Oklahoma Carbon Program

Methodology: Assessing Rangelands to Estimate GHG Storage and Other Ecosystem Service Benefits

v.2013

OKLAHOMA CONSERVATION COMMISSION

OKLAHOMA CARBON PROGRAM

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1.0 About the Oklahoma Carbon Program

1.1 Authority

The Oklahoma Conservation Commission has statutory authority to verify and certify carbon sequestration in Oklahoma under Oklahoma Administrative Code Title 155 to implement 27A O.S. § 3-4-101 thru 3-4-105, which authorizes the Commission to establish and administer a carbon sequestration certification program. Permanent rules for the program went into effect July 1, 2009. The rules are authorized by the Oklahoma Carbon Sequestration Enhancement Act**.** Persons conducting verification of agricultural carbon offsets under the Oklahoma Carbon Program (OCP) shall use protocols written or approved by the Oklahoma Conservation Commission.

1.2 Description

The Oklahoma Carbon Program (OCP) is a voluntary program for the verification, certification, and registration of voluntary carbon offsets and avoided emissions. OCP provides project verification services for aggregators and buyers of carbon offsets and offers third-party verification of anthropogenic carbon dioxide (CO2) stored by the oil and gas sector during enhanced oil recovery. The purpose of the OCP is to improve soil, water, and air quality by encouraging Oklahomans to voluntarily implement practices that sequester greenhouse gases (GHG). The purpose of verification is to provide an independent third party review of project sites, data, and implementation methods to determine if a project has sequestered an expected amount of GHG.

1.3 Objectives

The OCP strives to provide the following to Oklahomans:

- Oversight of carbon market transactions in Oklahoma
- Information about carbon sequestration
- Quality verification and certification of Oklahoma carbon offsets
- Financial opportunities for Oklahoma farmers, ranchers, forestland managers, oil and gas and utility operators, who take action to sequester greenhouse gases
- Funding opportunities for Oklahoma Conservation Districts

2.0 About this Document

This methodology was developed to train conservation districts to collect rangeland data so the OCP could determine their proficiency with the methods and set minimum standards for rangeland verifiers. The OCP partners with conservation districts on the verification of seeded grasslands and no-till fields, and are striving to determine if we can partner to verify rangeland carbon offset projects with districts either collecting data to determine baseline conditions or to assist rangeland managers with monitoring to assess progress toward management plan goals. The OCP uses rangeland field data, in consultation with the Natural Resource Conservation Service (NRCS) and other partners, to assess rangeland health and estimate GHG storage potential, and other ecosystem service benefits, of carbon offset projects in Oklahoma. While full-scale verification (100% of acres in a project) is typically not financially feasible for a project, the methods described here may be used at any scale for stand-alone verification or for ground-truthing to confirm model accuracy. For a summary of district proficiency with the methods in section 10, see the *Executive Summary of Project Deliverables*. The other sections in this document are draft project requirements of the OCP and are provided for context.

3.0 Applicability

This methodology is intended for use by persons with training in rangeland health and monitoring working in consultation with an experienced grazinglands specialist. It is intended for use on actively grazed or hayed native grass rangelands in Oklahoma that support the historic plant community, are used for grazing or haying according to a management plan, and are under contract with an aggregator whose project meets eligibility criteria listed in Section 4.2.

4.0 Project Requirements

4.1 Aggregation

This methodology provides an opportunity for agricultural land managers to benefit from the rangeland health and greenhouse gas storage that results from improved rangeland management. Aggregation, the pooling of acres owned and/or managed by separate landowners (entities) into a project with a defined geographic boundary, is an important component of carbon sequestration projects. **"**For agricultural offset projects to be effective, farm-level GHG emissions reductions need to be aggregated into larger, multi-landowner projects. Aggregation is one of – if not *the* most important – factor in the development of agricultural offset projects that are cost-effective and that will allow for the engagement of the agricultural sector in voluntary GHG mitigation efforts at a scale that matters (C-AGG 2013)."

[PLACEHOLDER for aggregation model language]

4.2 Project Eligibility Criteria

Table 1. Project Eligibility Criteria

Criteria	Definition	Requirement
Additionality	Additionality refers to a project or practice that, due to an incentive, adaptive management, or deviation from common practice, sequesters more GHG, or avoids more emissions of GHG, than would otherwise have occurred.	OCP requires projects and practices to meet the American Carbon Registry's Hybrid Additionality Test in which the project must: 1) exceed regulatory/legal requirements; 2) go beyond common practice; and 3) overcome one of three implementation barriers: institutional, financial or technical. Refer to the ACR Technical Standard 2009 v1.0.
Community and Environmental Impacts	The positive or negative impact to the community or environment where the project is located	OCP requires that, to qualify for certification, a project has not accidentally, intentionally, or through gross negligence violated the law as determined by a governmental entity having competent jurisdiction. The OCP also will not certify a carbon offset purported to be created by the intentional disturbance of soil followed by the subsequent replanting of crops or plants for the purpose of creating a carbon offset for monetary gain.

Criteria	Definition	Requirement
Duration	The length of time that the project or practice is under contract to sequester GHGs	OCP requires that agriculture projects have a minimum contract duration of five years.
Emissions	GHGs emitted from the project location during the project duration	OCP requires sectors under regulatory requirements by state or federal agencies to report GHG emissions to provide such information in the OCP application for verification. Sectors not subject to emissions reporting may voluntarily report emissions.
Frequency of Verification	The number of times verification occurs during the project period.	Frequency of verification depends on the length of the contract and the project budget. At minimum agricultural projects are monitored annually with site visits to 10% of the contracts and at least 10% of the acres, with self-certification done on 100% of contracts and 100% of acres.
Geographic Boundary	The above or below ground physical location of a project including the project's boundaries and all parcels or acres within the boundary that are individually sequestering carbon.	OCP requires project proponents to provide a detailed description of the geographic location and boundary of project activities. When multiple parcels are included, each parcel must be delineated and identified by county and legal location. Project aggregators shall provide maps, Geographic Information System shapefiles, layers, or other relevant information to delineate and identify the project location and boundary.
Information Management	The transmission, storage, and communication of information.	OCP requires project proponents to transmit information in the manner requested with a strong preference for electronic format when possible.
Location	Geographic area where project occurs.	Projects verified by the OCP must occur within the borders of Oklahoma. Projects that cross state lines will be considered for verification on a case-by-case basis, as the law allows.
Ownership	Legal entitlement to a carbon offset and its resulting benefits	OCP requires that offset contracts to be verified by the program clearly identify who has rights to the carbon offset. The OCP reserves the right to transfer a certificate to another person if the applicant/project proponent is found not to be legally entitled to the certificate.
Permanence	Permanence refers to the length of time the GHG is stored in soil, trees, or underground.	OCP requires soil carbon offset project proponents to ensure permanence during the carbon contract by having a plan to mitigate offset reversals by insurance and/or offset reserves.
Resource Management Plan	Description and explanation of the activities that have or will increase or maintain existing stored carbon.	OCP requires a resource management plan written in a format approved by the OCP to be submitted with each application for verification, or submitted within an approved timeframe after the application.
Temporal Boundary	The timeframe that applies to the project.	Management resulting in increased carbon sequestration must have begun after January 1, 2001, and as per contact requirements.

5.0 Rangeland Management Standard

The eligibility, management, and recordkeeping requirements together are referred to as the management standard. The standard is a reference for rangeland managers seeking certification of carbon offsets through the Oklahoma Carbon Program. It is based on the premise that overgrazing of rangeland can lead to surface erosion, decreased organic matter, decreased water infiltration, and a decline in desirable plant species. Once these symptoms of overgrazing are visible, they inhibit the ability of the land to support livestock and can ultimately lead to a loss of production.

The management standard is a critical informational and motivational tool for producers, which clearly lays out levels of basic to advanced management. It contains 5 management levels from basic to advanced and can be used to reward producers who are in the early stages of a practice that has a GHG benefit, but at a lesser payment level than a producer who is doing more aggressive, progressive management. The Progressive Crediting Matrix lets carbon offset project proponents and credit buyers decide the price and level of management effort that they can afford, while still allowing producers an incentive, benefit, and clear goals for stepping up their management. The rangeland management standard below lists eligibility and level 1 management requirements for participating rangelands. See Appendix G: Progressive Management Crediting Matrix.

5.1 Eligibility

To be considered for verification, lands must meet the definition of rangeland and be under carbon contract with a commitment to be managed under an approved formal management plan. Land must not otherwise be disqualified by the restrictions in section 5.2.

"Rangeland," according to NRCS, is defined as land on which the historic plant community is principally native grassland species comprised of grasses, grass-like plants, forbs or shrubs suitable for grazing and browsing. In most cases, rangeland supports native vegetation that is extensively managed through the control of livestock and fire rather than by agronomic practices, such as fertilization, mowing, or irrigation. Rangeland also includes areas that have been seeded to introduced species but are managed with the same methods as native rangeland.

5.2 Restrictions

Only swaths of contiguous rangelands grazed or hayed under a formal managed grazing plan are eligible. The following restrictions apply.

5.2.1 Cropland Corners

Small, isolated areas of native range in areas that are predominantly cropland or corners outside circles of irrigated cropland receiving incidental grazing, are not eligible.

5.2.2 Soil bank fields

Rangeland that is determined to be too degraded to sequester carbon at the expected rate during the length of the project is not eligible. For example, "soil bank fields" from the 1960s have little remaining topsoil ("A" Horizon) and therefore do not have the capacity to sequester carbon dioxide at similar rates as unbroken, native, rangelands.

5.2.3 Go-back land

Areas commonly referred to as "Go-back land," defined as abandoned cropland with permanent vegetation established by natural selection (as opposed to seeding or planting) are not eligible. In most cases these soils are identified as 'eroded' in the NRCS soil survey. Note: go-back lands may be eligible if they have no cropping history (verified using 578 historical records), are not too degraded (soils not labeled as 'eroded' on soil maps from NRCS), have limited to no inputs, and are part of an approved grazing management plan.

5.3 Requirements for Grazed Range

Eligible rangeland must be managed in accordance with a formal management plan and either be grazed or cut for hay every year unless allotted for deferment by the management plan. Participating rangeland is also expected to meet the following level 1 management requirements.

5.3.1 Biomass Management

- **Grazing plan** is prepared and implemented. See Appendix B for Grazing Management Plan Guidance.
- **Drought plan** is prepared and implemented as needed to minimize negative effects of drought. Drought plans must be implemented following 180 days of moderate or more severe drought conditions extending into the summer season, and when the long-term forecast is for drought continuation. See Section 6.2, Grazing Deferment, and Appendix C for Drought Management Plan Guidance.
- **Burn plan** is prepared and implemented with frequency and timing based on suggested fire return intervals for the region and specific management goals such as controlling the natural succession of woody plants or improving forage palatability. See Appendix D for Prescribed Fire Burn Plan Guidance.
- **Brush management plan** is prepared and implemented for the removal, reduction, or manipulation of non-herbaceous plants via chemical or mechanical techniques. When done, brush removal supports the desired plant community that is consistent with the ecological site description and is planned to achieve the desired control of target species while protecting soil stability, water quality, and wildlife habitat. This is accomplished by scheduling manual or chemical brush removal during periods of the year that will not endanger breeding wildlife or that experience frequent heavy rain events. Timing of removal is planned to ensure high colonization rates, is done in optimal growing seasons, and includes a level of grazing deferment that allows for vegetation recovery. See Appendix E for Brush Management Plan Guidance.
- **Herbicides** are not applied.

5.3.2 Nutrient Management

- **Fertilizer** is not applied.

5.3.3 Recordkeeping

- **Management records** are maintained, including documentation of forage-animal balance, grazing schedule with stocking rates, required brush removal documents, and any use of brush, drought, or burn plans, as applicable. Management records are required of land managers. The

records must track the stocking rates, livestock weight, turn in dates and turn out dates, implementation of any contingency plans, fertilizer application, harvest dates, as applicable.

5.4 Requirements for Ungrazed Native Hay Meadow

5.4.1 Biomass Management

- **Management plan** is prepared and implemented.
- **Harvest of hay** occurs no more than once every year and is completed before July 15 with a cut height no shorter than 4 inches. If haying must occur after July 15, cutting height is set at six inches or higher.
- **Harvest deferment** may occur for up to two years when precipitation is less than 60% of local average annual rainfall during the preceding 12 months.
- **Herbicides** are not applied.
- **Burn plan** is prepared and implemented with frequency and timing based on suggested fire return intervals for the region (Table 2). Burning does not occur within the same year as harvest but may be done if harvest is deferred for 6 months following the burn.

5.4.2 Nutrient Management

- **Fertilizer** may be applied with rates based on soil test results and nutrient removal calculations.

5.4.3 Recordkeeping

- **Management records** are maintained, including those that document cut height, date of cutting, fertilizer application and soil tests to accompany any fertilizer application.

6.0 Rangeland Management Standard – Rationale

The management restrictions and requirements in the rangeland performance standard are based on NRCS management standards and a review of the scientific literature. We have prepared a rationale explaining the requirements pertaining to grazing, brush management, haying, herbicide and pesticide use, and fire. Each section title states the premise on which the management requirement is based and is accompanied by an explanation.

“What causes loss of rangeland health? The most common reasons are overgrazing by domestic and wild animals, and change in the historical pattern of fire. Overgrazing reduces the productivity and competitiveness of plants desired by the grazing animals. Overgrazing can reduce plant cover and expose bare soil to erosion. A shift in the competitive balance between plants may result in a near-permanent change in plant species composition from plants desired by grazing animals to plants that are seldom grazed. Woody shrubs and low-growing trees often increase with overgrazing and lack of fire. Accelerated soil erosion and near-permanent changes in plant species composition represent a change in the values and commodities that can be obtained from an area of rangeland, and, by definition, a loss of rangeland health” (USDA 1996).

6.1 Improved Rangeland Management Increases GHG Storage

Primary carbon sequestration in rangelands comes from avoided conversion to other uses and from improved management of the land. It is estimated that up to 60 percent of rangelands in the U.S. are degraded (Schuman *et al.* (2001, 2002). Oklahoma contains almost 23 million acres of native rangeland, over 50 percent of the state's landmass. Statistically, that means 13.8 million acres of rangeland in Oklahoma are likely degraded. Implementing rangeland management plans on Oklahoma rangelands will sequester more GHG than leaving the rangelands overgrazed or degraded.

The GHG mitigation potential for rangeland occurs from improving biomass production rates on lands that were degraded or marginal (Eagle *et al.* 2012). Several options exist for defining marginal or degraded cropland, including the USDA Erodibility Index, CDM policies for Afforestation and Reforestation Projects, and the National Resources Inventory (Climate Trust 2012). Carbon sequestration occurs in rangelands primarily due to management that results in increased soil organic matter (SOM), which is created through plant roots, and aboveground litter than becomes incorporated into the soil (Eagle *et al.* 2012). Managing and monitoring for maximum soil organic carbon levels will provide the highest potential GHG storage. Soil carbon storage rates are determined by plant production, soil texture, moisture, and climate (Conant *et al.* 2005).

Soil Organic Matter can be increased with vegetation management using grazing, fire, or species removal that would increase plant production (more litter to incorporate into the soil) and root creation. The best method to increase soil organic carbon levels on rangeland is through grazing management because of its direct impact on plant species composition and productivity (Eagle *et al.* 2013).

A literature review by Eagle *et al*. (2013) indicates possible storage rates of carbon between 0.6 t CO_2e ha^{-1} yr^{-1} to 1.3 t CO_2e ha^{-1} yr^{-1} for non-degraded rangelands within the United States. At a more local level, a study conducted on the Texas rolling plains estimated carbon storage in well-managed rangelands ranging from 0.66 t CO_2e ha^{-1} yr^{-1} to 4.98 t CO_2e ha^{-1} yr^{-1} depending on texture, plant community, and precipitation (Lal 2001).

6.2 Light or Moderate Grazing Can Store More GHG than No- or Over-Grazing

Grazing management based on the carrying capacity of the land is the key component of OCP's rangeland protocol, so the overarching requirement in the standard is that if the land is grazed it must have a grazing management plan. Grazing plans prescribe an initial carrying capacity for management decisions based on average production values estimated from the NRCS soil survey. Across ecosystems, grazing has been found to have a positive- to no effect on SOC sequestration at study sites in Colorado, Wyoming, North Dakota, and Oklahoma, including the Shortgrass prairie, Northern mixed-grass prairie, and Southern mixed-grass prairie ecoregions (Derner & Schuman, 2007).

The grazing plan provides a benchmark condition based on the "average production" that can be used to document that the land meets the management standard. Oklahoma contains 7 out of the 12 soil orders found on earth. Because of this wide range, the OCP calculates production for each property individually, based on the dominant soil type at each site. From these production values, forage animal balances can be recommended at levels likely to increase production and maintain or increase GHG storage without stressing plants. Changes in biological carbon sequestration observed following changes in stocking rates is likely the result of grazing-induced changes in the plant community composition and not directly driven by the stocking rate (Derner & Schuman, 2007).

6.2.1 Take Half Leave Half

The carrying capacity and grazing management plans approved by the OCP are centered on the concept of removing no more than 50 percent of the current year's growth. This concept is based on the research by Crider (1955) that found when half or more of the current year's production by weight is retained, the plant will invest energy into maximum root creation and soil carbon storage. When more than 50 percent of the plant is lost, the plant will invest energy in creating more photosynthetic leaves and root production will stall (Figure 1). When estimating stocking rate, this approach assumes that only 25 percent of the total production will actually be consumed by the grazing animal, with the other 25 percent being removed through consumption by other herbivores or damage through trampling.

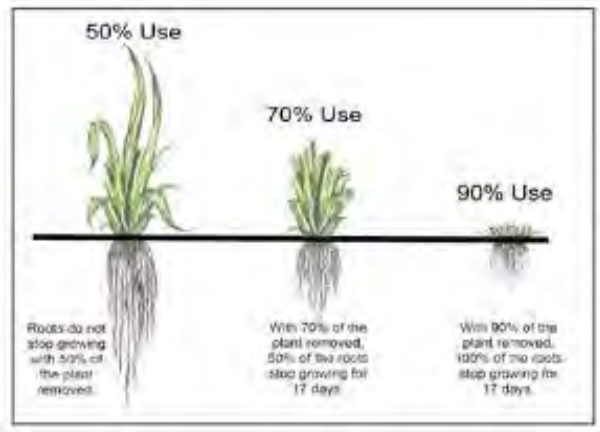

Figure 1: Reduction in root growth with removal of more than 50% aboveground biomass

The recommended stocking rates in the grazing plan designed for each producer will therefore be based on 25 percent of the estimated production supporting livestock. Stocking at these rates or less will ensure soil carbon rates are maintained or increased over time.

6.2.2 Grazing

The OCP requires harvest of grasses by grazing or haying because moderate or light grazing rates have been shown to increase carbon storage when compared with non-grazed or heavily grazed areas (Pineiro *et al*. 2010). The removal of biomass by grazers increases plant production, and the trampling of litter into the soil increases organic matter input, which increases the amount of carbon stored in the soil (LeCain *et al*. 2000, Schuman et al 1999). With increased biomass production and a dominance of grasses that store high amounts of CO2, rangelands can increase their GHG storage rates over time. In Oklahoma, native rangelands are dominated by warm season grass, also called C4 grasses. Native warm-season grasses have high carbon storage rates because they annually turn over 30 percent of their root mass (Hayes and Seastedt 1987, Marshall 1977). High rates of CO2 are converted to root mass to replace those roots that died from root pruning, shrink-swell of the soil, and disease every year. While woody species store more carbon in above-ground biomass, a healthy prairie will store equal amounts of carbon with the added ecological services of grazing and water storage (NRCS).

6.3 Grazing Deferment during Drought Avoids GHG Loss

Multi-year drought is common in Oklahoma. Grazing deferment is suggested during periods of low precipitation or on severely degraded rangeland to maintain and/or increase rates of carbon storage. For this reason, the OCP requires land managers to have and use drought plans. Long-term trend analysis shows that in years of sufficient precipitation, management on rangelands may have little impact on soil organic carbon, but during years of inadequate precipitation, management can have a significant impact as rangelands cease being sinks and become sources during drought periods under poor management (Zhang *et al.* 2010, Eagle *et al.* 2012).

Oklahoma's climate is also characterized by multi-year cycles of wet and dry years (Figure 2), which requires management to be flexible and attentive to the ecosystems needs depending on the year's precipitation events. Precipitation in Oklahoma decreases as you travel from east to west. On average, annual precipitation ranges from 17-56 inches with the majority of rainfall events occurring in the spring and late fall (mesonet.org 2013).

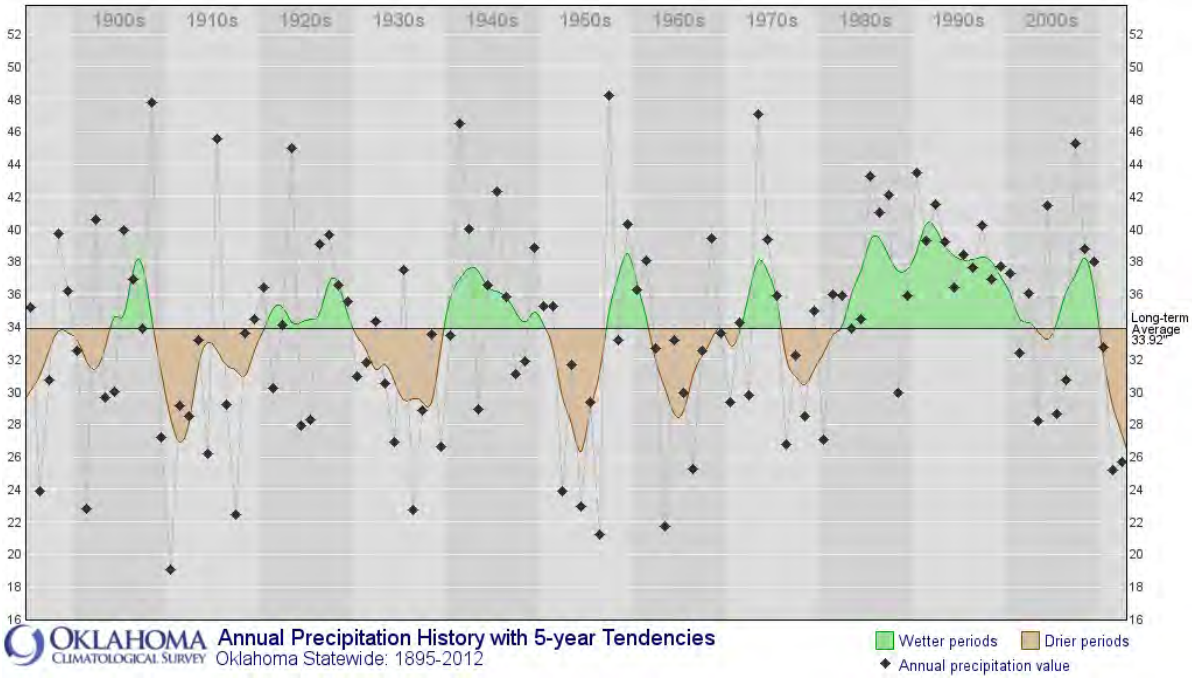

Figure 2: Oklahoma's precipitation history since 1895 with annual average in diamonds and weighted 5-year average in colors

6.4 Prescribed Fire Results in Net GHG Storage when Used at Proper Intervals

The use of prescribed fire for rangeland management is encouraged by the OCP, and prescribed burning plans are suggested and supported by the OCP because fire is a natural disturbance that improves forage production while increasing biodiversity and net GHG storage.

Fire controls woody encroachment, invasive weeds, and increases nutrient content of forage without resulting in as many negative soil disturbances and biodiversity impacts as do mechanical removal or herbicides. Fire also increases soil carbon storage, better than fertilizers or grazing alone, when used at a frequency suggested by historic fire return intervals. When applied annually, however, the percent of soil organic carbon and rate of nitrogen mineralization will decrease, resulting in a decline in carbon storage rates (Ojima *et al.* 1994, Blair, 1997). Significant amounts of aboveground biomass can be lost when burned (up to 89% in tallgrass prairie) but the increased plant production following compensates for that lost by ignition (Ojima *et al.* 1990, Rice and Owensby 2001). Studies have found that historical fire return intervals for the state of Oklahoma range from 3-5 years in tallgrass and mixed-grass prairies (Fuhlendorf and Engle 2004).

Historically, the interaction of fire and grazing maintained prairie ecosystems as a grass dominated system. Fire suppression and shifts of grazing patterns have changed the frequency of disturbance ranging from rarely disturbed woody encroached sites to heavily disturbed agricultural practices.

Research conducted in Oklahoma has isolated optimal fire return intervals for maximum bio-production and cattle weight gains. The interval ranges from 3-7 years depending on the ecosystem (Table 2).

Table 2: Suggested prescribed fire intervals for promoting maximum cattle weight gains, controlling woody encroachment, and maintaining the native plant community

Ecosystem Community	Healthy Fire Frequency	Reference
Sand Sagebrush	3-4 years	Winter *et al.* 2011
Shortgrass Prairie	3-7 years	Bidwell, *et al.* 2010
Tallgrass Prairie	3-4 years	Fuhlendorf and Engle 2004

Precipitation amounts and the increase in soil N after a fire will encourage higher production rates from the vegetation, which will lead to more carbon stored in both the soil and aboveground biomass (Bremer and Ham 2010). Fire and precipitation combined can substantially increase carbon storage, but fire without precipitation can result in carbon loss from the soil. With complete removal of aboveground biomass, there is a reduction in C and N inputs into the soil system and under conditions of minimal rain, regrowth could be deterred which slows the rate of carbon storage (Ojima *et al.* 2004).

6.5 Brush/Woody Management More Beneficial for Ecosystem Services

The OCP requires a brush management plan with baseline inventory to be included in each rangeland management plan if the producer plans to manually or chemically remove brush.

Soil carbon levels in response to woody plant removal are difficult to generalize. Studies have shown a wide response of soil organic carbon to woody plant removal due to the wide array of variables that play a role in organic carbon in soils (Archer *et al.* 2011). General trends suggest that semi-arid and sub-humid ecosystems like those found in Oklahoma show an increase in soil organic carbon with woody plant encroachment (Hibbard *et al.* 2003). Positive shifts were noted in the top 10-20 cm of the soil profile. Even so, the ecosystem services provided by grass-dominated rangelands outweigh those provided by woody dominated rangelands. Woody plant removal will provide more forage, wildlife habitat, base flow, and control soil erosion when management strategies are implemented correctly (Archer *et al*. 2011).

Rangeland management has struggled to control the number and density of woody plants since the turn of the 20th century (Leopold 1924). Concerns over woody encroachment have historically centered around negative impacts woody species have on forage production, livestock safety and health, livestock handling difficulties, and water shortages. Research has led landowners to the realization that past brush management practices including manual and chemical methods were:

- Treating the symptom and not the cause of shifts in plant communities
- Not conducted with the additional influence of livestock grazing in mind
- Could be detrimental to wildlife and biological diversity
- Increase catastrophic soil erosion and weed invasion
- A short-term fix for a reoccurring problem (Archer *et al*. 2011)

6.6 Haying Results in Greater Net GHG Storage than not Harvesting/Grazing

The Oklahoma Carbon Program requires hay meadows to be included in the rangeland management plan. In native rangelands in Oklahoma, carbon storage increases with plant regrowth after biomass removal. Studies have suggested that grazing returns more nutrients to the soil than haying which can

increase carbon storage rates when compared with annual hay cutting (Schnabel *et al.* 2001). However, haying has been shown to have greater net carbon storage than grazed pastures due to methane production rates from grazing animals (Skinner 2008). The OCP considers the full range of ecosystem benefits from healthy rangelands and therefore considers both grazed and hayed systems eligible.

6.6.1 Timing of Haying

Native grasses grow in response to climate conditions with precipitation playing a crucial role in carbon storage rates (Schnabel *et al.* 2001). Most production in native prairie is confined to a small part of the calendar year between April and September (Figure 3). By the end of July on an average year, native warm season grasses will have completed 70 percent or more of their annual growth (Bidwell *et al*. NREM-2891, Leopold and Kriedemann 1975). After this date, native grasses begin to elevate their growing points that will become seedheads. If this growing point is removed with cutting, plants invest the majority of their energy trying to create another rather than root creation (Bidwell *et al*. NREM-2891). Haying has been shown to be detrimental to plant root creation when cut shorter than 4 inches and when clipped later in the season.

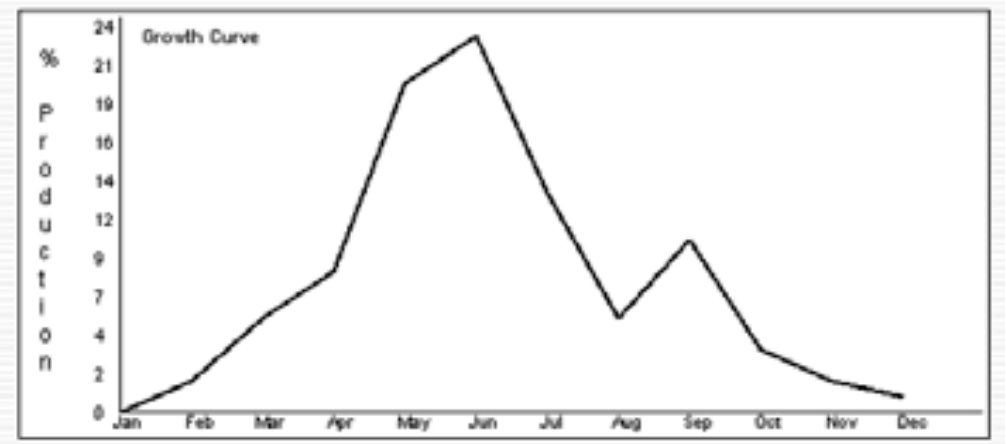

Figure 3: Example of typical growth curve for warm season C4 grasses in Oklahoma

6.6.2 Vegetation Height after Haying

The OCP requires that, if land is to be used for grazing on a rotation with haying, all haying should be completed before July 15. If haying must occur after July 15, cutting height should be set at six inches or higher. As with grazing, the height of vegetation remaining after haying activities will impact plant growth and carbon storage both above and belowground. When above ground biomass is removed, plants stop investing energy in root creation and use carbon stored in the remaining leaves to recover (Manske 1999). Grazing or haying vegetation shorter than four inches will stop carbon storage in roots and will slow down plant recovery, which can impact the plants' health in the following years.

6.6.3 Rotation of Haying and Grazing

The OCP requires that if haying is practiced on a site, there should be no grazing activity at that site within the same year. Combining grazing disturbance and hay cutting within the same year will remove more than 50% of annual biomass and result in a lower carbon storage rate.

6.7 There is No Net GHG Benefit to Fertilizing Grazed Rangeland

The OCP supports fertilizer application within the same year rangeland is harvested for hay to mitigate the lack of nutrient deposition from cattle feces. Fertilizer is not permitted in pastures grazed by livestock. Sustainable management of rangelands will increase nutrient cycling and storage within the

system, which should decrease the need for applied fertilizers. Seeding of native legumes will assist in increasing nitrogen storage in degraded rangelands (Morgan *et al.* 2010).
Fertilizer has been reported to have positive impacts on carbon storage in aboveground and belowground biomass (Reeder *et al.* 1998). However, the fuel used to apply fertilizer and the GHG byproduct from production of nitrogen fertilizer were considered into net GHG reduction and the benefit of added nitrogen does not outweigh the cost to recommend it on an annual basis, according to Schlesinger 1999, West and Marland 2002.

6.8 Herbicides Provide no Added GHG Storage and Increase GHG Emissions

The OCP prefers landowners refrain from herbicide application because it has no added effects on carbon storage or cattle production and increases greenhouse gas emissions during application and creation (Bidwell and Woods NREM-2869).

7.0 Applications for Verification

Aggregators and land managers are provided with eligibility and application information. All applications for rangeland monitoring and verification are screened for eligibility.

7.1 Screening

The application and supplemental information is reviewed for completeness, clarity, and adherence to program requirements prior to contracts being considered for verification. The screening includes a review of all information submitted to confirm the land meets eligibility requirements. A decision tree for determining eligible rangelands is provided to aggregators and land managers (Figure 4).

- Land manager's application
- Name, address, and phone number
- Number, size, and location of fields
- Legal location descriptions and aerial photographs
- Resource management plan with livestock stocking information
- Carbon contract
- FSA Form 578

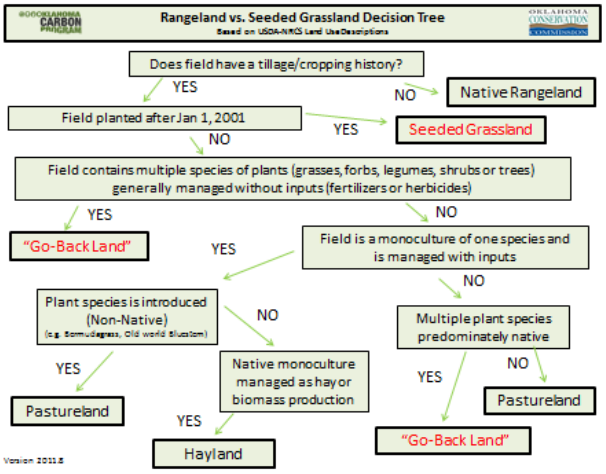

Figure 4: Decision tree for determining rangeland eligibility

7.2 Ecological Site Descriptions

Once it is determined that the land in question meets eligibility requirements, ecological site descriptions and soil survey information are compiled to determine monitoring locations for each field and dominant key species are identified for each site (Table 3). Transect monitoring locations are chosen within the major soil type comprising 50% or more of the site. If there are two major soil types, a second transect will be done or the first one will be placed to intersect both soil types. Identifying the historic percent composition of key species in this way helps verifiers gather the data necessary to assess the overall health of the plant community.

Table 3: Example ecological site description showing percent of key species at a site

Map symbol and soil name	Ecological site	Total dry-weight production (lb/ac)			Characteristic vegetation	Rangeland composition (%)
		Favorable Year	Normal Year	Unfavorable Year		
CaB: Carey	Loamy Prairie PE 32-44	5800	4200	3500	Other perennial grasses Little bluestem Indiangrass Other perennial forbs Sand bluestem Sideoats grama Other shrubs Switchgrass	35 15 10 10 10 10 5 5

7.3 Field Information Sheet

Once the ecological site description is retrieved and reviewed, field location and status information is synthesized and organized into a spreadsheet provided to the field verifier with maps. This allows the verifier to plan to optimize field time and facilitates overall GHG reduction reporting and project tracking.

Table 4: Example producer field information sheet

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Last Name	First Name	County	Town	Legal	Applic Descr #	Total Acres Contracted	Acres No-Till	Acres Grass	Acres Range	FSA Cropland	Date Began Practice	Irrigated	NRCS Farm Plan	Grazing Plan	Farm Bill
2	Joe	Producer	Best	Sometown	E2NW4 24-22-22	1	68.2	0	9	0	Y	2004	N	Y	N	CRP
3	Joe	Producer	Best	Sometown	E2NW4 24-22-22		0	0	59.2	0	Y	2004	N	Y	N	
4	Joe	Producer	Best	Sometown	NE4 13-22-22	2	55.9	0	55.9	0	Y	2006	N	Y	N	
5	Joe	Producer	Best	Sometown	N2SE4 13-22-22	3	21.2	0	21.2	0	Y	???	N	Y	N	
6	Joe	Producer	Best	Sometown	S2NW4 22-22-22	4	64.4	0	64.4	0	Y	2006	N	Y	N	
7	Joe	Producer	Best	Sometown	SE4SW4 and SW4SE	8	49.3	0	49.3	0	Y	2006	N	Y	N	
8	Joe	Producer	Best	Sometown	SW4NE4 11-22-22	9	13.7	0	13.7	0	Y	2006	N	Y	N	

7.4 Selecting Stands for Monitoring

The OCP randomly selects at least 10% of eligible contracts for verification. If the total acres do not equal 10% of the project acres, additional sites are randomly selected to reach the 10%. After year one, the same process is followed with a random selection of previously visited sites added to the verification pool.

7.5 Contacting the Field Verifier

Once fields are selected for monitoring, the OCP contacts a verifier to request field verification services, provide instructions, and transmit the information in section 8.1.

8.0 Preparing for Field Visits

After applications are reviewed and fields are selected for verification, the OCP contacts a verifier to request field verification services, provide instructions, and transmit the application information listed in section 8.1. Field verifiers are tasked with performing a thorough review of the field information, and planning travel logistics before departing for field locations.

8.1 Gathering and Reviewing Information

Verifiers review field information and contact the OCP with any questions. Information includes:

- Producer's field summary
- Name, address, and phone number
- Number, size, and location of fields
- Legal location descriptions and aerial photographs/maps
- Ecological site descriptions with percent compositions of key species for each field
- Noxious or Invasive species of the area
- Common plant species encountered in the area
- Field data forms and attestation

These resources are integral to the successful use of this methodology and accurate data collection:

- NRCS Web Soil Survey – http://websoilsurvey.sc.egov.usda.gov
- Oklahoma Mesonet – www.mesonet.org
- USDA plants database – www.plants.usda.gov
- Noble Foundation plant image gallery http://www.noble.org/apps/plantimagegallery/
- North Rolling Plains Resource Conservation and Development Council http://www.northrollingplains.com/
- *Field Guide to Oklahoma Plants*. Tyrl, R.J., T.G. Bidwell, and R.E. Masters. 2002. Oklahoma State University, Stillwater, Oklahoma.

8.2 Contacting the Land Manager

Verifiers are responsible for contacting the land manager to set a date and time to conduct monitoring and to confirm field locations and best access. This is the time to ask if gates are locked, if the land is under hunting lease, and to determine if the land manager wants to be present during the field visit.

8.3 Planning Travel

Verifiers are required to plan travel routes in advance to optimize time spent driving and reduce fuel cost and GHG emissions from travel. Based on a review of the application and maps of field locations, the quickest, most efficient route is planned from the office to the fields.

9.0 Monitoring

Visual observations and data collection are referred to as monitoring. The OCP monitors rangelands to determine how fields are progressing toward management plan goals and to verify that a field or project is being managed in a way that sequesters an expected amount of greenhouse gas (GHG). Monitoring is

required to help manage and maintain the necessary stocking rates and utilization amounts to prevent overgrazing that will result in GHG storage at or below the baseline. Monitoring includes identifying plant species present, the condition of those plants, and the overall condition of the range. This is done by running at least one transect per field, collecting line-point data to determine utilization, and collecting dry-weight data to determine production. All data and field observations are then used to complete a range health assessment.

9.1 Timing

Collecting rangeland data soon after frost provides a good estimate of standing crop at the end of the growing season. The OCP monitors rangelands between **August 15 and October 15**. Although some forage will have been lost, the production at this time can be used to determine if enough forage will be available until spring green-up. At its discretion, the OCP may vary the annual verification dates based on seasonal fluctuations in rainfall, planting time, or crop emergence.

9.2 Frequency

Frequency of verification depends on the length of the contract and the project budget. At minimum agricultural projects are monitored annually with site visits to 10% of the contracts and at least 10% of the acres, with self-certification done on 100% of contracts and 100% of acres. The OCP recommends annual monitoring of all fields during the first two years of the contract to establish a baseline for trend analysis, and then monitoring on a rotation every three years.

9.3 Field Forms

Field data collections begin with a working knowledge and understanding of the field forms to be used. There are three forms to fill out for each site: line-point, dry-weight rank, and a range health assessment form. Each form is used to collect specific information. Basic information that should be on all three forms includes the land manager's name, the month, date, and year of data collection, field id number and legal description. The data form includes an attestation of truthfulness signed by the field verifier.

10.0 Methods

Because rangeland management decisions are based on trends observed in the field, it is important that the method used to collect the data each year is consistent so trends observed over years of data collection will accurately represent the site.

Management plans are designed to optimize growth of key species and maintain native grass biomass at 50% of the current year's growth. The purpose of a grazing plan is to provide a starting point for management based on average production values. Initially, these values are derived from the NRCS soil survey and provide for a forage animal balance we would expect not to degrade the field below its production limits during an average year. Annual modifications will typically be needed due to past management, current conditions, and the typical grazing. The need for modifications will be determined from data collected during monitoring. These methods are adapted from Herrick *et al.* 2009.

10.1 Line-Point Data Collection

When beginning a monitoring regimen, it is useful to quantify soil cover and vegetation to establish a benchmark. This benchmark can be used as a reference for data collections in future years. The OCP uses the line-point intercept technique as a rapid method for quantifying soil cover, which is necessary

to assess utilization, or the amount of biomass that can be removed without causing degradation. These measurements will assist in assessing the land's susceptibility to wind and water erosion, rates of water infiltration and the ability of the site to resist and recover from degradation.

Utilization data are important for evaluating the effects of grazing on rangeland and can be used as an indicator of grazing pressure and potential overstocking. Utilization is used to determine if adjustments are needed in grazing management or stocking rate. Utilization measures the percentage of annual herbage production that has been removed. It is generally the percentage of available forage that has been consumed or destroyed. Utilization is expressed in terms of the current year's production removed. The Line-point intercept information helps estimate percent cover, vegetative diversity, and abundance of key species to assess utilization.

Equipment Needed

- Clipboard
- Camera
- Field data form (Appendix A)
- Tape measure (200')
- Compass
- Handheld GPS unit
- Straight pointer, such as a rod, wire or pasture stick

10.1.1 Determine Where to Sample

The first step to gathering cover data is to determine where to sample. Verifiers should get familiar with the site before placing the transect. This can be done by driving around the field or exploring within the field to identify the most prevalent vegetation. Transects should not be placed close to feeding lots, water sources, shade trees, gates, or other places cattle congregate. Pick a site that best represents the entire field and best represents the average forage production over the pasture. Alternatively, several samples can be collected on distinctly different areas of the pasture and summarized. For instance, if the pasture has been heavily grazed in some parts and lightly grazed in other parts, pick an area that represents an average of the two, or sample and summarize each part separately. Areas should be within the ecological site and soil series outlined in the ecological site descriptions.

10.1.2 Record GPS Coordinates

Record the latitude and longitude of the starting point of the transect using a handheld GPS device. Write down the heading, or direction, of the line in degrees using a compass. The direction and starting point are very important to keep consistent because the vegetation in rangelands can vary within a short distance. A shift of the transect sideways, uphill, or downhill can skew the data results.

10.1.3 Place the Transect

Once the GPS coordinate has been recorded, stretch the tape to 200 feet using a compass to follow the heading. Make sure the tape is taut and as close to the ground as possible**.** Anchor each end and take a panoramic picture of the field showing the extended tape and some sky.

10.1.4 Establish Photopoints

A photopoint is a point of visual geographic reference. Field verifiers are the eyes of the OCP. Pictures should accurately represent the site.

- **Panoramic photos** are the first photopoints to take at a site. Panoramic photos are taken from the transect's GPS coordinate looking down the tape from the zero end. At least one photopoint panoramic is taken at each site and should include only 1/3 sky to show a representation of the landscape.

Figure 5 & 6: Examples of correctly taken field photos and "unknown plant" photo

10.1.5 Begin Collecting Data

- **Identify the canopy**. Collect data every 4 feet along one side of the tape (Figure 7). Using a flag, pasture stick, or a pen, lower the item vertically to the ground exactly at the number on the tape. Imagine a raindrop falling from the sky encountering plants along the way. Record the name of each plant touched from the top downward. The first species touched is the top canopy. Up to four species of plant cover may be recorded. The other three canopy distinctions continue down to the ground.

- **Determine the ground cover**. Ground cover is its own separate category. Enter either 'C' for 'cover' or "B" for 'bareground' noting whether the soil surface is covered with detached plant residue, attached plant canopy, or if it's bare. Bare ground is bare soil with no cover. If dead plant matter is attached to the plant, it counts as a canopy level and not a soil cover. Only plant remnants separated from the plant are considered soil cover. Soil cover consists of litter, duff, or plant base that acts as a protective layer between wind and water and the soil surface. Rock is recorded if the pointer hits a rock. If litter covers a rock, record cover.

Figure 7: Collect line-point data consistently on one side of the tape

10.2 Dry-Weight Data Collection

The dry-weight data collection is used to estimate forage production and grazing pressure at the site. Matching forage production with quantity of grazing animals is referred to as stocking rates. Proper stocking rates are the key to maintaining rangeland resources and success of livestock production. Measuring forage production is an essential part of a grazing management plan and can be used to calculate stocking rate, which will in turn influence economic performance of the grazing operation. Stocking rates above carrying capacity hurt the land, limit its ability to survive climatic extremes, and increase the cost of livestock production. The dry-weight data is collected by estimating or clipping vegetation every 10 feet.

Equipment Needed

- Set of gram scales
- Field form (Appendix A)
- Grass shears
- Bags to collect samples
- Tape measure (200')
- Clipping frame (quadrat: 1.92ft2 – 11.5 in x 24 in) or Hoop (93" circumference)

10.2.1 Determine Where to Sample

Conduct sampling along the same transect laid out for the line-point intercept. Use the same starting point, latitude and longitude, and compass heading so the exact location is documented for subsequent visits.

10.2.2 Identify the Vegetation

Place the hoop on the ground next to the tape centered at the 10-foot mark. Identify and record the plants rooted within the boundaries of the frame. Learning to identify common plants makes fieldwork go more quickly. Recorded unknown plants on the field form as UK1 or Unknown 1 until identified. Identify unknowns using the steps below.

- **Take a picture** of unknown plants with a clipboard or something else solid-colored as a backdrop for easier viewing. Figure 6 on page 22 shows an example. Make sure the picture shows the growth form, any seeds or flowers, leaf shape, and where leaves join the stem.

- **Identify the plants** after returning to the office using resources listed in section 8.1.

- **Replace all the temporary UK1 distinctions** on the field form with the correct name. Note: This can be done by clicking the 'Find' button and using the 'Find and Replace' option in Microsoft Word. Common names can be used on the data form, but should be changed to the USDA plant code in the final forms sent to the reviewer. The codes are included on the back of the field form, and can be found at plants.usda.gov.

- **Send the pictures with the field forms** to the auditor. If the plant is too dried up or damaged to get a good picture, choose from the unknown options at the bottom of the data form.

10.2.3 Clip and Weigh/Estimate Vegetation

Clipping vegetation in quadrats is the most accurate way of measuring forage production. Determine the weights of plants in each plot by weighing every other plot and estimating the weight of alternating plots. Alternate clipped measured weight plots with visually estimated-weight plots for a total of 10 clipped plots and 10 estimated plots. Clipped plots will serve as calibration for the estimated plots.

- **Clip and weight plots every 20 feet**. Starting at the 10-foot mark, clip vegetation at ground level within the hoop focusing on harvesting all of the current year's growth, avoiding roots or plant crowns (Figure 8). Separate previous years' old growth from the current year's growth. Record the weights of each clipped plot in grams. To calculate pounds of dry weight per acre, multiply final weight times the appropriate factor based on hoop or quadrat size (Table 5). Weigh the current year's growth by placing it in a bag and hanging it from the gram scale. Be sure to subtract the weight of the bag.

Table 5: Converting sample weights in grams to pounds of forage per acre

Size of Quadrat	Dimensions of Quadrat	Factor
93" hoop	93" circumference	multiply grams by 20
1.92 sq. ft	11.5 X 22 inches	multiply grams by 50

- **Estimate weight of plots every 20 feet**. Starting at the 20-foot mark, evaluate visually what the heaviest plant would be. If you clipped everything out of the plot and dried it, which species would comprise the majority of the weight? Pick the top three heaviest plants species. List each species seen. Rank 1 has the highest amount of weight with rank 3 having the least. Alternate clipped and estimated plots to get 10 estimated and 10 clipped plots.

Figure 8: Clip annual production at the base of all plants rooted within the sample hoop; measure weight of clipped production using a hanging scale

Tips for Estimating and Ranking Vegetation Weight

- To better understand the rankings on the dry weight form, think of rank one equaling 70% of the combined weight. Rank 2 will equal 20% of the combined weight and rank 3 will equal 10%. This all adds up to 100% of the weight.
- In a quadrat where one plant, like big bluestem, will make up about 90% of the weight, check ranks 1 and 2 for big bluestem and leave 3 (10%) for the second species.
- If a species comprises 80%, check ranks 1 and 3 for that species, leaving 20% for a second species.

Figure 9: Tips for estimating and ranking vegetation weight

10.3 Field Form Calculations

10.3.1 Dry-Weight Form

The dry-weight worksheet is designed to calculate production automatically as data are entered. Enter the plants and their rank, the hoop size, and the multiplying factor for the hoop (Table 5). Since grazing calculations related to livestock demand are on an air-dry basis, convert the clipped weights to dry weights.

- **Air-dried plants.** To air-dry forage plants, let clipped samples air dry until the weight no longer changes (3-4 days).

- **Dry matter lookup table.** Estimate the dry weight using the dry matter table. The table estimates how much the grass would weigh at different growth stages. To calculate the dry weight of undried plants, multiply the clipped weight by the percent dry matter based on growth stage in Table 6. Identify if the key species have seedheads, and if these seedheads are

  ripe or dried, to identify the number from the dry matter table to enter into the form. Choose numbers in-between those noted in the table if the plants themselves are between the stages highlighted. There can be a difference in the end of growing season based on growth patterns: Warm season grass growth ends Sept/Oct and cool season grass growth ends June/July. For

example, if clipping was done at the end of the growing season, after frost, then percent dry matter of a warm season or cool season grass would be 95-100%.

Table 6: Estimated percent (%) dry matter based on growth stage

Plant	Before Heading (%)	Headed Out (%)	Ripe Seed (%)	Dry Leaves (%)	Dormant Plant (%)
Cool Season Grasses	35	45	60	85	95
Warm Season Tall Grasses	30	45	60	85	95
Warm Season Mid Grasses	40	55	65	90	95
Warm Season Short Grasses	45	60	80	90	95
Forbs / Legumes	20	40	60	90	95

End of growing season for warm season grasses (WSG) is Sept/Oct and for cool season grasses (CSG) is June/July

- **Growth curve completed (%GCC)**. The growth curve completed is calculated by adding all the growth from January up to the month sampling occurred (Table 7). The growth stage is figured into the equation to calculate annual forage production on the dry-weight rank datasheet. This method only calculates what plant cover is *currently* at the site. It does not take into account what has been removed (grazed) at the time the site was clipped.

  Example. If there was 3,000 lbs clipped on July 1 and this represents 70% of the annual growth curve completed, then 3,000 divided by 70% = 4,285 estimated pounds of *current* production.

- **Percent ungrazed (%UG)**. The percent of vegetation ungrazed is the estimated percent of all plants not removed by herbivores. Any forage removed by grazing or haying should also be reconciled. The amount of forage production in pounds that *would be* on the site if it were ungrazed can be calculated by dividing the weight of the clipped production by the percent ungrazed. If the area has been heavily utilized, estimation will be more difficult. This difficulty may be overcome by comparing the heavily utilized area to an ungrazed area in the pasture or a similar area outside of the pasture.

  ***Example*.** 3000 lbs clipped on July 1, and 70% of annual growth complete, and grazing has removed 20% so 80% remains. 3000 / .70/ .80 = 5357 lbs estimated annual production.

- **Percent of normal production (%NP)**. Production is estimated using the percentage of the average rainfall that has occurred during the calendar year up to the point of sampling. To get Oklahoma rainfall information, go to mesonet.org, click the Weather tab at top, then choose the rainfall option on the side. Choose the Rainfall by Month table, and select the Mesonet site closest to the field site. Add up the total rainfall that has fallen from January 1 through the date of sampling. Separately, add up the average rainfall for the same time period. Divide the total rainfall by the average rainfall amount. The field data collected allows calculation of annual production as of the day of data collection.

- **Reconstructed estimated production**. To estimate the total annual production for the whole year, some reconstruction will have to be done, which includes information on the timing of the monitoring and how much of the current year's production has been grazed or hayed. To

reconstruct an estimate of total annual production, take standing forage in pounds, divided by % growth completed, divided by % ungrazed equals the estimated total annual production.

Example: If 4,285 lbs were reconstructed based on how much of the growing season was complete, 4,285 lbs divided by 80% ungrazed = 5356 lbs. estimated total annual production.

Table 7: Typical Vegetation Growth Curves for Oklahoma by Month (NRCS)

Forage Systems	Typical Growth Curves- Percent Growth by Month											
Species listed below are considered average values for Oklahoma	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Bermudagrass	0%	0%	3%	11%	24%	27%	14%	7%	10%	6%	0%	0%
Bermudagrass / Fescue	1%	2%	10%	18%	21%	15%	5%	3%	8%	10%	5%	2%
Bermudagrass w/ Small Grains	2%	2%	10%	17%	14%	18%	12%	5%	6%	4%	6%	4%
Eastern Gamagrass	0%	0%	0%	13%	23%	30%	23%	11%	2%	0%	0%	0%
Fescue	1%	2%	14%	25%	20%	8%	0%	0%	8%	14%	10%	1%
Intermediate wheatgrass	1%	2%	10%	25%	25%	9%	0%	0%	7%	12%	8%	1%
Native Range	0%	0%	3%	15%	31%	25%	10%	5%	9%	3%	0%	0%
Native w/med Overstory Canopy	3%	4%	7%	25%	30%	15%	4%	2%	1%	3%	4%	2%
Old World Bluestems	0%	0%	2%	10%	24%	23%	17%	8%	13%	4%	0%	0%
Orchardgrass	0%	0%	4%	15%	21%	18%	7%	5%	9%	14%	7%	0%
Perrenial Ryegrass	1%	2%	17%	27%	15%	6%	0%	0%	5%	10%	15%	2%
Small Grains	2%	5%	25%	30%	9%	2%	0%	0%	1%	10%	12%	4%
Forage sorghums / Sudan	0%	0%	0%	0%	2%	17%	32%	29%	16%	4%	0%	0%
Weeping Lovegrass	0%	0%	2%	14%	28%	24%	14%	8%	8%	4%	0%	0%

11.0 Data Management

Adherence to this protocol, associated methodology and principles of accounting will ensure that project-based offsets represent emissions reductions and removals that are real, measurable, permanent, in excess of regulatory requirements and common practice, additional to business as usual, net of leakage, and verified by a competent third party .

11.1 Unit of Measure

Sequestration rates and GHG reductions are reported in metric tons, converting each metric ton to its carbon dioxide (CO2) equivalent (CO2e).

11.2 Conservativeness

Carbon sequestration rates used by the OCP are conservative default values based on soil carbon data and USDA modeling that provided regional averages of soil carbon sequestration rates over land areas with similar soils, climate, and water resources. As the dataset gathered from direct measurement of soil carbon samples in Oklahoma continues to grow, we routinely compare the sequestration rates with the default rates to make sure the rates we recommend to s are based in science and a fair representation of soil dynamics in Oklahoma.

11.3 Uncertainty, Accuracy, and Precision

For agriculture practices the OCP verification protocols meet the targeted 90% statistical confidence at +/- 10%. Calculations and estimates need to be as precise as possible to prevent material errors. It is important to identify errors during the verification process. Any of the common errors below could result in the project aggregator or verifier potentially over crediting GHG reductions: incorrectly defining project boundaries, transcription errors.

11.4 Reporting

Verification activities consist of a pre-verification application screening, site visit of selected acres, and desk audit of field data documentation provided for those acres. Site visits are necessary to assess management, confirm the project boundary, and assess management techniques.

11.5 Data Quality

The OCP has trained quality assurance advisors in place to assess the performance of field verifiers and assure consistency of gathered data and reporting.

11.6 Confidentiality

The OCP requires verifiers to keep all matters of contracts and verification strictly confidential.

11.7 Baseline Estimation

OCP considers baseline emissions to be an estimate of the GHG emissions from sources within the project boundary that would have occurred in the absence of the project.

11.8 Quantifying Reversals

Verifier reports include photo documentation of management activities that positively and negatively affect GHG sequestration. Soil disturbance and other activities that violate eligibility requirements are considered a reversal and result in no credit given for the contract period.

11.9 Assessing Leakage

This protocol does not include a method to assess leakage at the field or project scale.

11.10 Quantifying Emission Reductions

The OCP uses GHG sequestration rates compiled for the Chicago Climate Exchange, which for conservativeness are discounted 20 percent from the average published rate for the region. The rates do not assume that each enrolled acre sequesters that amount each year. The rate is “based on the average accumulation rates expected for large pools of farmland over multiple years based on the best available scientific information. The issuance rates are viewed as a discounted average that could be expected to occur for the entire pool of enrolled acreage over the …contract period” (CCX 2008).

Note: Suggested rate variations for the 5-Tier Management Standard: Progressive Crediting Matrix have not yet been estimated.

Table 8: Sequestration rate used to calculate carbon offset payments for Oklahoma rangelands

Sector	Practice	Sequestration Rate (metric tons CO2/acre/year)
Agriculture	Improved Rangeland Management	0.2

Calculation: Price per ton x sequestration rate x acres = Payment to producer
Example: $3.50/metric ton CO2e x 0.2 metric tons CO2e/ac/yr x 300 acres = $210/yr

Table 9: GHG Sources and sinks of native rangeland

Source/Sink	GHG	Include (I) or Exclude (E)	Quantification Method	Explanation
Soil	CO2	I	Visual; default sequestration rates	Actions that result in less sequestration than anticipated are documented and considered in GHG credit accounting.
	N2O	E	N/A	Not considered by this protocol at this time.
Equipment	CO2	E	N/A	Compared to emissions from managing the land as marginal croplands, emissions are expected to decrease and are not accounted for.
	CH4	E	N/A	
	N2O	E	N/A	
Leakage	CO2	E	N/A	Possible if grazing pressure is found to have shifted to and negatively impacted other fields.
Fertilizer Production and Application	CO2	E	N/A	Possible from grazing by livestock. Improved rangeland management and optimal stocking rates can result in higher quality forage that may mitigate effects.
	CH4	E		
	N2O	E		Indirect emissions or reductions are not accounted for by this protocol, but are discouraged in the performance standard's fertilizer restrictions.

11.11 Quantifying Project Emissions

The OCP includes in the rangeland management standard requirements that reduce or avoid project emissions. The monitoring protocol for rangelands does not include the quantification of project-based emissions.

12.0 Verification Audit

The field verifiers do not make the final decision about eligibility for carbon credit payments. Field verifiers are the eyes of the desk auditor. Providers of monitoring and field verification services for the OCP are tasked with using their knowledge, skills, and tools to accurately document with notes and photographs what they observe. Observations and data collection processes should be thoroughly documented on the forms provided so that a second verifier using these methods and previous field forms would arrive at similar results. The data collected is expected to be accurate and complete to be

used by the desk auditor to make a reasonable and valid decision about each field's eligibility for carbon credit payment.

[Placeholder for additional information]

13.0 Reporting

[Placeholder for reporting guidelines]

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Appendix A: Field Forms

Line-Point Intercept Data Form

Name of producer _____ **Field #**_____**Date** _____ **Page** ____ **of** ___

Coordinates: _____ **Observer:** _____**Recorder:** _____

Direction: _____ **Intercept (Point) Spacing Interval =** _____ **ft (** ___ **in)**

Pt.	Top canopy	Lower canopy layers			Soil surface	Pt.	Top canopy	Lower canopy layers			Soil surface
		Code 1	Code 2	Code 3				Code 1	Code 2	Code 3	
0						100					
4						104					
8						108					
12						112					
16						116					
20						120					
24						124					
28						128					
32						132					
36						136					
40						140					
44						144					
48						148					
52						152					
56						156					
60						160					
64						164					
68						168					
72						172					
76						176					
80						180					
84						184					
88						188					
92						192					
96						196					

% canopy (foliar) cover = ____ pts (1st col) x 2 = % _____

% bare ground* = ____ pts (w/NONE over S) x 2 = %___

% basal cover = ____ pts (last col) x 2 = %_____

Top canopy codes: Species code, common name, or NONE (no canopy).

Lower canopy layers codes: Species code, common name, or NONE (no canopy).

Unknown Species Codes:

AF = annual forb
PF = perennial forb
AG = annual graminoid
PG = perennial graminoid
SH = shrub
TR = tree

Soil Surface Codes:

R = rock fragment (>5 mm ~1/4 in diameter)
B = bare ground
C = cover

**graminoid is grasslike or grass*

Version 2012.9.19/SH

CODE	COMMON NAME	SCIENTIFIC NAME
AMDR	Annual Broomweed	*Amphiachyris dracunculoides*
ERAN4	Annual Buckwheat	*Erogonum annuum*
ECMU2	Barnyard Grass	*Echinochloa muricata*
GAURA	Beeblossom	*Gaura*
CYDA	Bermuda Grass	*Cynodon*
ANGE	Big Bluestem	*Andropogon gerardii*
LIATR	Blazing Star	*Liatris*
BOGR2	Blue Grama	*Boutelous gracilis*
SEPA10	Bristlegrass	*Sotaria*
BROMU	Brome	*Bromus*
GUTIE	Broom Snakeweed	*Gutierrezia*
SORO	Buffalo Bur	*Colanum*
BODA2	Buffalograss	*Buchloe dactyloides*
DESMA	Bundle Flower	*Desmanthus*
HESU3	Camphorweed	*Heterotheca subaxillaris*
ELCA4	Canada Wildrye	*Elymus canadensis*
PACA6	Common Witchgrass	*Panicum*
SILA3	Compass Plant	*Silphium*
COREO2	Coreopsis	*Coreopsis*
CROTO	Croton	*Croton*
COMME	Dayflower	*Commelina*
TRDA3	Eastern Gammagrass	*Tripsocum dactyloides*
HETER8	Flase Goldenaster	*Heterotheca*
ERIGE2	Fleabane	*erigeron*
CAGI3	Giant Sandreed	*calamovilfa gigantea*
SPHAE	Globe Mallow	*Sphaeralcea*
SOLID	Goldenrod	*Solidago*
PHYSA	Ground Cherry	*Physalis*
GRIND	Gumweed	*Grindelia*
BOHI2	Hairy Grama	*Bouteloua hirsuta*
GAPU	Indian Blanket	*Gaillaria pulchella*
SONU2	Indiangrass	*Sorghastrum nutans*
VERNO	Ironweed	*Vernonia*
AMCA6	Lead Plant	*Amopha canescens*
HOPU	Little Barley	*Hordeum*
SCSC	Little Bluestem	*Schizachyrium scoparium*
HIVU2	Mare's-tail	*Hippuris vulgaris*
ASTRA	Milkvetch	*Astragalus*
ASCLE	Milkweed	*Asclepias*
POLYG	Milkwort	*Polygala*
BRASS2	Mustard	*Brassicacea*
STIPA	Needleandthread	*Stipa comata*
SOLAN	Nighshade	*Solanum*
BOIS	Old-world Bluestem	*Bothriochloa ischaemum*
ALLIU	Onion	*Allium*
CHFA2	Partridge Pea	*Chamaexrista*
POPE2	Penn. Smartweed	*Polygonum pensylvanicum*

CODE	COMMON NAME	SCIENTIFIC NAME
DALEA	Prairie Clover	*Dalea*
SPPE	Prairie Cordgrass	*Spartina pectinata*
OPPUN	Prickly Pear	*Oppuntia*
ARGEM	Pricklypoppy	*Argemone*
ARPU9	Purple Threeawn	*Aristido purpurea*
STSY	Queen's Delight	*Stillingia*
JUNCU	Rushes	*Chaetopappa*
SALSO	Russian Thistle	*Salsola*
ARLU	Sagewort	*Juncus*
SPCR	Sand Dropseed	*Artemisia ludoviciana*
ERT3	Sand Lovegrass	*Eragrostis trichodes*
PAMA16	Sand Paspalum	*Paspalum*
ARFI2	Sand Sagebrush	*Artemisia filifolia*
CENCH	Sandbur	*Cenchrus*
PRAN3	Sandhill Plum	*Prunus*
DIOL	Scribner's Panicum	*Dichanthelium oligosanthes*
PSORA2	Scurfpea	*Psoralidium*
CAREX	Sedges	*Carex*
MIMI22	Sensitive Briar	*Mimosa*
BOCU	Sideoats Grama	*Bouteloua curtipendula*
BOSA	Silver Bluestem	*Bothiochloa*
SCUTE	Skullcap	*Scutellaria*
DAEN	Slender Dalea	*Dalea*
OXVI	Sorrel	*Oxalis violacea*
ANHA	Spiderwort	*Andropogon hallii*
CENTA	Star Thistle	*Centaurea*
HELIA3	Sunflower	*Helianthus*
PAVI2	Switchgrass	*Panicum virgatum*
CIRSI	Thistle	*Crisium*
STHE9	Trailing Wild Bean	*Strophostyles*
VERBE	Vervain	*Vebena*
PAOB	Vine Mesquite	*Panicum obtusum*
AMPS	Western Ragweed	*Ambrosia psilostachya*
PASM	Western Wheatgrass	*Pascopyrum smithii*
SYER	White Health Aster	*Syphyotrichum ericoides*
BAAL	White Indigo	*Baptisia alba*
VEUR	White Vervain	*Verbena*
BAAU	Wild Indigo	*Baptisia australia*
CHVE2	Windmill Grass	*Chloris*
PLPA2	Wolly Plantain	*Plantago*
ACHIL	Yarrow	*Achillea*
CASE12	Yellow Sundrops	*Calylophus*
YUCCA	Yucca	*Yucca*

Producer Name		Field Number:		Mesonet Station:		Date:	
GPS Coordinates start of transect:		Frame Size:		Observers:			

Species	Rank	P10	P20	P30	P40	P50	P60	P70	P80	P90	P100	P110	P120	P130	P140	P150	P160	P170	P180	P190	P200	Rank Tally	Rank Factor	Weighted	% Comp	Lbs of each species
		Rank each species in frame by determining top 3 species that have the greatest yield of current years growth on a dry weight basis. A ranking of 1 is the most dominant; 2 is second most dominant; 3 is third most dominant.																								
	1																						7			
	2																						2			
	3																						1			
	1																						7			
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Production - Lbs Dry Weight	2	4	6	8	10	12	14	16	18	20	Ave.	%GCC	%UG	%NP	Rec. Lbs
Clipped wet wt. or inches															
Conversion factor or # per inch															
% dry matter (if clipped)															
Current Lbs															

Modified Range Health and Trend Evaluation

Landowner: _____ **Location:** _____

Ecological Site:_____ **Completed by:** _____

Date: _____ **Precipitation:** **Above Normal** **Normal** **Below Normal**

Evaluation Criteria	+1	0	-1	-2	-3
Plant community composition Changes Evaluate composition as compared to ESD reference community or known desired plant community that can be expected on the site.	Plant composition closely matches that which is described as the Historic Plant Community. Desirable key species dominate the site (>40%). Less desirable species are <10%.	Desirable key species have decreased but still dominate (>40%). Less desirable plant species have slightly increased to more than expected for the site (10-20%).	Desirable key species have decreased and no longer dominate the site (20-40%). Less desirable plant species have increased to match that of the desirable species (20-40%).	Desirable key species have decreased on the site (10-20%). Less desirable plant species have increased and now dominate(>40%).	Desirable key species have decreased (<10%) or been replaced by less desirable plant species which totally dominate the site (>60%).
Noxious or Invasive Species Noxious species are those officially listed and invasive are those that are not expected for the site or introduced	No noxious or invasive species present.	Noxious or invasive species present but scattered / isolated and at levels <5.	Noxious or invasive species are present, but scattered and at levels 5-15%	Noxious or invasive species are present and common throughout the site at levels 15-25%	Noxious or invasive species are present throughout the site at levels >25%
			If invasive plants are considered desirable based on objectives, add +1 (i.e. introduced species in tallgrass prairies desirable as forage)		
Plant Health and Vigor Evaluate plant decadence, plant spacing, reproduction (recruit plants), plant stature, leaf size, productivity, etc. of desirable species	Health and Vigor of desirable species is very high. Dead and/or decadent plants are present but in amounts considered to be normal for the site under normal disturbances (fire, grazing)	Health and Vigor of desirable species is high. Dead and/or decadent plants greater than what should be found but new recruits are found and new growth and younger plants still exceed that of the dead or dying plants.	Health and Vigor of desirable species is average. Dead and/or decadent plants are in equal proportions to that of the new growth and younger recruits. Plants are showing signs of decreased health and vigor	Health and Vigor of desirable species is poor. Dead and/or decadent plants slightly exceeds that of the new growth and younger recruits. .	Health and Vigor of desirable species is extremely poor. Dead and/or decadent plants are numerous with few if any new recruits (i.e. plant community mostly old, dying plants)
Site Productivity Evaluate overall production for the site relevant to site potential and weather	Production is above expected levels for the site relative to weather.	Production is >75% of expected levels for the site relative to weather.	Production is 50-75% of expected levels for the site relative to weather.	Production is 25-50% of expected levels for the site relative to weather.	Production is <25% of expected levels for the site relative to weather.
Plant Residue and Litter Evaluate the amount of litter and plant residues relative to weather and rate of decomposition	Litter is present and in amounts and coverage (%) expected for the site.	Litter is slightly less than or more than what is expected for the site relative to site potential and weather.	Litter is moderately less than or more than what is expected for the site relative to site potential and weather.	Litter is greatly increased or reduced relative to site potential and weather.	Litter is absent or dominant relative to site potential and weather.

Modified Range Health and Trend Evaluation

Evaluation Criteria	+1	0	-1	-2	-3
Soil Erosion Evaluate water flow patterns, rills, pedestals and terracettes to evaluate existing and potential erosion. For sites with high potential for wind erosion, evaluate scour areas.	Water flow patterns are not visible; no evidence of rills, pedestals or terracettes. Wind: no evidence of scour areas	Water flow patterns are visible in the vegetation but not in the soil. The general flow of the water is distributed evenly over the landscape. May be some evidence of past rills or pedestals, but these are not active and have "healed over". Wind: Minimal evidence, infrequent, small areas	Water flow patterns are visible and beginning to form channels in the soil that are short and stable rather than evenly over the ground; rill formation is beginning to be apparent but not severe and at infrequent intervals, mostly on exposed areas; Slight active pedestalling only in flow paths and occasional terracettes present. Wind: visible evidence and occasional exposed plant roots	Water flow patterns are numerous in the soil surface and occasionally connected. Rill formation is moderately active and well defined throughout most of the area; pedestalling is active and visible in and between flow patterns with occasional exposed roots; terracettes common. Wind: Scour areas common throughout site with exposed roots	Water eroded channels are numerous, extensive and mostly connected throughout. Most channels have signs of headcutting and actively eroding bottom channels. Rill formation is severe and well defined throughout the entire area. Abundant active pedestalling and numerous terracettes. Most rocks and plants are pedestalled Wind: ares are extensive with exposed roots; exposed plant roots are common.
Exposed Soil Evaluate site for amount of soil exposed	Exposed soil is minimal (<5%) to non-existent.	Exposed soil has increased (5-10%) but found in small, isolated patches and not connected.	Exposed soil (10-20%) with areas of moderate size and sporadically connected.	Exposed soil (20-30%) is found in large areas and occasionally connected.	Exposed soil exceeds 30% and are large and generally connected.

TOTAL SCORE	

Score of greater than 5 indicate a positive trend and overall good range health for the site

Score of less than 5 but greater than -4 indicate a trend that is not apparent and fair range health. Management practices that address the lowest scored items can easily improve heath and trend.

Score of -5- to -10 indicates a negative trend and poor range health. Management practices to improve health and reverse trend would be more extensive with more time involved.

Score lower than -10 indicate very poor range health. Management practices to improve health and reverse trend would be more extensive with more time involved.

Appendix B: Grazing Management Plan Guidance

The purpose of a grazing plan is to provide a starting point for management based on average production values. Initially, these values are derived from the NRCS soil survey and provide for a forage animal balance we would expect not to degrade the resource below its production limits during an average year. Annual modifications will typically be needed due to past management, current conditions, and the typical grazing. The need for modifications will be determined from data collected during monitoring.

The production amounts that a grazing plan is based on may be closer to the favorable or unfavorable production estimates dependent on the growing conditions two years before the plan was written, but the hope is that the numbers contained in the plan will fit during an average year. Calculations for initial stocking are based on these estimates and should be adjusted in the future as production becomes more or less favorable. Ultimately, the livestock numbers estimated in the plan will have to be merged with the documentation needed by the Oklahoma Carbon Program to make sure that the management meets program requirements regardless of the estimates contained in the plan.

B.1 Stocking Rates / Forage-Animal Balance

Flexibility and stocking rates is the key to optimizing rangeland management regardless of grazing system. The stocking rate on rangelands is the key to maintaining rangeland resources and success of livestock production. An ideal stocking rate balances the needs of the plants with the needs of the animals. Stocking rates typically are a moving target based on amount of precipitation in any given year. Grazing plans include an estimated stocking rate in an Animal Unit Equivalent (AUE) that was calculated based on the following **items**:

1. The total acres available and the estimated production of those areas matched to a stocking number based on a 1000 lb grazing animal.
2. AUE that the pasture(s) can be expected to provide for continuous stocking.

Note that moving and/or removing livestock in a grazing system should be based on degree of utilization, not calendar days or estimates of herd size or grazing days per pasture. These are only estimates to use as a guide to get started. Recordkeeping and pasture monitoring help track utilization.

B.2 Recordkeeping

The land manager is asked to keep records to track stocking rates and duration by recording how many animals they had within a site and at what dates those animals arrived or were removed. This is necessary to determine if changes to the management plan are needed to meet stocking and production goals. During verification, management records will be examined along with monitoring data to evaluate if the management plan is working, if changes are needed, and if the management was sufficient to meet the expected carbon sequestration rate.

Table B-1. Example of estimated grazeable production and stocking rate prescribed to keep utilization at 50% or below current year's growth (measured near the end of the grazing season)

Crain	PLSS	Acres	Grazeable Production	AUE	Live Weight	Grazing Days
	3-22-22	49.86	31665.7	3.4	3383.1	21.3
	4-22-22	128.4	72235	7.7	7717.5	48.7
	11-22-22	78.8	46190	4.9	4934	31.1
	12-22-22	161.78	96745.2	10.3	10336	65.2
	13-22-22	52.95	29861	3.2	3190.3	20.1
	13-22-22	60.13	35511.1	3.8	3793.9	23.9
	13-22-22	187.68	110046.3	11.8	11757.1	74.1
	22-22-22	52.09	33554.0	3.6	3584.8	22.6
	24-22-22	133.31	78787.6	8.4	8417.5	53.1
Total		905.00	534595.86	57.10	57114.20	360.1

Values for grazeable forage production are taken from the USDA Web Soil Survey based on ecological site descriptions. Where multiple soil types or ecological sites are present within a management unit and constitute multiple forage production values, an average forage production is used.

B.3 Monitoring to Assess Utilization

Visual observations and data collection, referred to as monitoring, are required to help make changes to management or maintain the necessary stocking rates based on utilization amounts. Tracking this information throughout the growing season is ideal for landowners to adjust the grazing plan due to changes in rainfall patterns or extremes in temperatures. Typically stark changes happen over time and early indicators are missed if observations are not made and documented multiple times during the growing season.

Key Grazing Species. Key grazing species are grasses that grazing animals prefer over other species and are a major component of the ecological site. Key Species also exhibit higher rates of carbon storage. Monitoring of Key Species will assist in accurate grazing plans as well as accurately representing the maximum carbon storage available on the site. If these key species are managed for 50% removal, then the rest of the vegetation should have been removed at 50% or less. When desirable species are not available, it may be necessary to manage an undesirable species.

Figure B-1: Example of a grazing exclosure

Choosing Key Grazing Areas. The key grazing areas are chosen as an area that represents grazing over the entire pasture. These areas will be away from heavily or lightly grazed portions of the pasture due to proximity to water, salt, feeding areas, rough terrain, etc. If proper utilization is occurring on the key species within the key area, then proper grazing should be occurring over the entire pasture. These areas can be used to make decisions about the grazing system such as when to move livestock in a rotational system, remove them due to dry conditions, make changes in the grazing system, or to

determine overall utilization at the end of the growing season. These observations are made because OCP promotes above ground biomass for increased C storage.

Grazing Exclosures. The use of key grazing plants and areas should be used in conjunction with grazing exclosures (Figure B-1) so that comparisons can be drawn between grazed and ungrazed plants in the pasture. Locate exclosures within the areas marked on the maps and make sure they contain plants that represent the monitored area as well as the key species plants.

B.4 Annual Adjustments to Monitoring

Adjustments to monitoring may be needed, so the following steps should be taken annually:

Determine if the monitoring areas need to be moved. Monitoring areas may need to be moved on a yearly basis, particularly if grazing animals have milled around and rubbed on the exclosure and created an area of bare soil around the structure.

Evaluate key species to see if they are still acceptable. The amount of each species in the plant community may be different than what was originally inventoried on that site. If there is an increase in a more desirable grass species, then changes should be made accordingly to use that grass as the key species. They may need to be adjusted depending on the treatments that are used within the unit and how the plant community is responding. For example, if an area in a pasture is treated with mechanical brush treatment or a prescribed burn, those areas can be used as the key grazing area to follow responses by grazing animals and the plant communities. If resting a pasture for a growing season is needed, changes to the grazing management plan may be required because feed must still be provided in some form for the animals, and also when grasses are allowed to rest production potential and species compositions may change. Grazing plans include a table showing the available grazing days based on two items:

1. The total acres available and the production of those areas matched to a stocking number based on a 1000 lb grazing animal
2. The number of grazing days each pasture can provide based on this initial stocking number

Note that moving and/or removing livestock in a grazing system should be based on degree of utilization, not calendar days or estimates of herd size or grazing days per pasture. These are only estimates to use as a guide to get started. Recordkeeping and pasture monitoring help track utilization.

Table B-2: Standing Dry Matter estimations for varying forage types

Estimated Available Standing Dry Matter - lbs /acre inch				Grazing Management Guidelines		
Forage Types	% Cover			Begin Graze - In.	Residue Height	Rest Days
	<75%	75-90%	>90%			
Bermudagrass	125 - 225	250 - 375	450-600	4"	2 - 3"	18 - 28
Fescue	75 - 150	175 - 250	300 - 425	6"	3 - 4"	21 - 30
Introduced Mixed Grass / legume	125 - 200	225 - 325	350 - 475	4 - 6"	2 - 4"	20 - 30
Native Range - Mixed Tall / Mid grasses	75 - 125	150 - 225	275 - 400	8 - 12"	4 - 8"	30-90
Introduced Bluestems	100 - 175	200 - 300	325 - 450	4"	2 - 4"	25 - 35

Appendix C: Drought Management Plan Guidance

Recordkeeping and monitoring by land managers can be used to determine when it is time to use a contingency plan. Contingency plans should be made ahead of time in order to deal with a drought, wildfire, or any other unforeseen event that would significantly impact growth and vegetative production.

Contingency planning should provide enough available forage to increase flexibility for altering management plans in response to a shift in biomass production. For example, grass biomass production is closely related to yearly rainfall amounts. Within Oklahoma, rainfall can vary high or low compared with the average rainfall reported, which requires landowners to shift the grazing pressure in accordance with that year's rain. There are alternatives that land managers can use to deal with this, including:

- Supplement grazing animals with hay to offset the loss of grass growth
- Move livestock to other land
- Destock to be able to match grass supply with grazing animal demand
- Stock lighter than recommended by the management plan

[Placeholder for additional information]

Appendix D: Prescribed Fire Burn Plan Guidance

This section gives example forms needed to design and conduct a safe prescribed burn. The fact sheet was created by the Oklahoma State University Extension Service to assist landowners with applying prescribed fires on their property.

Burn Plan for Prescribed Burning

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Oklahoma Cooperative Extension Fact Sheets are also available on our website at:
http://osufacts.okstate.edu

A burn plan helps to determine the safest and easiest way to complete tasks before, during and after a prescribed burn. The most important reason for having a burn plan is to thoroughly think about each action before striking the match. The burn plan will help determine where the burn should be conducted, what type of management is required before burning, how to conduct the burn, when to burn and what should be done after the burn.

A burn plan is a written prescription for the prescribed fire including critical elements such as the weather conditions under which the burn will be conducted, number of personnel and duties of each, and the type, amount and placement of equipment needed to safely conduct the burn. All of this information allows the fireboss to consider all actions prior to the burn, reducing many problems and complications. A burn plan also helps the fireboss consider any social impacts of the burn such as: smoke management concerns, traffic patterns or problems, how to contact neighbors and fire departments, along with other public safety issues. In rural areas many of these issues may not be of concern, but in areas associated with urban sprawl, it can be a major problem. Finally, a well-written burn plan can help reduce liability risk, which is a major concern for most people conducting prescribed burns. A burn plan can be used to show the amount of diligence and care used in planning and conducting the burn if some type of liability issue occurs.

No burn plan is perfect and no two are alike because they are as different as the burn units for which they are written. Each burn plan may require different information or planning, with some requiring more information about a specific topic than others. A burn plan should be written to meet local needs and be adapted to the region. The more experience a person has preparing plans, the easier it will become to write good ones. When preparing a burn plan, it is important not to limit implementation by being too specific with details or prescriptions. For example using weather conditions with a range that is too narrow and cannot be followed for the duration of the burn is not a prescription for success. Be sure to include all necessary information, but do not clutter a plan with pointless information that could cause confusion, or prevent the execution of a burn, and potentially increase liability.

The following instructions on completing a burn plan and the sample burn plan contained in this publication will assist anyone interested in conducting a prescribed burn. This burn plan provides information appropriate for most situations.

Information: Provide basic information about the unit and landowner/manger conducting the burn.

Description of Area to be Burned: Include pasture name, legal description and dominant vegetation type in the burn unit.

Vegetation Present: Describe the main vegetation/fuels present. *Example - Tallgrasses, scatted shrubs with cedars <6 ft tall in the upland and solid stands of cedar >15 ft tall along the creek.*

Directions from Nearest Town: Provide directions to the burn unit. This may be needed in case of an accident or escaped fire. In emergency situations, people often forget things as simple as providing directions to the burn unit. Also, someone not familiar with the area can provide directions from the burn plan to emergency responders.

Objectives: Explain what the burn will accomplish. Objectives can be singular or multiple, along with being broad or very specific. *Examples – Forage production for livestock, wildlife habitat management, cedar control, brush suppression, improve forage quality, hardwood reduction, fuel reduction and wildfire suppression.*

Notification: List the names of fire departments, adjoining landowners, and others that need to be notified prior to conducting the burn. This allows the planner to have all phone numbers in one place for quick reference. It also provides a place for the planner to enter the date, time and person notified, which can be helpful if problems arise or for verification of notification.

Pre-Burn Preparations: Describe what should be done before conducting burn.

Management Needed Prior to Burn: Describe management required to prepare for the burn in order to meet objectives. These practices could include grazing management, mechanical treatments to make the burn safer or more effective, or the protection of specific areas or items.

Firebreak Types and Location Around the Burn Unit: Describe the type of firebreaks used and the location of each around the burn unit. Firebreaks can be disked, dozed, roads, cultivated fields or natural breaks like creeks. *Example- Firebreaks on the west and north side of the burn unit are disked strips 15 feet in width and the east and south firebreaks are comprised of a two-track pasture road.*

For more information about firebreaks see Extension Fact Sheet NREM-2890, *Firebreaks for Prescribed Burning*. (http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-8542/NREM-2890web.pdf)

Fuel Conditions: Record the amount and continuity of fine fuel (herbaceous vegetation) desired for the burn and actual amount in the burn unit on the day of the burn.

Fine Fuel Amounts: Determined by visual estimation or by clipping and weighing samples.

Fuel Continuity: Describes the amount of coverage or distribution of fuels. This is important for fire spread. Many times there may be adequate fuel amounts, but fuel continuity will not allow the fire to spread or carry across the burn unit.

Prescribed Weather Conditions: Define the weather conditions needed to safely and effectively conduct the burn.

Desired Range: Describes ideal weather conditions for the burn.

Maximum Range: Upper and lower weather conditions allowable for the burn. These ranges allow flexibility in order to account for daily weather variation. *Example- Relative humidity desired range 40 percent to 60 percent, maximum range 20 percent to 80 percent.*

For more information about weather conditions for prescribed burning, see Extension Fact Sheet NREM-2878, *Fire Prescriptions for Maintenance and Restoration of Native Plant Communities*.
(http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-2704/NREM-2878web.pdf)

Smoke Management Considerations: Identify and list smoke sensitive areas around the burn unit and with what wind direction and dispersion conditions will be needed to reduce smoke impacts. *Example- Due to road on west side of burn unit and homes to the south of burn unit, a west or southwest wind is needed to reduce smoke impacts.* Attach a smoke dispersion forecast map to the burn plan. Smoke sensitive areas can be roads, communities, airports and houses.

Other Smoke Management Considerations: Category day can be determined from the National Weather Service Fire Weather websites Go to www.weather.gov , select your region from map, then select fire weather).

Dispersion Condition: Information can be found at sites like OK-Fire (http://okfire.mesonet.org/public/?cat=smoke) or Kansas Flint Hills Smoke Management (http://www.ksfire.org). For more information about smoke management see Extension circular E-1008, *Smoke Management for Prescribed Burning*. (http://pods.dasnr.okstate.edu/docushare/dsweb/Get/Document-5672/E-1008%20Smoke%20Management.pdf)

Pre-Burn Checklist: This allows the planner to determine if there are potential problems within or around the burn unit and what could be done to reduce or eliminate them. *Example – Brush piles are present along firebreaks and will be pushed a minimum of 300 feet inside the burn unit.*

Observed Weather: On the day of the burn, record on-site weather conditions before, during and after the burn.

Equipment: List equipment that is needed or might be needed to conduct the burn. It also provides area for recording what was actually on the burn.

Crew Members: List the number of people needed to safely conduct the burn. On the day of the burn, record names of the people comprising the burn crew.

Ignition Plan: Describe the ignition sequence(s) required to ignite the burn safely. This forces the planner to consider in what sequence the burn crew(s) will move around the burn unit igniting the fire and potential problems or hazardous areas that should be addressed. Describe each sequence in writing and draw them on a map of the burn unit. *See sample plan on how to write ignition plan and draw an ignition plan map*.

Go-No Go Check List: List items needed and tasks to be done prior to conducting the burn. The fireboss should review this list prior to conducting the burn to make sure everything is in order.

Escaped Fire Plan: This is a step-by-step action plan describing what should be done if the fire escapes and the proper procedures for controlling an escaped fire.

Signature Box: Signed and dated by the preparer when the plan is finished

Prescribed Burn Notification Form: In Oklahoma, this form should be completed and attached to the burn plan. Doing so may limit liability in the event of an escaped fire. A copy of this form should also be filed with the nearest rural volunteer fire department and if in the forestry protection area, a copy must be provided to the local Forestry Services Division office or representative. This portion of the electronic fire plan version will automatically be filled in with information from the fire plan. The only blank that will need to be filled in is the date of previous burn. For more information see Forestry Services Division publication *"Notification Requirements and Considerations for Safe and Lawful Prescribed Burning in Oklahoma."* (http://www.forestry.ok.gov/Websites/forestry/Images/Burn%20within%20the%20law,%202009%20Update.pdf).

The following sample prescribed burn plan is to show how the burn plan is filled out, along with examples of smoke management, written and mapped ignition plans.

PRESCRIBED BURNING PLAN

Information

Landowner/Lessee Information

Name: OSU Research Range **Phone:** 405.744.5442

Address: 4922 S Coyle Road **County:** Payne

City: Stillwater **State:** OK **Zip:** 74074

Description of Area to be Burned

Pasture Name/Number: Section 17

Vegetation Present:
Tallgrass prairie, scattered oaks and brush, few large cedars

Acres: 160

Legal Description: **Section:** SW/4 17 **Township:** 18N **Range:** 1E

Directions from nearest town:

8 miles W of Stillwater on Hwy 51 to Coyle Rd, then 4.5 miles south, turn east into unit

Range of Projected Burn Dates: 10 Jan-15 May 2014 **Actual Burn Date:** 10 April 2014

Objectives to be Accomplished

Control eastern redcedar, improve livestock forage quality, improve wildlife habitat

Notification

When burning within Forest Protection Areas, Contact Oklahoma Dept. of Ag. Forestry Services:	Location	Phone Number
	n/a	n/a

Fire Departments	Phone Number	Date, Time and Person Notified
Stillwater FD	372.0497	10 April, 8:10 Am FRANK
Coyle VFD	466.3741	10 April, 8:12 Am Brenda
Adjoining Landowners	**Phone Number**	**Date, Time and Person Notified**
J. Smith	555.5555	9 April 7:30pm J. Smith
F. Jones	777.7777	9 April 8:05pm Mrs. Jones
P. Pete	888.8888	10 April 7:45Am P. Pete

Others, as Needed (Sheriff, OHP, DEQ, Utility Companies, Oil and Gas Leases)	Phone Number	Date, Time and Person Notified

Pre-Burn Preparations

– Describe management needed prior to burn in order to successfully accomplish burn and meet objectives.
(Grazing management, fireguard preparation, burning of bush piles; etc.)

Continue grazing with proper stocking rate. Cut down and drag large cedars (>6 ft tall) within 300 ft of North and East sides of burn unit to reduce spotfire potential.

Firebreak Types and Location Around Burn Unit

North and East side-mow 20 ft wide path where possible, inside fence just after grass goes dormant. Then disk a 10' wide firebreak in the mowed path, leaving as much mowed area inside the burn unit to reduce fire intensity when igniting.
South and West sides-use existing county roads

Fuel Conditions

	Desired			Actual (day of burn)		
Fine Fuel Amount	☐ Light	☐ Moderate	✓ Heavy	☐ Light	☐ Moderate	☐ Heavy
Fuel Continuity	✓ Good	☐ Fair	☐ Poor	☐ Good	☐ Fair	☐ Poor

Prescribed Weather Conditions

Prescription	Desired Range	Maximum Range
Temperature (F)	50-80	35-90
Relative Humidity (%)	40-60	30-80
Wind Direction	west or southwest	
Wind Speed (mph)	4-15	4-15

Smoke Management Considerations

Sensitive Areas Identified	Direction from Burn Area	Distance to Area
neighbors houses	north	100 yards to .25 miles
Coyle Road	west	next to unit
Stillwater	northeast	10 miles
highway 51	north	4.5 miles

Other Smoke Management Considerations

Category Day	**Preferred Category Day**	3 or greater	**Actual Category Day (day of burn)**	4
Dispersion Conditions	**Preferred Dispersion Conditions**	moderately good or greater	**Actual Dispersion Conditions (day of burn)**	Good

Attach Smoke Screening Map or Smoke Dispersion Forecast to plan as needed

Attachment A

Pre-Burn Checklist

	Present in burn unit	If Present Action Needed / Recommended	Accomplished
Brush Piles	☐		☐
Pens/Barns	☑	metal corrals in NW corner should not be a problem	☒
Oil/Gas/Pipelines/ Utility Structures	☐		☐
Fences	☑	will burn through fences on South and West sides not a problem	☒
Homes/Cabins	☐		☐
Windmills/Watering Facilities	☐		☐
Feeding Facilities/Hay Storage	☐		☐
Equipment/Vehicles	☐		☐
Wildlife Habitat Areas	☐		☐
phone junction box	☑	located at SW corner of burn unit, weedeat around junction box to remove fuel and wet it down prior to burning	☒
	☐		☐
	☐		☐

Observed Weather

For Pre & Post-Burn Weather Monitor Available Weather Sources

Burn Site Observed Weather Conditions

Observation Time	9:05 Am	9:45 Am	10:30 Am	11:15 Am
Temperature	51	55	59	64
Relative Humidity	62%	51%	45%	40%
Wind Direction	SW	WSW	SW	SW
Wind Speed	6-8	8-9	8-9	9-10

ATTACH COPY OF OK-FIRE PRESCRIPTION PLANNER AND OR WEATHER FORECAST

Equipment	Desired on burn	Number Available at Burn	Comments/Other Considerations
Drip Torch/Ignition Device	✓	4	
Matches\Lighter	✓		
Shovel			
Rake	✓	2	
Backpack pump	✓	1	
Flapper/Swatter	✓	1	
Chainsaw			
Leaf Blower	✓	1	
Pumper Units/Sprayers	✓	2	will have 1 200 gallon unit and 1 300 gallon unit mounted on trucks
ATV Sprayers			
ATV/4-Wheelers			
Utility Vehicle (UTV)	✓	2	these have 55 gallon sprayers on them
Torch Fuel	✓	5 gallon	
Pump Fuel	✓	2 gallon	
2-Cycle Fuel	✓	1 gallon	
Weather Instrument/Kit	✓	1	
Two-Way Radios	✓	6	if not enough radios for entire crew, radios will be spread out along fireline to facilitate communication
Cell Phone	✓	1	
Drinking water	✓	5 gallon	
Fence Pliers/Bolt Cutters	✓	4	should have 1 pair in each vehicle/UTV
Road Signs	✓	2	place on Coyle Road N and S of unit
Stop/Go Signs	✓	2	have in case issue arises that we need to control traffic on Coyle Road
NOAA Radio			

Crew Members

Crew Members Present	
T. Bidwell	
D. Scasta	
R. Stevens	
J. Weir	
D. Elmore	
M. Porter	
G. Strasbury	
A. Gourley	

Ignition Plan

Draw and write ignition plan and add as attachment to fire plan — Attachment B & C

Go-No Go Check List

If answer to any is NO, do not burn until corrected

Firebreaks prepared	Yes ☒	No ☐	Adequate crew available	Yes ☒	No ☐
Neighbors contacted	Yes ☒	No ☐	Smoke management goals within prescription	Yes ☒	No ☐
Fire departments contacted	Yes ☒	No ☐	Crew briefed on plan and safety hazards	Yes ☒	No ☐
Weather conditions within prescription	Yes ☒	No ☐	Can burn objectives be met	Yes ☒	No ☐
Equipment ready	Yes ☒	No ☐	All hazards in unit identified	Yes ☒	No ☐

Escaped Fire Plan

1. If fire escapes all ignition stops until escape is contained, unless needed to control the fire
2. Use standard fire suppression methods to control escaped fire
3. If fire cannot be contained by standard methods other tactics will be used (i.e. backfires)
4. If other methods do not work or are not practical fire boss or designated person will call for assistance

This Prescribed Burn plan was prepared by:	
Name: John Weir	Date: 15 Dec 2013

The prescribed burn described below is to be conducted according to the information provided here and the Oklahoma forestry code (title 2, sections 16-28 and 16-28.2 of the state statutes). File the original copy of the notification plan with the local rural fire department, and keep a copy for your records. Inside the designated forest protection area in eastern Oklahoma (refer to list of forestry offices), also provide a copy to the forestry division representative.

Prescribed Burning Notification Plan

Name: OSU Research Range — Telephone: 405.744.5442

Address: 4922 S Coyle Road — County: Payne

City, State, Zip Code: Stillwater OK 74074

Ranch Name (if any):

Description of area to be burned: SW/4 17 18N 1E

Approximate acres to be burned: 160

Written description of location: 8 miles W of Stillwater on Hwy 51 to Coyle Rd, then 4.5 miles south, turn east into unit

Projected time frame:
10 Jan-15 May 2014

Date of previous burn: March 2012

Objectives to be accomplished through the prescribed burn:
Control eastern redcedar, improve livestock forage quality, improve wildlife habitat

Contact information:

Rural Fire Department Name	Location	Phone No.
Stillwater FD		372.0497
Coyle VFD		466.3741

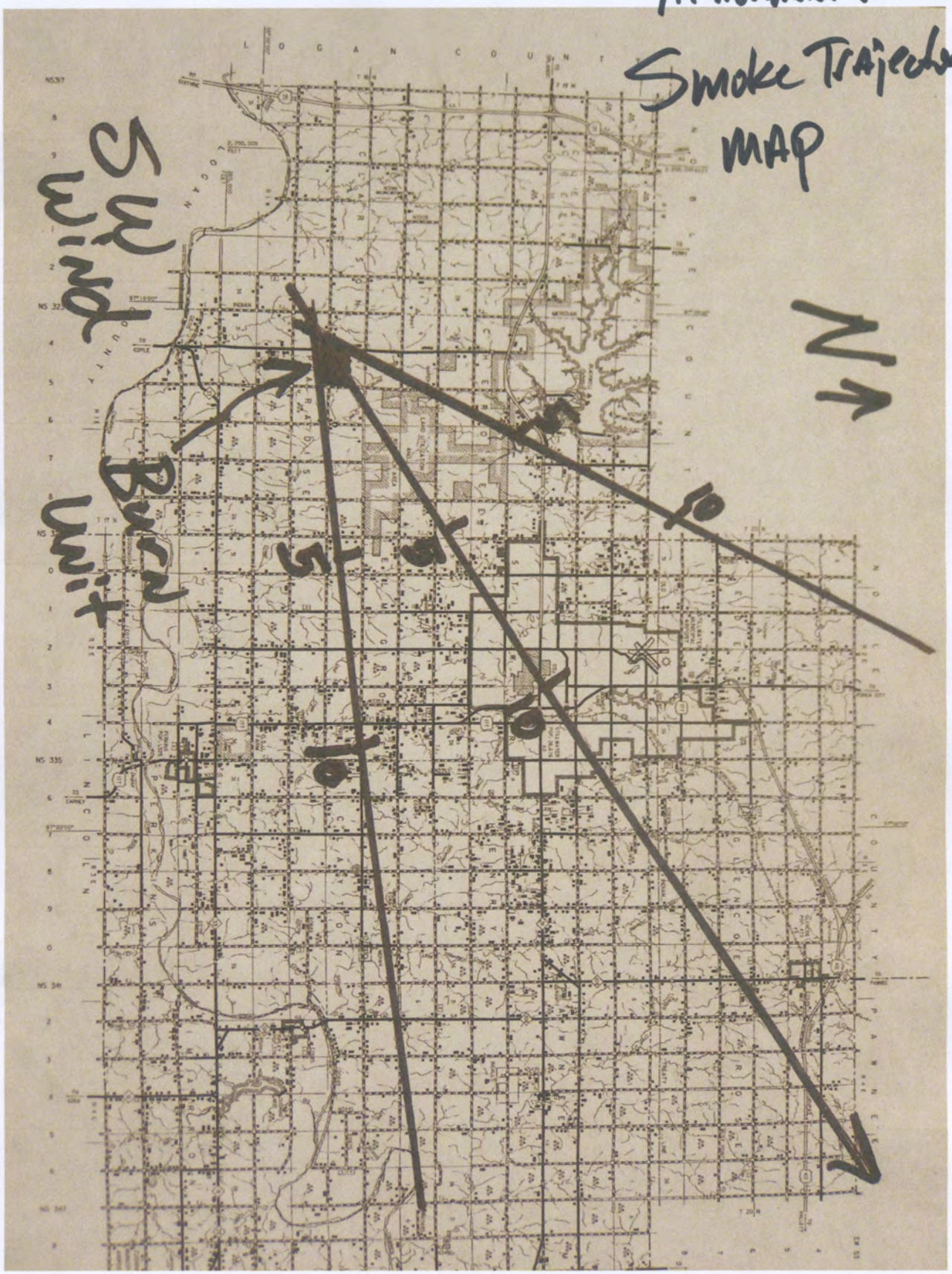
Forestry Division Office (for protection areas):
n/a n/a

Adjoining landowners:

J. Smith	555.5555
F. Jones	777.7777
P. Pete	888.8888

Attachment A

Smoke Trajectory MAP



Attachment B

With a southwest wind ignition will start in the northeast corner at point A (see attachment C). Crew will be divided into two groups, crew 1 (east) and crew 2 (west). Equipment will be divided between both groups with 1 UTV and the 200 gallon pumper going with Crew 1 since that firebreak is rough and harder to traverse. The 300 gallon pumper and other UTV will go along the north line. Ignition will consist of strip heaffires using a minimum of 2 torches starting at Point A with Crew 1 going south along the east line stopping at Point B and Crew 2 going west along the north line stopping at Point C. A blackened area of 300 ft wide minimum will need to be established before either Crew can proceed. The UTV's will patrol their respective lines, while the pumpers will be positioned in problem areas and moved as needed. Once adequate black is established one torch from each crew will begin igniting the headfire and meet at Point D. While the headfire is being ignited equipment and crew will continue to monitor the east and north lines. Equipment will be moved to the west and south lines as needed. Crew 2 should take extra caution along the west side due to traffic on Coyle Road.

Attachment C

PRESCRIBED BURNING PLAN

Information

Landowner/Lessee Information			
Name:		Phone:	
Address:		County:	
City:		State:	Zip:

Description of Area to be Burned			
Pasture Name/Number:			
Vegetation Present:			Acres:
Legal Description:	Section:	Township:	Range:
Directions from nearest town:			
Range of Projected Burn Dates:		Actual Burn Date:	
Objectives to be Accomplished			

Notification

When burning within Forest Protection Areas, Contact Oklahoma Dept. of Ag. Forestry Services:	Location	Phone Number

Fire Departments	Phone Number	Date, Time and Person Notified
Adjoining Landowners	**Phone Number**	**Date, Time and Person Notified**
Others, as Needed (Sheriff, OHP, DEQ, Utility Companies, Oil and Gas Leases)	**Phone Number**	**Date, Time and Person Notified**

Pre-Burn Preparations

– Describe management needed prior to burn in order to successfully accomplish burn and meet objectives.
(Grazing management, fireguard preparation, burning of bush piles; etc.)

Firebreak Types and Location Around Burn Unit

Fuel Conditions

	Desired	Actual (day of burn)
Fine Fuel Amount	☐ Light ☐ Moderate ☐ Heavy	☐ Light ☐ Moderate ☐ Heavy
Fuel Continuity	☐ Good ☐ Fair ☐ Poor	☐ Good ☐ Fair ☐ Poor

Prescribed Weather Conditions

Prescription	Desired Range	Maximum Range
Temperature (F)		
Relative Humidity (%)		
Wind Direction		
Wind Speed (mph)		

Smoke Management Considerations

Sensitive Areas Identified	Direction from Burn Area	Distance to Area

Other Smoke Management Considerations

Category Day	**Preferred Category Day**		**Actual Category Day (day of burn)**	
Dispersion Conditions	**Preferred Dispersion Conditions**		**Actual Dispersion Conditions (day of burn)**	

Attach Smoke Screening Map or Smoke Dispersion Forecast to plan as needed

Pre-Burn Checklist

	Present in burn unit	If Present Action Needed / Recommended	Accomplished
Brush Piles	☐		☐
Pens/Barns	☐		☐
Oil/Gas/Pipelines/ Utility Structures	☐		☐
Fences	☐		☐
Homes/Cabins	☐		☐
Windmills/Watering Facilities	☐		☐
Feeding Facilities/Hay Storage	☐		☐
Equipment/Vehicles	☐		☐
Wildlife Habitat Areas	☐		☐
	☐		☐
	☐		☐
	☐		☐

Observed Weather

For Pre & Post-Burn Weather Monitor Available Weather Sources

Burn Site Observed Weather Conditions

Observation Time				
Temperature				
Relative Humidity				
Wind Direction				
Wind Speed				

ATTACH COPY OF OK-FIRE PRESCRIPTION PLANNER AND OR WEATHER FORECAST

Equipment	Desired on burn	Number Available at Burn	Comments/Other Considerations
Drip Torch/Ignition Device	☐		
Matches\Lighter	☐		
Shovel	☐		
Rake	☐		
Backpack pump	☐		
Flapper/Swatter	☐		
Chainsaw	☐		
Leaf Blower	☐		
Pumper Units/Sprayers	☐		
ATV Sprayers	☐		
ATV/4-Wheelers	☐		
Utility Vehicle (UTV)	☐		
Torch Fuel	☐		
Pump Fuel	☐		
2-Cycle Fuel	☐		
Weather Instrument/Kit	☐		
Two-Way Radios	☐		
Cell Phone	☐		
Drinking water	☐		
Fence Pliers/Bolt Cutters	☐		
Road Signs	☐		
Stop/Go Signs	☐		
NOAA Radio	☐		
	☐		
	☐		
	☐		
	☐		
	☐		
	☐		

Crew Members

Crew Members Present	

Ignition Plan

Draw and write ignition plan and add as attachment to fire plan

Go-No Go Check List If answer to any is NO, do not burn until corrected

Firebreaks prepared	Yes ☐ No ☐	Adequate crew available	Yes ☐ No ☐
Neighbors contacted	Yes ☐ No ☐	Smoke management goals within prescription	Yes ☐ No ☐
Fire departments contacted	Yes ☐ No ☐	Crew briefed on plan and safety hazards	Yes ☐ No ☐
Weather conditions within prescription	Yes ☐ No ☐	Can burn objectives be met	Yes ☐ No ☐
Equipment ready	Yes ☐ No ☐	All hazards in unit identified	Yes ☐ No ☐

Escaped Fire Plan

1. If fire escapes all ignition stops until escape is contained, unless needed to control the fire
2. Use standard fire suppression methods to control escaped fire
3. If fire cannot be contained by standard methods other tactics will be used (i.e. backfires)
4. If other methods do not work or are not practical fire boss or designated person will call for assistance

This Prescribed Burn plan was prepared by:	
Name:	Date:

The prescribed burn described below is to be conducted according to the information provided here and the Oklahoma forestry code (title 2, sections 16-28 and 16-28.2 of the state statutes). File the original copy of the notification plan with the local rural fire department, and keep a copy for your records. Inside the designated forest protection area in eastern Oklahoma (refer to list of forestry offices), also provide a copy to the forestry division representative.

Prescribed Burning Notification Plan

Name:	Telephone:
Address:	County:
City, State, Zip Code:	
Ranch Name (if any):	

Description of area to be burned:

Approximate acres to be burned:

Written description of location:

Projected time frame:

Date of previous burn:

Objectives to be accomplished through the prescribed burn:

Contact information:

Rural Fire Department Name	Location	Phone No.

Forestry Division Office (for protection areas):

Adjoining landowners:

The Oklahoma Cooperative Extension Service
Bringing the University to You!

The Cooperative Extension Service is the largest, most successful informal educational organization in the world. It is a nationwide system funded and guided by a partnership of federal, state, and local governments that delivers information to help people help themselves through the land-grant university system.

Extension carries out programs in the broad categories of agriculture, natural resources and environment; family and consumer sciences; 4-H and other youth; and community resource development. Extension staff members live and work among the people they serve to help stimulate and educate Americans to plan ahead and cope with their problems.

Some characteristics of the Cooperative Extension system are:

- The federal, state, and local governments cooperatively share in its financial support and program direction.
- It is administered by the land-grant university as designated by the state legislature through an Extension director.
- Extension programs are nonpolitical, objective, and research-based information.
- It provides practical, problem-oriented education for people of all ages. It is designated to take the knowledge of the university to those persons who do not or cannot participate in the formal classroom instruction of the university.
- It utilizes research from university, government, and other sources to help people make their own decisions.
- More than a million volunteers help multiply the impact of the Extension professional staff.
- It dispenses no funds to the public.
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Appendix E: Brush Management Plan Guidance

Brush management plans are required if the landowner wishes to remove woody species from the rangeland under carbon contract. The disturbance created by common brush removal practices, such as slash & burn, dozing, and cutting, could increase soil degradation and decrease carbon storage.

To assist landowners in meeting these requirements, the carbon program recommends land managers have an Integrated Brush Management Strategy (IBMS), which is a long-term planning process that focuses on management of rangelands for multiple uses rather than solely livestock production. IBMS can help land managers address the cause of a woody encroachment through adjustments in the rangeland management plan.

IBMS identifies management goals and objectives, which are refined to a comprehensive inventory of ecosystem components, and suggests the best combination of techniques and timing of these techniques to minimize negative impacts on the ecological site while maximizing woody plant control. This approach encourages land managers to consider the type and timing of a given brush management and the follow-up treatments. Short, medium and long-term goals should be outlined in these brush management plans (Archer, Boutton, and Hibbard 2001).

Brush removal includes invasive or noxious species in Oklahoma including *Juniperus virginiana, Lespedeza cuneata, Tamarix spp., Ligustrum sinense,* and *Ulmus pumila*.

Baseline inventories should be recorded to better guide drafting of brush management plans. Variables to observe include:

- Shrub average age, height and stem density
- Plant composition and frequency of occurrence
- Ground cover
- Biomass
- Weather and seasonal growth patterns
- Grazing management
- Soil characteristics and ecological site descriptions

[PLACEHOLDER for more information]

Appendix F: Wildlife Management Plan Guidance

[PLACEHOLDER]

Appendix G: Progressive Management Crediting Matrix

Improved Rangeland Management Progressive Management Crediting Matrix

Mgmt Level	1	2	3	4	5
Soil Health & GHG Seq Mgmt	◦ Grazing plan created and implemented ◦ Maintains written logs that document forage-animal balance, grazing schedule with stocking rates, with any use of the contingency plan. ◦	◦ Drought plan in place and used when needed ◦ Approved prescribed burn plan in place. ◦ Brush management plan in place ◦ Hay harvested no more than once yearly before July 15 to height at least 4" ◦ Harvest deferment occurs for up to 2 years when precipitation is <60% of local avg annual rainfall during preceding 12 mos.	◦ Vegetation and residue covering >60% of soil surface ◦ Range Health -10 to -5 ◦ Soil disturbance during brush removal less than 50% and not accelerating erosion ◦ Plant species observed in 1m by 1m quadrats 35-59% of ecological site ◦ Refrains from herbicide application unless prescribed ◦	◦ Key species average height taller than 6 inches (as listed in ecological site descriptions from NRCS) ◦ Actively controls woody encroachment* ◦ Utilizes exclosures to monitor growth of key species ◦ Prescribed fire applied in accordance with historic frequency and approved plan ◦ Plant species observed in 1m by 1m quadrats 60-74% of ecological site ◦ Range Health -4 to 5	◦ Grazing on clay soils Light in wet years ◦ Grazing on sandy soils Light in dry years ◦ Range Health 5+ ◦ Plant species observed in 1m by 1m quadrats represent >75% of ecological site
Nutrient Mgmt & Avoided Emissions	◦ Soil test annually on hayed lands	◦ Fertilizer application does not occur except on hayed lands and then when based on soil test results and nutrient removal calculations	◦ Brush removal via chemical or mechanical techniques occurs on less than 10% of the acreage.	◦ Supplemental feeding of cattle does not occur ◦	◦ Range Health 5+ ◦
Wildlife Mgmt	◦ Grazing plan created and implemented ◦	◦ Creates and implements wildlife management plan ◦	◦ Implements contingencies for improving wildlife habitat. ◦ Refrains from herbicide application ◦ Water sources available for wildlife use ◦ Refrains from haying until after July 1 and no shorter than 10 inches	◦ Grazing, fire and/or haying disturbance managed strategically to create a variety of vegetative cover ◦ Range Health -4 to 5 ◦	◦ Range Health 5+ ◦ Plant diversity >30 species in a 1m by 1m quadrat ◦ Water sources exist with native wetland species present ◦
Water Quality Mgmt	◦ Grazing plan created and implemented	◦ Plant base pedestalling < 10 mm high ◦	◦ Livestock excluded from buffer or only flash grazing ◦ Fire return interval 3+ years ◦ Refrains from herbicide application.	◦ Livestock excluded from stream or drawn away using fire ◦ Plant base pedestalling < 5mm high, ◦ Range Health -4 to 5	◦ Exposed soil is <5% ◦ No evidence of rill, pedestals or terracettes