds per acre and from 1,200 to 1,500 pounds per acre for tallgrass rangeland. Leaving these amounts of forage promotes maintenance or possibly gradual improvement of rangeland health. Selection of a maintenance threshold of 750 pounds of ungrazed forage per acre aims to maintain current rangeland health conditions and to reduce erosion.

- ***Conservation Threshold (1,000 pounds of ungrazed forage residue per acre)*** – Similar to the Maintenance Threshold approach, this strategy retains a greater amount of ungrazed forage (1,000 pounds per acres versus 750 pounds per acre) to promote an increased rate of rangeland recovery and decrease soil erosion. Cattle stocking rates calculated using this approach would be developed under the limitation that only the volume of forage in excess of 1,000 pounds per acre would be available for grazing.

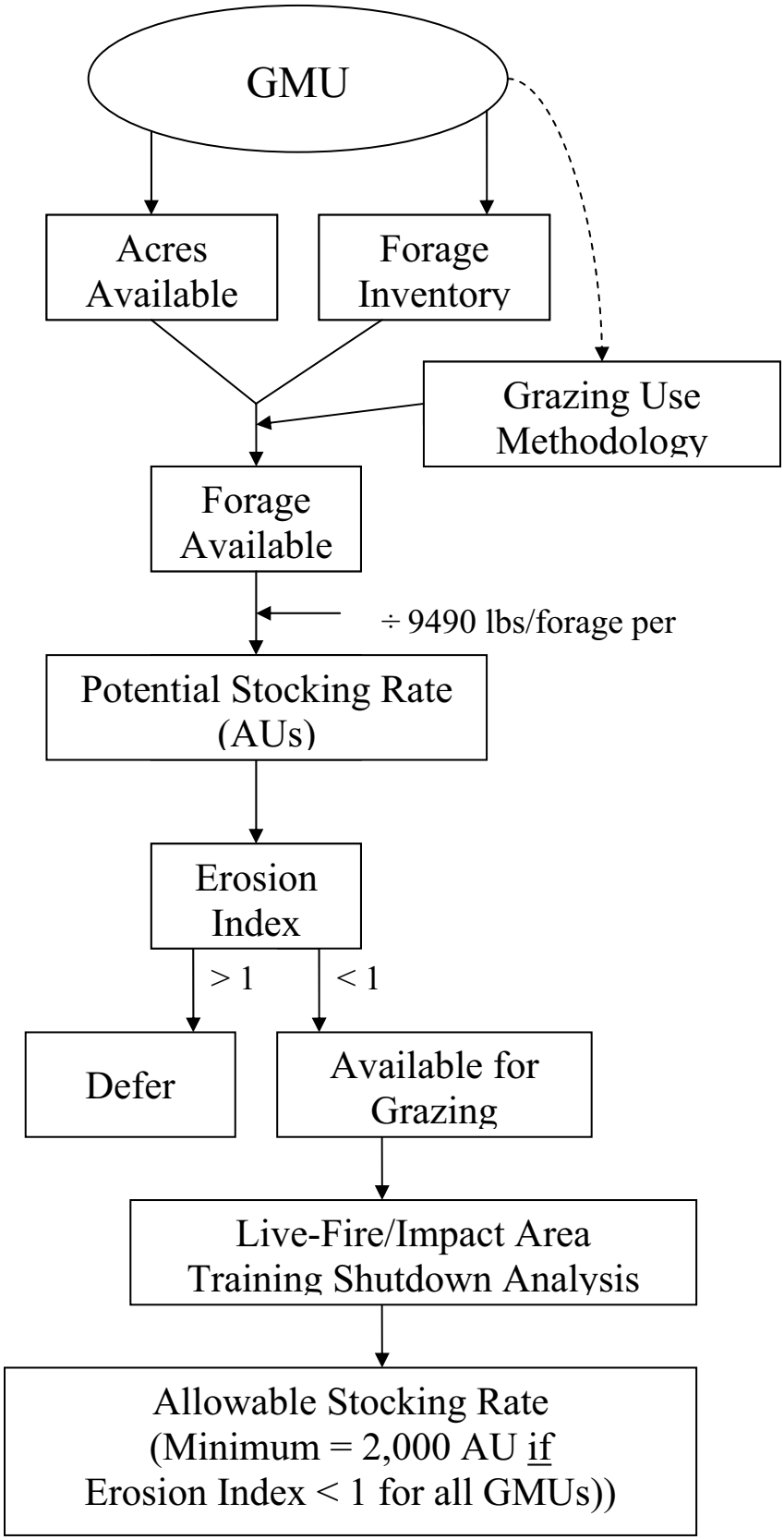



**Figure 2 Stocking Rate Calculation Process**

The SEA established baseline range conditions related to cattle grazing at Fort Hood. In the SEA, specific stocking rate calculation methods were assigned to each GMU based on these baseline range conditions. A process is included in this GMP to evaluate each GMU on an annual basis to select the stocking rate calculation method that is appropriate for the upcoming fiscal year on the basis of current range conditions and military training intensity.

Stocking rates are determined on the basis of AUs. Since the installation supports multiple age-classes of cattle, the AU equivalents for cattle shown in Table 1 shall be used to do determine the number of cattle that can graze on the Installation. Stocking rates are designated as AUs/year.

## 2.2 Grazing Use Methodology

Stocking rate calculation methods will be selected for each GMU on an annual basis using military training utilization data obtained from Fort Hood Range Control. This data is compared to a scale which has been established for each GMU using baseline range conditions described in the SEA. This approach allows for maximized use of GMUs for cattle grazing while allowing the Army the flexibility to properly manage GMUs if future training intensity or droughts result in changes in range conditions.

The Points of Agreement state that an objective measure of training intensity will be established in order to select the appropriate stocking rate calculation method for each GMU (i.e., based on platoon days of training, wheeled versus tracked vehicles). Fort Hood Range Control does not maintain records of military training at the platoon-level. However, records are available for scheduled training area use at larger unit levels. Additionally, specific training areas are used for the same common types of training activities on a recurring basis. For example, much of the tracked-vehicle training occurs in the Western Maneuver Areas. The Eastern Training Areas are used for wheeled vehicle and dismounted infantry training. The Grazing Use Methodology (GUM) model developed for this GMP takes into account the best available data for training area utilization and relative differences in training impacts on vegetation. This approach is consistent with the intent of both the SEA and the Points of Agreement.

The specific data that will be used in these determinations will consist of training information available from Fort Hood Range Control concerning military training area utilization for the past year. Training area utilization data that may be used are either official training schedules developed by Fort Hood Range Control or records of actual use of military training areas. When available, records of actual use will be used instead of scheduled use. Annual utilization is determined by calculating an annual sum of individual days that at least a portion of a GMU is used for military training. For example, if a specific training area is used for 180 days out of the year, the calculated training utilization for the purposes of this GMP is 49.32 percent (180 days/365 days).

The GUM model utilizes a three-category training utilization scale (green, amber, red) to determine the stocking rate calculation methodology and training-related forage reduction factor (FRF) for each GMU. The Training Intensity Scale is GMU-specific and is based upon a comparison to military training utilization that occurred in Fiscal Year (FY)02 and ecological conditions observed during that same period. FY02 baseline data are described in detail in the SEA.

The scale for each GMU was determined by selecting the actual military training utilization rate in FY02 as the midpoint of the portion of the scale that corresponds to stocking rate calculation approach selected in the SEA. For example, the Eastern Training Area – South Subunit was utilized for military training 68 percent of the time in FY02. The SEA identified the Maintenance Threshold as the applicable stocking rate calculation approach for that GMU using forage inventory data from FY02. As a result, 68 percent training utilization represents the midpoint of the amber range (which corresponds to the Maintenance Threshold) for that GMU.

Since the SEA established the 25 percent Harvest Efficiency Method as the applicable method for use in the North Fort Hood, South Fort Hood, and Live-Fire/Impact Area GMUs based on the 2002 forage inventory data, the entire training utilization scale is considered "green" for those areas. Table 1 summarizes the training utilization thresholds established for each GMU. Using this scale, the stocking rate calculation approach will be selected for each GMU on an annual basis using current military training utilization data.

**Table 1. Animal-Unit Equivalents**

| ***Cattle Age-Class*** | ***Animal-Unit Equivalent*** |
|---|---|
| Cow or bred heifer (dry) | 0.92 |
| Cow (with calf) | 1.00 |
| Bull (mature) | 1.35 |
| Yearling (bull, steer, or heifer) | 0.60 |
| 2+-Year Old (bull, steer, or heifer) | 0.80 |

Training utilization will be plotted on the Training Utilization Scale described in Table 2 and shown graphically in Appendix A. The training-related FRF is determined by each GMU's Training Intensity Scale. The FRF is the percentage by which the total volume of perennial consumable forage in a GMU identified by the most recent forage inventory is reduced to account for vegetation loss due to military training. The following FRFs have been assigned to each portion of the Training Intensity Scale:

- Green Range: 10 percent
- Lower Half of Amber Range: 15 percent
- Upper Half of Amber Range: 30 percent
- Red Range: 40 percent

The rationale for selection of these FRFs is described in the SEA and is addressed in the Points of Agreement. To allow for added flexibility for grazing and to account for lack of detailed training utilization data at the platoon level, this scale allows for application of lower FRFs in the Western Maneuver Area than is specified in the Points of Agreement if training intensity falls below levels that require use of the Conservation Threshold. In order to comply with the intent of the SEA while allowing for this added flexibility in the Western Maneuver Area, the upper half of the amber range of the scale has been assigned a FRF of 30 percent to account for a gradual reduction in training impacts between the lower end of the "red" range and the lower end of the "amber" range.

For example, if the training utilization calculated for the Western Maneuver Area–South Subunit in 2005 is 39.18 percent, the Maintenance Threshold Approach would be selected to determine cattle stocking rates in that GMU. This training utilization falls within the upper end of "amber" range for that GMU, so a FRF of 30 percent would be utilized in stocking rate calculations.

### 2.3 Live-Fire/Impact Area Stocking Rate Calculation Approach

Although the 2 percent Harvest Efficiency stocking method applies to the entire range of the Training Intensity Scale for the Live-Fire/Impact Area, this GMU is particularly sensitive to training interruptions due to the presence of cattle. Soldiers participating in gunnery practice must stop activities when cattle cross into their line of fire. Either personnel must be dispatched to move cattle out of the way or units must wait until cattle leave their line of fire voluntarily. This often results in significant losses in time available for training.

The potential for interruptions to live-fire training due to the presence of cattle must be accounted for in this GMU during stocking rate determinations. In FY02, there were 419 training shutdowns when 750 head of cattle were present in the area. Fort Hood has determined that this is the maximum number of shutdowns that is acceptable.

**Table 2. Grazing Use Methodology Model Training Utilization Scale**

| *GMU* | *Green Range (25 % Harvest Efficiency Method)* | *Amber Range (Maintenance Threshold)* | *Red Range (Conservation Threshold)* |
|---|---|---|---|
| Eastern Training Area – North Subunit | 0-57 % | 58-100 % | N/A |
| East Training Area – South Subunit | 0-45 % | 46-90 % | 91-100 % |
| Western Maneuver Area – North Subunit | 0-20 % | 21-40 % | 41-100 % |
| Western Maneuver Area – South Subunit | 0-22 % | 23-44 % | 45-100 % |
| North Fort Hood | 0-100 % | N/A | N/A |
| South Fort Hood – North Subunit | 0-100 % | N/A | N/A |
| South Fort Hood – South Subunit | 0-100 % | N/A | N/A |
| Live-Fire/Impact Area | 0-100 % | N/A | N/A |

Since the number of training shutdowns is based on both the number of cattle present and the amount of training that is actually occurs, a formula has been developed to link current conditions to the FY02 baseline data. The formula developed is:

***{(FY02 Shutdowns – Most Recent Shutdowns) x 1.8 AUs/Shutdown} + 750 AUs = Allowable Stocking Rate***

This formula allows for either an upward or downward adjustment in the stocking rate if military use of the Live-Fire/Impact Area increases or decreases relative to the FY02 baseline or if use of the area for cattle grazing results in fewer training shutdowns in the future.

The maximum number of cattle that can be supported for grazing in the Live-Fire/Impact Area will be determined using the 25 percent Harvest Efficiency Method. However, the stocking rate determined by this approach will be modified on the basis of the number of "training shutdowns" due to the presence of cattle that are recorded by Range Control.

The actual stocking rate will be the lesser of the carrying capacity calculated by the 25 percent Harvest Efficiency Method or the allowable stocking rate calculated on the basis of the number of cattle-related training shutdowns.

## 2.4 Forage Inventories

The Army conducts annual forage inventories on Fort Hood to determine the amount of available forage in each of the GMUs. These data allow the Army to determine potential cattle stocking rates. Texas A&M University completed the forage inventories in 2004 and 2005. The NRCS had assisted with previous forage inventories. The data from the most recent inventory will be used in the development of stocking rates each year.

During previous forage inventories, Texas A&M and the NRCS used digital ortho-photography to map plant communities and established 116 sample locations scattered across Fort Hood. These inventories employed the standard weight unit/harvest sampling method for assessing forage production in each GMU on the Installation, except for the Live-Fire/Impact Areas. Due to safety concerns, only a visual estimate of forage availability is made in the Live-Fire/Impact Areas. For the other GMUs, sample points were established in areas representative of each vegetation community and monitored during each forage inventory (USACE 2003b).

Data gathered at individual sample points provide the basis to determine total forage biomass and production of individual plant species. Data adjustments will occur to reflect total forage production for a normal growing season and to account for warm season plant species based on current precipitation conditions.

To calculate perennial consumable forage available in a given GMU, the actual grazeable acreage is calculated. The studies determined this acreage by using a combination of image classification and analysis by geographic information system (GIS) software on high-resolution aerial photography. Subsequently, the total area of bare ground identified by this analysis and the total area of grazing exclosures (i.e., sensitive environmental areas fenced to keep out livestock) in each plant community are subtracted from the total area of that community to obtain a value for grazeable acreage. The total grazeable acreage within each GMU comprises the sum of the grazeable acreage within each plant community within that GMU (USACE 2003b).

The amount of perennial consumable forage is reduced by the training-related FRF as described in Section 2.2 of this document. The assumed forage requirement to support one AU is 9,490 lbs of perennial consumable forage per year. The carrying capacity or stocking rate of each GMU is determined by dividing the modified total perennial consumable forage by a factor of 9,490 lbs forage/AU/year.

Appendix B contains a copy of the most recent completed forage inventory.

## 2.5 Soil Erosion Rate Estimation

The results from the most recent forage inventory are used in the development of estimates of soil erosion in each GMU using the RUSLE, version 1.6 (Renard *et al.* 1997). This method is commonly used by the military for assessing erosion on military training lands and as part of Integrated Training Area Management (ITAM) Programs. Detailed procedures for RUSLE calculations referenced in this GMP are found in Section 4.3 of the SEA. Erosion estimates are compared to acceptable soil loss values that were developed by the NRCS for each soil type found on the Installation (USACE 2003b). If erosion estimates exceed the acceptable limits, grazing must be deferred in that GMU for a period of one year or until estimated erosion rates fall below acceptable limits.

Appendix A summarizes the erosion estimates made using the RUSLE model based on data obtained during the most recent forage inventory.

## 2.6 Final Stocking Rate Selection

The recommended stocking rates calculated by the process described in this section of the GMP are shown in Appendix A, Table 1. However, the Army has established a minimum Installation-wide stocking threshold of 2,000 animal units per year if calculated erosion indices are below one in all GMUs.

If calculated erosion indices are below one for all GMUs but the sum of recommended annual stocking rates for each GMU is below 2,000 AUs, the CTCA shall submit a proposed alternative stocking rate plan for each GMU based on the Installation-wide 2,000 AU limit.

As stated in Section 2.5, any GMUs with a calculated erosion index greater than one shall be deferred from cattle grazing. The recommended annual stocking rates calculated and shown in Appendix A, Table 1 shall be implemented.

## 3.0 CONTINGENCY PLANS

This GMP is intended to maximize grazing opportunities while minimizing interference with military training and protecting rangeland health under typical climatic conditions. The methodology described for calculating cattle stocking rates in this GMP should be adequate for necessary annual adjustments in cattle stocking rates due to normal variations in rangeland conditions and military training intensity.

Rangeland conditions can vary dramatically on Fort Hood due to a variety of factors. Drastic changes in rangeland conditions or military training may require substantial modifications to cattle stocking rates on a GMU or Installation scale. Examples of such might include:

- ***Severe Drought*** – Long-term drought conditions (greater than 12 months in duration) may require changes in stocking rate calculation methods in addition to the training-intensity method.

- ***Floods*** – Flooding conditions may wash out roads, bridges, or strand cattle, limiting the ability of lessees to manage cattle. Additionally, fences between Army land and privately-owned property may be destroyed, allowing cattle from privately-owned grazing land to move onto Fort Hood. The Army will coordinate with the grazing lessee to repair roads, bridges, or provide alternative means to access cattle during major floods. If fences are washed out on adjoining private property, the Army will allow a reasonable amount of time for fences to be repaired and unauthorized cattle to be removed from Fort Hood (i.e., 30 days after flood conditions subside).

- ***Range Fires*** – Fort Hood lands are periodically subject to wildfires caused by lightning, military training, or other accidental causes. Additionally, the Army conducts prescribed burning as part of habitat management and to decrease the intensity and spread of wildfires by reducing vegetation, particularly in the Live-Fire/Impact Area.

  Due to the immediate loss of forage, the potential for severe erosion, and the need to conserve remaining vegetation, cattle may need to be immediately relocated to other GMUs following a large wildfire. Temporary removal of the cattle from Fort Hood may also be an option. The Army will notify the grazing lessee if such movements are required.

  Most prescribed burning actions are conducted during the winter months. Although most burns are targeted on relatively small areas, burns on larger areas may necessitate temporary cattle removal from GMUs or portions of GMUs. The Army will notify the grazing lessee of required

cattle movements in as far advance as possible; however, cattle removal from areas targeted for burning may be required on short-notice in extreme situations.

- ***Military Training*** – Since only limited tracked-vehicle training occurs on portions of the Installation such as South Fort Hood and North Fort Hood, the 25 percent Harvest Efficiency stocking rate calculation method applies to the entire range of the training utilization scale. If the tracked vehicle training increases significantly in these areas in the future, the training utilization scale could require adjustment to account for more intensive military training activities.

If modifications to stocking rates or other deviations from this GMP are required due to significant changes in range conditions, the Army will coordinate with the CTCA to arrange a time schedule for implementation of any changes.

## 4.0 FUTURE IMPLEMENTATION OF PHYGROW MODEL

A predictive forage response model (called PHYGROW) is currently in development by Texas A&M University's Ranching Systems Group that shows promise to assess and predict forage response and fire risk to emerging conditions. Use of PHYGROW, if validated and approved by the Department of the Army, is proposed by Texas A&M to be integrated with a multiple model system for assessing and predicting fire behavior, erosion and forage to assist Fort Hood with land management decisions where cattle grazing coincides with the military training mission. While the model(s) shows merit, a key component of its validated accuracy will be the system's capability to assess and predict forage loss throughout the year due to Fort Hood's military training mission and fluctuating military traffic intensity.

If PHYGROW is validated and approved for use at Fort Hood by the Department of the Army in the future, this GMP will be revised to utilize that tool for selection of cattle stocking rates on the Installation. Implementation and use of PHYGROW will allow the Army the flexibility to balance cattle stocking rates with military training intensity throughout the year based on current rangeland health conditions. To fully implement PHYGROW for this purpose and maximize the benefits of the model, it is possible that the Lessee may be required to adjust cattle stocking rates on a shorter time scale than the current annual adjustment.

## 5.0 REFERENCES

Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, and D.C. Yoder, coordinators. 1997. Predicting Soil Erosion by Water: A Guide to Conservation Planning With the Revised Universal Soil Loss Equation (RUSLE). *USDA Agricultural Handbook* No. 703, 404 pp.

Texas A&M University. 2004. Fort Hood Vegetation Surveys 2004 Report. The Center for Grazinglands and Ranch Management. 15 August.

Texas A&M University. 2005. Fort Hood Vegetation Surveys 2005 Report. The Center for Grazinglands and Ranch Management. 1 October.

U.S. Army (Army). 2000. Integrated Natural Resources Management Plan. U.S. Army FORSCOM. Fort Hood, Texas. June.

_____. 2004. Finding of No Significant Impact – Supplemental Environmental Assessment for Grazing Outlease at Fort Hood, Texas. 5 January.

U.S. Army Corps of Engineers (USACE). 2003a. Supplemental Environmental Assessment for Grazing Outlease at Fort Hood, Texas,. December.

_____. 2003b. May 2002 Forage Inventory Summary and Cattle Stocking Rates, Fort Hood, Texas. Final Report. January.

# Appendix A

# Grazing Use Methodology Calculations

# Fort Hood Cattle Grazing Management Plan
## Appendix A - Table 1
## Grazing Use Methdology Model Summary

| GMU | Total Acres[1] | Grazeable Acres[1] | % Training Utilization[2] | Grazing Strategy[3] | Training-Related Forage Reduction Factor[3] | Cattle Carrying Capacity (AUs/yr)[1] | Estimated Erosion Rate (tons/acre/yr)[1] | Acceptable Soil Loss (tons/acre/yr)[1] | Erosion Significance Factor | Max. Live-Fire/Impact Area Stocking Rate | Recommended Stocking Rate (AUs/yr) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Eastern Training Area - North Subunit | 27,772 | 27,091 | 63.56% | Maintenance Threshold | 15 | 24.7 | 0.48 | 1.4 | 0.34 | N/A | 24.7 |
| Eastern Training Area - South Subunit | 22,654 | 21,935 | 28.22% | 25% Harvest Efficiency | 10 | 196.5 | 0.49 | 2.06 | 0.24 | N/A | 196.5 |
| Western Maneuver Area - North Subunit | 34,798 | 32,983 | 40.27% | Conservation Threshold | 40 | 0 | 1.18 | 2.79 | 0.42 | N/A | 0 |
| Western Maneuver Area - South Subunit | 32,237 | 30,399 | 39.18% | Maintenance Threshold | 30 | 128.1 | 1.46 | 4.05 | 0.36 | N/A | 128.1 |
| West Fort Hood - North | 4,378 | 4,282 | 23.29% | 25% Harvest Efficiency | 10 | 87 | 0.47 | 3.45 | 0.14 | N/A | 87 |
| West Fort Hood - South | 9,938 | 9,549 | 23.29% | 25% Harvest Efficiency | 10 | 99.1 | 0.5 | 2.06 | 0.24 | N/A | 99.1 |
| North Fort Hood | 3,877 | 3,793 | N/A | 25% Harvest Efficiency | 10 | 40.1 | 0.55 | 4.74 | 0.12 | N/A | 40.1 |
| Live-Fire/Impact Area | 59,757 | 58,150 | N/A | 25% Harvest Efficiency | 10 | 1178 | 0.89 | 2.43 | 0.37 | 869 | 869 |
| ***Totals*** | ***195,411*** | ***188,183*** | | | | ***1753.5*** | | | | | ***1,444*** |

***Cell autocalculates value.***

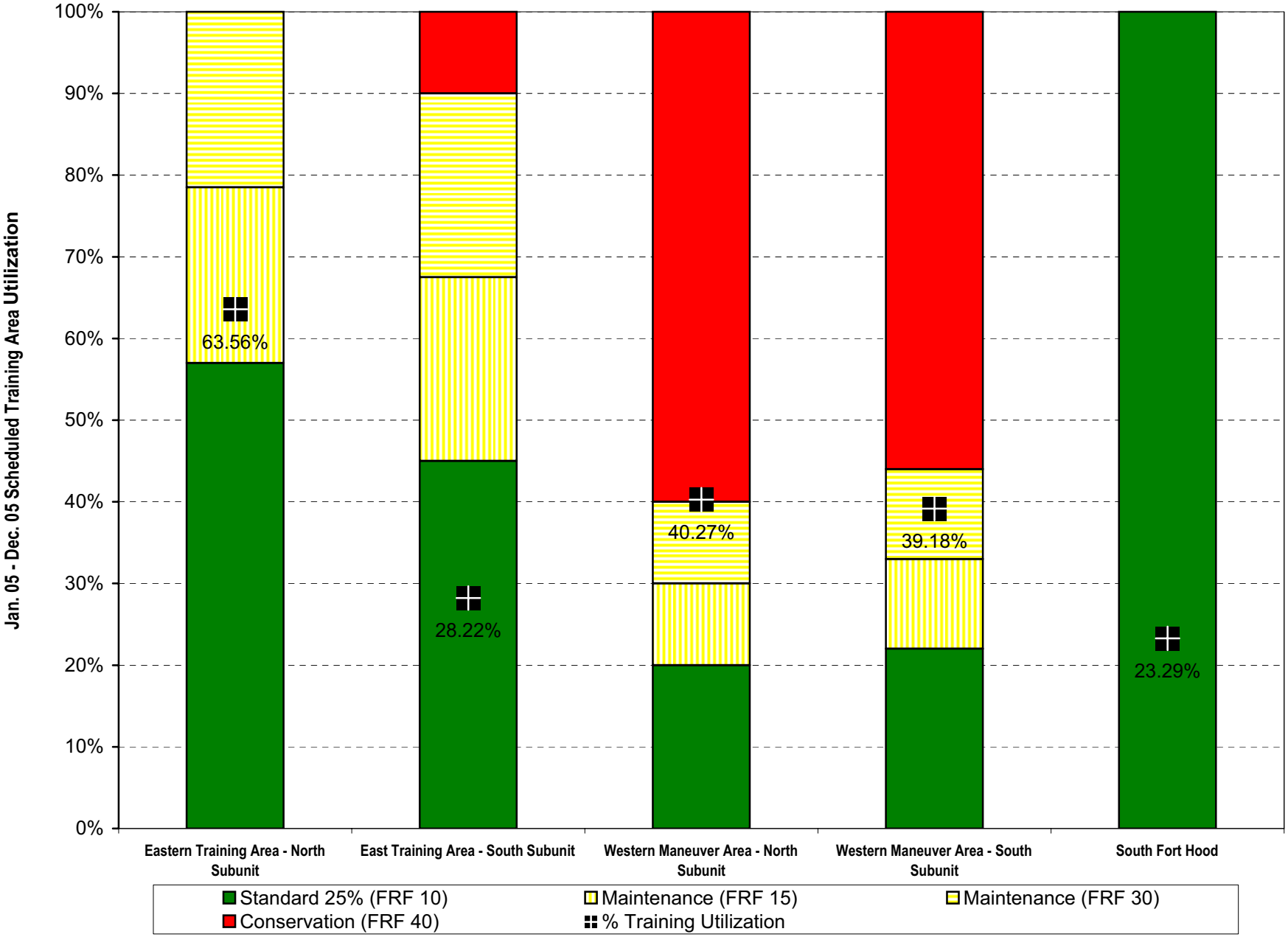
***Data Sources***
*1 - Forage Inventory*
*2 - Appendix A, Table 2 (Military Training Area Utilization)*
*3 - Grazing Use Methodology Model*

# Fort Hood Cattle Grazing Management Plan
## Appendix A - Table 2
## 2005 Military Training Area Utilization

| GMU | Land Group | Scheduled Days of Use | | | | | | | | | | | | Total Days Scheduled | % Annual Utilization |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 16 Dec 04 Schedule | | | | | | | | | 24 May 05 Schedule | | | | |
| | | Jan-05 | Feb-05 | Mar-05 | Apr-05 | May-05 | Jun-05 | Jul-05 | Aug-05 | Sep-05 | Oct-05 | Nov-05 | Dec-05 | | |
| Eastern Training Area - North Subunit | Land Groups 1 & 2 | 21 | 21 | 9 | 23 | 26 | 4 | 30 | 27 | 18 | 20 | 17 | 16 | 232 | 63.56% |
| East Training Area - South Subunit | Land Groups 3A & 3B | 13 | 12 | 5 | 10 | 5 | 24 | 0 | 17 | 5 | 4 | 4 | 4 | 103 | 28.22% |
| Western Maneuver Area - North Subunit | Land Group 5A, 5B, 6 | 10 | 13 | 14 | 20 | 12 | 22 | 13 | 17 | 0 | 1 | 18 | 7 | 147 | 40.27% |
| Western Maneuver Area - South Subunit | Land Group 4A & 4B | 10 | 13 | 11 | 19 | 12 | 22 | 13 | 17 | 0 | 1 | 18 | 7 | 143 | 39.18% |
| South Fort Hood | Land Group 7 | 14 | 15 | 10 | 11 | 5 | 8 | 0 | 5 | 5 | 4 | 4 | 4 | 85 | 23.29% |

*Source: Fort Hood Gunnery Standardization Program Schedules*

# Fort Hood Cattle Grazing Management Plan
## Appendix A
## Grazing Use Methodology Model - Training Utilization Scale




***Legend - Stocking Rate Calculation Methods***
***(FRF = Training-Related Forage Reduction Factor)***