Oklahoma Carbon Program

Methodology: Assessing No-Till Fields to Estimate GHG Storage and Other Ecosystem Service Benefits

v.2013
Acknowledgements

This material is based upon work supported by the Natural Resources Conservation Service, U.S. Department of Agriculture, under #69-3A75-10-167 from the FY2010 Conservation Innovation Grant. Support was also provided by Touchstone Energy via Western Farmers Electric Cooperative, Oklahoma State University, Oklahoma Association of Conservation Districts, and participating conservation districts, and grant funds from the U.S. Environmental Protection Agency. Special thanks to John Mustain, Oklahoma NRCS Crop Specialist, for his technical and training assistance.

Any options, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.

Direct questions or comments to:

Oklahoma Carbon Program
Oklahoma Conservation Commission
2800 N. Lincoln Boulevard, Suite 160
Oklahoma City, Oklahoma  73105   USA
Ph: 405.522.4739
Email: stacy.hansen@conservation.ok.gov

This publication is issued by the Oklahoma Conservation Commission as authorized by Mike Thralls, Executive Director. Copies have not been printed but are available through the agency website. Two printout copies have been deposited with the Publications Clearinghouse of the Oklahoma State Department of Libraries. All programs and services of the Oklahoma Conservation Commission and Oklahoma’s Conservation Districts are offered on a nondiscriminatory basis without regard to race, color, national origin, religion, age, gender, marital status or disability. 2013.12/SH
# Table of Contents

1.0 About the Oklahoma Carbon Program ................................................................. 5  
   1.1 Authority ........................................................................................................ 5  
   1.2 Description .................................................................................................... 5  
   1.3 Objectives ...................................................................................................... 5  

2.0 About This Document .......................................................................................... 5

3.0 Applicability ...................................................................................................... 5

4.0 Project Requirements .......................................................................................... 6  
   4.1 Aggregation ................................................................................................... 6  
   4.2 Project Eligibility Criteria ............................................................................ 6  

5.0 Continuous No-Till Management Standard ....................................................... 7  
   5.1 Eligibility ...................................................................................................... 8  
   5.2 Restrictions ................................................................................................... 8  
   5.3 Requirements ............................................................................................... 8  

6.0 Continuous No-Till Performance Standard - Rationale ...................................... 9  
   6.1 No-Till is an Uncommon Practice in Oklahoma ............................................ 9  
   6.2 Cover Crops Result in Higher Soil Carbon Sequestration ......................... 9  
   6.3 Partial Grazing Does Not Significantly Impact GHG Sequestration .......... 10  
   6.4 Biomass Removal by Haying, Grazing Impacts GHG Sequestration .......... 11  
   6.5 Burning Negatively Impacts Carbon Sequestration ................................. 11  
   6.6 Fallowing Limits Carbon Sequestration .................................................... 11  
   6.7 Irrigated Cropland Sequesters GHG at a Higher Rate than Non-Irrigated ... 12  
   6.8 Strip-Till has a Positive Soil Condition Index ............................................. 13

7.0 Applications for Verification ............................................................................... 13
   7.1 Screening ...................................................................................................... 14  
   7.2 Field Information Sheet ............................................................................... 14  
   7.3 Selecting Fields for Verification ................................................................ 14  
   7.4 Contacting the Field Verifier ...................................................................... 14  

8.0 Preparing for Field Visits .................................................................................. 14
   8.1 Gathering and Reviewing Information ....................................................... 15  
   8.2 Contacting the Producer ......................................................................... 15  
   8.3 Planning Travel .......................................................................................... 15

9.0 Monitoring ......................................................................................................... 15
   9.1 Timing ......................................................................................................... 15  
   9.2 Frequency .................................................................................................. 15  
   9.3 Field Forms ............................................................................................... 15

10.0 Methods ............................................................................................................ 16
   10.1 Continuous No-Till Field Data Collection .............................................. 16  
   10.2 Field Form Completion ............................................................................ 23

11.0 Data Management ............................................................................................ 23
   11.1 Unit of Measure ....................................................................................... 24  
   11.2 Conservativeness ..................................................................................... 24  
   11.3 Uncertainty, Accuracy, and Precision .................................................... 24  
   11.4 Reporting ................................................................................................ 24  
   11.5 Data Quality ........................................................................................... 24  
   11.6 Confidentiality ......................................................................................... 24  
   11.7 Baseline Estimation .............................................................................. 24  
   11.8 Quantifying Reversals ............................................................................ 24  
   11.9 Assessing Leakage ................................................................................... 24
11.10 Quantifying Emission Reductions .................................................................................................. 24
11.11 Quantifying Project Emissions .................................................................................................. 25
12.0 Verification Audit ..................................................................................................................... 25
13.0 Reporting ..................................................................................................................................... 26
14.0 Works Cited ............................................................................................................................... 28
15.0 Resources ..................................................................................................................................... 26
Appendix A: Field Forms .................................................................................................................. 30
Appendix B: Progressive Management Crediting Matrix .................................................................... 29

List of Figures
Figure 1: How to walk a transect ........................................................................................................ 16
Figure 2: Good residue and stubble, evidence of planting, but no green growing crop ................. 17
Figure 3: Aerial view map showing evidence of center pivot irrigation ........................................ 18
Figure 4: Close-up picture allowing for identification of crop and residue type by desk auditor. .... 18
Figure 5: Example of correctly taken field photos .......................................................................... 19
Figure 6: Fields with evenly distributed residue ............................................................................. 19
Figure 7: Residue will be sparser in some fields, but still evenly distributed. ................................. 20
Figure 8: Green growing crop with residue of previous crop absent; both fields were tilled. ............ 20
Figure 9: Green growing crop with residue present ......................................................................... 21
Figure 10: Winter wheat field in the process of being grazed out .................................................. 22
Figure 11: Grazed out winter wheat with cow presence evident (left). Winter wheat of same age that will be harvested (right) ................................................................. 22
Figure 12: No-till cropland with fallow evident due to presence of grazed annual grass cover ........ 23
Figure 13: Example of field transects drawn on a map. ................................................................. 23

List of Tables
Table 1: Project eligibility criteria ....................................................................................................... 6
Table 2: Example producer field information sheet for verifier ....................................................... 14
Table 3: Sequestration rate of Oklahoma no-till fields ...................................................................... 25
Table 4: GHG Sources and sinks of no-till fields ............................................................................. 25
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 Oklahoma Carbon offsets and avoided emissions from agriculture, forestry, and geologic sequestration. OCP provides project verification to aggregators and buyers of carbon offsets. The purpose of the OCP is to improve soil, water, and air quality by encouraging Oklahomans to voluntarily implement practices that sequester greenhouse gases. 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 provides an opportunity for agriculture land managers to benefit from the greenhouse gas storage that results from no-till agriculture in Oklahoma. It was developed to train approved verifiers to collect management data used by OCP to quantify GHG sequestration and carbon offset benefits. The OCP uses the data to assess and quantify greenhouse gas storage potential, and other ecosystem service benefits of participating acres, as applicable. While full-scale verification (100% of acres in a project) is typically not financially feasible for a project, methods included here may be used at any scale as a stand-alone verification or for ground-truthing to confirm modeling results.

3.0 Applicability
This methodology is intended for use by trained professionals with significant experience and background in agriculture. It applies to fields designated as “cropland” by FSA that were converted from
conventional tillage to continuous no-tillage management on or after January 1, 2001, and are under carbon contract with an aggregator whose project meets eligibility criteria listed in Section 4.2.

4.0 Project Requirements

4.1 Aggregation
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>
<thead>
<tr>
<th>Table 1. Project Eligibility Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Criteria</strong></td>
</tr>
<tr>
<td>Additionality</td>
</tr>
<tr>
<td>Community and Environmental Impacts</td>
</tr>
<tr>
<td>Duration</td>
</tr>
<tr>
<td>Emissions</td>
</tr>
<tr>
<td>Criteria</td>
</tr>
<tr>
<td>--------------------------</td>
</tr>
<tr>
<td>Frequency of Verification</td>
</tr>
<tr>
<td>Geographic Boundary</td>
</tr>
<tr>
<td>Information Management</td>
</tr>
<tr>
<td>Location</td>
</tr>
<tr>
<td>Ownership</td>
</tr>
<tr>
<td>Permanence</td>
</tr>
<tr>
<td>Resource Management Plan</td>
</tr>
<tr>
<td>Temporal Boundary</td>
</tr>
</tbody>
</table>

**5.0 Continuous No-Till Management Standard**

The eligibility, management, and recordkeeping requirements together are referred to as the no-till management performance standard. The standard is a reference for no-till cropland managers, project proponents, and offset credit buyers seeking certification of carbon offsets through the Oklahoma Carbon Program.
Carbon Program. It is based on the premise that tilled cropland is a source of GHG and leads to surface erosion, decreased organic matter, decreased water infiltration, and less wildlife habitat than tilled cropland, and that when biomass is managed there are broad ecosystem service benefits gained. To accommodate varying levels of management and project budgets, the management standard is divided into 5 tiers.

The management standard is a critical informational and motivational tool for producers, which clearly lays out levels of basic to advanced management. It 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. For example, stopping tillage has immediate, quantifiable, ecosystem benefits, but not as many benefits as stopping tillage, using cover crops, using precision application for fertilizer application, avoiding herbicide use, and establishing filter strips along a stream. The Ecosystem Services Progressive Management Crediting Matrix (Appendix B) lets carbon offset project proponents and credit buyers decide the price and level of management effort that they can afford, while still allowing producers to have an incentive, benefit, and clear goals for stepping up their management. The no-till performance standard below lists the level 1 eligibility and management requirements for participating fields.

5.1 Eligibility
To be considered for verification, lands must meet the definition of continuous no-till and be under carbon contract. Land must not otherwise be disqualified by the restrictions in section 5.2.

“Continuous No-Till,” according to NRCS, is defined as managing the amount, orientation and distribution of crop and other plant residue on the soil surface year round while limiting soil-disturbing activities to only those necessary to place nutrients, condition residue, and plant crops (NRCS).

5.2 Restrictions
Tillage with full width tillage implements may not occur. This includes equipment such as chisels, cultivators, disks, harrows, plows, rotary hoes, sweeps, or any combination. Fields found to be out of compliance will not be certified for payment.

5.3 Requirements
Fields may not be tilled and must be managed with low soil disturbance instruments, such as no-till planter, no-till drill, strip-till implement, subsoil ripper with at least 24-inch shank spacing, anhydrous ammonia applicator, or low disturbance liquid manure injectors. Additional level 1 requirements must be observable during field verification as follows:

5.3.1 Biomass Management

- **Growing crop** is present in the field.
- **Residue** from previous crop is present and evenly distributed.
- **Anchored stalks** from previous crop are visible.
- **Cover crops** follow continuous cotton, soybeans, and legumes (i.e., beans, peas, lentils, etc.) in order to meet residue requirements.
- **Burning of residue/stubble** does not occur.
6.0 Continuous No-Till Performance Standard - Rationale

Primary carbon sequestration occurs in fields managed with no-till due to the discontinuation of tillage, which slows the oxygenation of soil and the breakdown of organic matter. However, this protocol also assesses crop rotation, residue management, and the use of cover crops as an additional resource to assess and potentially credit secondary carbon sequestration.

The management restrictions and requirements in the no-till 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, strip-till, haying, fallowing, biomass removal, and burning. Each section title states the premise on which the management requirement is based and is accompanied by an explanation.

6.1 No-Till is an Uncommon Practice in Oklahoma

The OCP considers no-till to be an uncommon practice in Oklahoma and therefore does verify no-till fields for carbon offset payments. According to the CTIC as cited in Vitale et al. 2011, no-till is an uncommon practice in Oklahoma, which ranks 35th out of 50 US states in conservation tillage use with 20.8 percent of cropped area under conservation tillage, and 32nd in no-till use with 10.1 percent of cropped area under no-till. In Oklahoma, winter wheat is the primary annual crop, accounting for nearly 80 percent of the acres seeded to annual crops (Vitale et al. 2011). The wheat monoculture appears to be a constraint to the adoption of no-till because of weed and insect pressure and a lack of an economically viable crop rotation system (Vitale et al. 2011).

6.2 Cover Crops Result in Higher Soil Carbon Sequestration

The use of cover crops has the potential to mitigate the deleterious effects of fallow periods, residue removal, or low-residue crop rotations (e.g., continuous cotton, soybeans, legumes, and sunflowers) as it relates to SOC sequestration. Numerous research studies across the U.S. with all types of cropping systems have shown the beneficial use of cover crops on soil properties.

Blanco-Canqui et al., 2013, examined the effects of three cover crops; triticale, lentil and peas in a continuous wheat and a wheat-fallow rotation in southwest Kansas. They found after 5 years that the use of cover crops triticale and lentil significantly increased the SOC pool as compared with fallow and that triticale haying compared with no haying did not affect soil properties. This research also showed, though, that nine months after termination of the cover crops, that the cover crops had no effect on soil
properties, demonstrating that they must be continued in this semiarid climate to achieve long-term benefits.

In a 15-year study of a conservation and no-till winter wheat-grain sorghum crop rotation in south-central Kansas, Blanco-Canqui et al., 2011, found the use of hairy vetch as a winter cover crop or sun hemp or late-maturing soybeans as a summer cover crop resulted in higher SOC concentrations than the no cover crop rotations, especially in the 0-7.5 cm depth.

In no-till cotton-sorghum rotation plots in Georgia, Sainju et al. 2006, found that the inclusion of winter cover crops, vetch and rye, resulted in SOC sequestration as compared to winter weeds, which caused SOC depletion in the no-till plots. Similarly, Locke et al., 2012, found that the inclusion of rye or clover cover crops in cotton production near Stoneville, Mississippi, accumulated more soil C than no cover crops regardless of tillage.

In a literature review of 20 studies of cotton production systems in the southeastern U.S., Causarano et al., 2006, found that SOC sequestration with adoption of conservation tillage compared with conventional tillage was greater with than without a cover crop. They found that the data indicated that a cover crop in a conservation tillage system can essentially double the C sequestration benefit from that expected using conservation tillage alone.

### 6.3 Partial Grazing Does Not Significantly Impact GHG Sequestration

The OCP does not restrict partial grazing of winter wheat. It is assumed that if wheat is harvested then the grazing did not diminish yield to the point of impacting GHG sequestration. If yield was not affected by grazing, then it is assumed that the residue has not been reduced.

Any time residue is removed from an annual cropping system; there is less of an opportunity to sequester soil carbon. The ability to sequester soil carbon will be a function of the type (e.g. burning, haying, grazing), intensity, and frequency of residue removal. As reported by Hossain and cited by Vitale et al. 2007, nearly two-thirds of Oklahoma’s producers are engaged in mixed crop-livestock systems. Much of this wheat is managed as dual purpose. Edwards et al. 2007 cited by Vitale et al. in 2011 explain that “Dual-purpose wheat is planted in the late summer, grazed in the fall and winter, and livestock are removed prior to the development of the first hollow stem to enable grain development and subsequent harvest in June.”

Research in Oklahoma by Krenzer and Horn 1997 has shown that removing cattle from wheat pasture one to eight weeks prior to first hollow stem had no effect on grain yield. This was true regardless of the year or yield level. This is relevant to carbon sequestration because, depending on when livestock are removed, the amount of residue can be affected.

In Oklahoma, winter wheat is typically planted in mid-October and harvested in mid-June. “Edwards [Edwards et al. 2011] found that grazing usually decreases grain yield by 7% and early planting decreases grain yield by 7%. Early planting decreased grain yield because the wheat used more water in the fall. Because Oklahoma winters are generally dry, in March when the wheat comes out of dormancy, it tends to be more water stressed and therefore does not produce as much grain but could actually have grown more roots and aboveground biomass. Therefore, early planting would not decrease carbon input to the system, it just limits grain production. In some cases it could cause a greater input of carbon than wheat grain yields would indicate. This is true if the additional water stress is experienced after flowering, which decreases grain fill but doesn’t decrease the production of straw. I suspect that over time the planting date would have a very small if any impact on carbon sequestration because it has more of an
impact on grain yield than on total biomass produced. This likely has little impact on carbon sequestration because of greater growth in the fall. These findings by Edwards likely don’t significantly impact carbon sequestration as they are likely the result of alterations in the soil moisture after animals are removed more so than affecting carbon input into the system” (Warren 2013, pers. comm.).

6.4 Biomass Removal by Haying, Grazing Impacts GHG Sequestration
The OCP imposes an eligibility restriction on the use of “graze-out” wheat. When livestock are allowed to graze winter wheat beyond mid-March without the crop harvested for grain, this is called “graze-out.” Because graze-out reduces the amount of residue that would be left in the field compared to harvest, OCP only certifies fields for carbon credit if graze out occurs only one in 3 years, and then only if it is immediately followed by a high residue, warm season crop (sorghum, corn, etc.) or cover crop. There is scant research on the effects of graze-out on carbon sequestration. The OCP restricts the practice on the assumption that it reduces carbon sequestration because it results in lower carbon inputs from residue and there is a lack of data to dispute this assumption.

The OCP requires residue removal from haying or baling to no more than once in 3 years and when residue removal occurs, it must be followed by a cover crop. Removing some or all crop residues from a field can have negative consequences for SOC sequestration for two reasons: (1) it reduces the amount of plant residue that can subsequently be transformed into SOC and (2) it can make the soil surface more vulnerable to water or wind erosion thereby depleting the soil of the most organic matter-rich portion of the soil profile.

In research conducted in western Kansas, Blanco-Canqui et al., 2009, found that in no-till winter wheat and plow till grain sorghum cropping systems, that residue removal at rates as low as 50% increased loss of sediment. They also found that no-till with 100% residue removal lost as much sediment as freshly tilled wheat plots with 0 or 25% removal and residue removal at 75 and 100% increased losses of SOC associated with sediment. They concluded erosion protection provided by no-till management was lost when residue removal exceeded 25%. In a study in eastern South Dakota of a no-till corn-soybean rotation, Osborne et al., 2011, found that increasing corn residue removal of 37%, 55% and 98% resulted in a significant decrease in soil organic matter (SOM). In a literature review of the effects of corn residue removal on soil productivity, Wilhelm et al., 2004, generally found negative effects on SOC with increasing residue removal.

6.5 Burning Negatively Impacts Carbon Sequestration
Burning has two negative effects related to carbon offsets in annual crop production systems: (1) it reduces the amount of plant residue that can subsequently be transformed into SOC (Hooker et al., 1981; Wuest et al., 2005; and Amuri et al., 2008) and (2) it produces CO₂ emissions from the combustion of the plant residue. It also negatively impacts soil health, especially if a soil is already of poor quality, which most cropland soils are. The soil surface devoid of grass succumbs to the pressure of raindrops, which pound the surface causing macropores made by worms to seal over. This increases erosion from runoff and decreases water absorption. Unhealthy, bare soil is also slower to regrow vegetation cover.

6.6 Fallowing Limits Carbon Sequestration
The OCP defines fallowing (laying idle) as a time period of more than 12 months in a growing season (e.g., October 1-September 30) without a growing crop. Based on a review of the literature, OCP has determined that continuous wheat-fallow systems are not eligible under the no-till protocol. Other cropping systems that do not use fallowing more frequently than once every 3 years, e.g. corn-wheat-fallow, are eligible, but are not eligible to receive carbon credits for the fallow year.
Cropping intensity and the amount of residue returned to the soil plays a key role in the amount of carbon (C) sequestration that occurs. Research has shown that greater cropping intensity, and limiting fallowing periods within the confines of what annual precipitation will allow to produce a viable crop, leads to greater carbon sequestration.

Researchers believe that summer fallow reduces C storage in several ways. First, frequent summer fallow usually reduces inputs of C into soils because there are no plant C inputs and second, it may enhance the rate of mineralization of soil organic carbon (SOC) to carbon dioxide CO₂ because it keeps the soil wetter and perhaps warmer for longer periods (Campbell et al., 2005).

Halvorson et al., 2002a, found that in eastern Colorado that a crop rotation of continuous corn under no-till (NT) management resulted in greater levels of SOC than a crop rotation of wheat-corn-fallow under NT management, which resulted in greater levels of SOC than a wheat-fallow rotation under NT management. In addition, this research also showed that a continuous wheat-fallow rotation under NT management did not result in any greater SOC than continuous wheat-fallow under reduced tillage or conventional tillage. Halvorson et al., 2002b found similar results for spring wheat cropping systems in North Dakota. The results of this study suggested that a continuous spring wheat-fallow system even under no-till may result in a loss of SOC.

Sherrod et al., 2003, showed that at three locations in eastern Colorado after 12 years of NT management, that those cropping systems that eliminate summer fallowing and integrate higher residue crops such as corn, grain sorghum or millet, maximize the amount of SOC sequestered. In research conducted near Bushland, Texas, Potter et al., 1998 also found that fallowing limits carbon accumulation and found that SOC content was not significantly different between tillage treatments in wheat-fallow and wheat-sorghum-fallow systems. Schomberg and Jones, 1999, in research conducted near Bushland, Texas found that a cropping system of continuous wheat under no-till management had higher SOC levels than a wheat-sorghum-fallow rotation under no-till management.

Historically, the cotton-winter wheat-fallow rotation is uncommon in Oklahoma, but it is becoming more likely for SW Oklahoma as drought conditions persist. In this rotation there are 11-12 months of fallow time instead of 15 months as would be found in a wheat fallow system. The fallow period in a cotton-wheat fallow system would also not generally be longer than 12 months (Warren 2013, pers. comm.) so this cropping system is eligible for certification.

### 6.7 Irrigated Cropland Sequesters GHG at a Higher Rate than Non-Irrigated

The OCP calculates carbon sequestration at a higher rate for irrigated cropland than for non-irrigated cropland, excluding the field corners not reached by the irrigation. NRCS classifies the corners as “dryland” which means they are considered non-irrigated (Mustain 2010, pers. comm.). The carbon sequestration rate in irrigation is higher under irrigation because higher yields equal higher amounts of residue delivered to the soil system, which should increase the potential carbon sequestration rate when the fields are converted to no-till (Warren 2010, pers. comm).

In a 10-year study of various no-till, irrigated, cropping systems (continuous corn, corn-winter wheat, corn-winter wheat-grain sorghum, and corn-winter wheat-grain sorghum-soybeans) near Tribune, Kansas, Halvorson and Schlegel found that these systems sequestered SOC at a rate ranging from 0.40 MT CO₂/ac/yr for the rotation with soybeans to a high of 1.0 MT CO₂/ac/yr for the continuous corn rotation, with an average across all cropping rotations of 0.80 MT CO₂/ac/yr for the 0-30 cm soil depth. This sequestration rate is substantially higher than the 0.2 to 0.4 MT CO₂/ac/yr rate used by OCP for
dryland no-till systems. Even with a 20% discount for conservativeness, this research would support a 0.60 MT CO₂/ac/yr crediting rate for irrigated no-till systems in Oklahoma.

Halvorson et al., 2003, found SOC sequestration rates of >1MT CO₂/ac/yr for no-till, irrigated continuous corn cropping systems near Ft. Collins, Colorado and near Dalhart, Texas at the 0-15 cm soil depth. They also found that under conventional tillage at the Ft. Collins site or with heavy grazing of the corn stalks at the Dalhart site, there was no appreciable SOC sequestration. Gillabel et al., 2007 found that various irrigated, conservation tillage cropping systems in southwest Nebraska stored up to 25% more SOC than similar dryland cropping systems. Most of this research attributed the additional SOC to the increased residue levels in the irrigated as compared to the dryland systems.

6.8 Strip-Till has a Positive Soil Condition Index

The OCP methodology includes assessment and crediting of strip till fields. Strip-till is a type of conservation tillage that tills only the strips where the crop will be planted. This inclusion is based on a review of NRCS’s Soil Condition Index (SCI), which is a tool used by NRCS to determine if there is a soil health or soil quality concern caused by a cropping system. The SCI is based on three important conditions: (1) organic material grown or added to the soil, (2) field operations that alter organic material placement in the soil profile and that stimulate organic matter breakdown, and (3) erosion that removes and sorts surface soil organic matter (Franzluebbers et al. 2011). If the index rating equals a negative number, the cropping system is considered to be causing deteriorating soil health. If the index rating is positive, soil health is considered to not be a concern (Mustain 2009, pers. comm.).

An informal review of the SCI for this protocol included comparisons of the SCI for no-till and strip-till fields in three counties in west, central, and southeast Oklahoma. In all instances, the strip-till fields had worse indexes than the no-till fields by 0.1 to 0.25; however, the indexes were always positive, which indicates that there is not a soil health concern with strip-till (Mustain 2009, pers. comm.). A further review was done to determine if the location of tilled strips within strip-till fields would affect the SCI. The reviewers concluded that when no till or strip till is used with appropriate crop rotations, the SCI will more than likely be positive. This means there should be a positive trend in organic matter accumulation in the soil whether the same strip or new strips are tilled (Matlock 2009, pers. comm.).

The scientific literature provides little information to compare carbon sequestration in no-till and strip-till fields (Warren 2009, pers. comm.). There is a need to establish a baseline management condition so that a change in soil organic carbon (SOC) can be expected. If the baseline condition were to have a highly negative SCI score, then even a minimal conservation management technique would likely improve SOC sequestration. If, however, the baseline condition were at an acceptable level, then only more rigorous conservation measures could be expected to achieve SOC sequestration in the future. The successful calibration of SOC content on SCI scores will allow SCI to become a more quantitative tool in predicting SOC content for farmers wanting to adopt conservation practices (Franzluebbers et al. 2011).

7.0 Applications for Verification

Aggregators and land managers are provided with eligibility and application information. All applications for no-till verification are screened for eligibility.
7.1 Screening
The following application and supplemental information will be reviewed for completeness, clarity, and adherence to program requirements prior to contracts being considered for verification:

- Producer aggregator application
- Name, address, and phone number
- Number, size, and location of fields
- Legal location descriptions and aerial photographs
- Resource management plan with crop information
- Producer contract
- Proof of date converted from conventional tillage to no-till
- FSA current and historic Form 578 showing acres designated as “cropland”
- Aerial photo/map with fields delineated and acres shown

7.2 Field Information Sheet
Field location and status information is synthesized and organized into a spreadsheet provided to the field verifier. This allows the verifier to plan to optimize field time and facilitates overall GHG reduction reporting and project tracking.

Table 2: Example producer field information sheet

|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|   | Last Name | First Name | County | Town | Legal | Applic Desc # | Total Acres Contracted | Acres No-Till | Acres Grass | Acres Ridge | FSA Cropland | Date Began Practice | Irrigated | NRCS Farm Plan | Grazing Plan | Farm Bill |
| 2 | Joe | Producer | Best | Somewtown | E2NW4 22-22-22 | 1 | 68.2 | 0 | 9 | 0 | Y | 2004 | N | Y | N | CRP |
| 3 | Joe | Producer | Best | Somewtown | E2NW4 22-22-22 | 1 | 68.2 | 0 | 9 | 0 | Y | 2004 | N | Y | N |
| 4 | Joe | Producer | Best | Somewtown | NE4 22-22-22 | 2 | 59.9 | 0 | 35.9 | 1 | Y | 2004 | N | Y | N |
| 5 | Joe | Producer | Best | Somewtown | NE4 22-22-22 | 2 | 59.9 | 0 | 35.9 | 1 | Y | 2004 | N | Y | N |
| 6 | Joe | Producer | Best | Somewtown | NE4 22-22-22 | 2 | 59.9 | 0 | 35.9 | 1 | Y | 2004 | N | Y | N |
| 7 | Joe | Producer | Best | Somewtown | SW1NE4 22-22-22 | 4 | 13.7 | 0 | 13.7 | 0 | Y | 2006 | N | Y | N |
| 8 | Joe | Producer | Best | Somewtown | SW1NE4 22-22-22 | 4 | 13.7 | 0 | 13.7 | 0 | Y | 2006 | N | Y | N |

7.3 Selecting Fields for Verification
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.

7.4 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
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 are provided the following information and contact the OCP with any questions:

- Producer’s application
- Name, address, and phone number
- Number, size, and location of fields
- Legal location descriptions and aerial photographs/maps
- Resource management plan with crop information
- Producer information sheet

8.2 Contacting the Producer
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 Oklahoma Carbon Program monitors no-till fields to verify that a field or project is being managed in a way that sequesters an expected amount of greenhouse gas (GHG). Monitoring includes identifying the current and previous crop, width between rows, tillage, biomass removal, and irrigation status. This is done by walking a transect across the field and recording visual observations.

9.1 Timing
The optimum time to verify winter wheat fields is after planting when the planted crop has emerged, but is not so tall that it obscures residue, stalks, or the overall viewing of the field. The optimal time to verify cool season crops is from October 15 to November 30 and warm season crops from April 15 to June 30. These dates represent the ideal verification timing based on normal rainfall, planting time, and visibility after emergence. At its discretion, the OCP may vary the annual verification dates based on seasonal fluctuations in rainfall, planting time, or crop emergence. This timing does not allow for visual confirmation of graze-out during the current growing season. However, indications of graze-out are typically evident the next year by lack of residue and stalks in the field.

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 totaling at least 10% of the acres, with self-certification done on 100% of contracts and 100% of acres.

9.3 Field Forms
Field data collections begin with a working knowledge and understanding of the field forms to be used. There is one set of forms to fill out for each site. Basic information that should be on the 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

10.1 Continuous No-Till Field Data Collection

Equipment Needed

- Aerial photographs or NRCS maps
- Digital camera w/charged battery
- Field data forms
- Clipboard and pen
- GPS (optional)

10.1.1 Review the Map and Plan Field Transect Location

Look at the map to assess the size and shape of the field. Get an idea of what transect to walk to get the most complete overview of the field. If the field is relatively flat there may not be a need to walk the entire field.

<table>
<thead>
<tr>
<th>How to Walk a Transect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walk enough of the field to see all corners and gather enough data to get an accurate assessment of the field. If portions of the field are visually very different, record those acres on the field form and write notes to record your observations. The size and shape of the field will dictate how the field is walked to collect the data. The goal is to collect data that reflects the entire field. See examples below.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Examples of transects based on field shape and size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Example A.</strong> 20 acre field – Straight line: Pick a spot on the horizon to walk toward in a straight line.</td>
</tr>
<tr>
<td><strong>Example B.</strong> 100 acre field – Zig-zag: Due to size, one line on the diagonal, as in example A, may not accurately capture the field. Try one of the two options shown below.</td>
</tr>
<tr>
<td><strong>Example C.</strong> 200 acre field – Odd shaped field: may pose a challenge. Below is a suggested transect.</td>
</tr>
</tbody>
</table>

Figure 1: How to walk a transect
10.1.2 Confirm Field Acreage
Walk the field to determine if actual no-till acres equal the acres under contract. Begin observations away from the field boundary, 50 feet into the field: At this point begin walking the transect. Use visual comparison of field boundaries to NRCS maps or other aerial photos, and/or use GPS points taken and input to ARC-GIS or other aerial map program. Look for areas removed from cropping a (e.g. building new homesite, oil field activities) and note whether or not they are on the map. If not, subtract these acres from the acres you list under in the column “Acres in Field.”

**Note:** When large, easily delineated and measureable areas exist that do not contain a newly planted crop or residue, or otherwise do not meet the practice standard, indicate the area on the map and field form.

![Figure 2: Good residue and stubble, evidence of planting, but no green growing crop](image)

10.1.3 Identify Tillage Type and Irrigation Status
Determine if the field is in continuous no-till or strip-till, or conventional tillage management, and whether or not it is irrigated.

- **Look at the soil surface** for loose crop residues remaining on the field after harvest. No-till fields build a surface mulch layer of partly decomposed crop residue on or near the soil surface. It may be more apparent between rows of crops.
- **Look across the field** to observe anchored crop stubble remaining (standing or angled) from the previous crop.
- **Look at the field and the map** to determine if a field is irrigated.
- **Note if the field appears to have been fallow** for one year or more. If so, determine the number of fallow acres and record the number on the field data form. If the field is fallow, there is no reason to continue verification.
10.1.4 Identify Irrigation Status
Center pivots do not reach the edges of the field, so if a 160 acre quarter section field is irrigated by center pivot, the edges (28 acres) are not included in the “Irrigated” acres column. Instead, record the number of irrigated acres as 132 acres.

![Aerial view map showing evidence of center pivot irrigation](image)

**Figure 3:** Aerial view map showing evidence of center pivot irrigation

10.1.5 Identify the Current Growing Crop and Residue from Previous Crop
Identify the new growing crop and the previous crop type by identifying the standing stalks and residue. Take pictures of each. If you are unable to identify the growing crop and/or residue, ask the producer or take a piece of the residue to an NRCS specialist for assistance.

**Note:** Crops must be planted annually, except when alfalfa is used in the crop rotation. Fields that contain greater than a 50% stand of alfalfa count as no-till. If less than 50% with the remainder in grass, the field are verified as seeded grassland.

![Close-up picture allowing for identification of crop and residue type by desk auditor](image)

**Figure 4:** Close-up picture allowing for identification of crop and residue type by desk auditor
10.1.6 Take Pictures
Take at least three pictures in each field. Record the photo number from the camera onto the data form so that the correct pictures match up with the fields which fields as listed on the field form. Note that this is not the number of pictures taken, but the actual picture number 1,2,3, etc. showing on the camera.

- **Panoramic** taken looking down the rows providing an overview of field with no more than 1/3 of the picture showing sky.
- **Close up** that represents what the majority of the field looks like.
- **Close up at 45 degree angle** of the dominant cash crop or cover crop plants.
- **Areas of note** such as bare soil, tilled areas, evidence of burning, overgrazing, or haying.

![Figure 5: Examples of correctly taken field photos](image)

10.1.7 Determine if Residue and Stubble is Evenly Distributed across the Field
Loose crop residues remaining on the field after harvest should be uniformly distributed over the field. Examine the soil surface for any anchored crop stubble remaining (standing or angled) from the previous crop. Over time, no-till fields will build a surface mulch layer. A surface mulch layer is a layer of partly decomposed crop residue on or near the soil surface. It may be more apparent between rows of crops.

![Figure 6: Fields with evenly distributed residue](image)
10.1.8 Record Evidence of Full Width Tillage

Implements that require a leveling or smoothing after their use generally disturb the soil too much for an entire field to qualify as no-till. Determine the amount of acres under full width tillage and record the number on the field form. If less than one acre is disturbed, take a picture and write “<1” on the field form.

Figure 7: Residue will be sparser in some fields, but still evenly distributed

Figure 8: Green growing crop with residue of previous crop absent; both fields were tilled
10.1.9 Determine if the residue or stalks have been removed by burning
Determine if the residue has been removed from all or some of the field by burning, determine the amount of acres burned and record the number on the verification form.

10.1.10 Determine the number of acres with residue removed by short-term grazing
Look for evidence of grazing livestock. If there is evidence of removal of plant residue by grazing during the current growing season, indicate on how many acres.

Note: If the field is or has been grazed, then grazing took place on 100% of the acres. An example of “short-term grazing” is when winter wheat is grazed until mid-march and then harvested in June.

10.1.11 Note if the previous crop was grazed-out
Determine whether the crop has been removed from all or some of the field by grazing instead of being harvested. Determine the amount of acres affected and record the number on the verification form.

Note: If the field is or has been grazed or grazed out, then grazing took place on 100% of the acres. “Grazed out” means that a crop has not been or will not be harvested by an implement, but instead has been used as forage for livestock with a majority of the plant being consumed by the animal, resulting in minimal or no residue remaining in the field. This is not the same as “short-term grazing,” such as the grazing that occurs on winter wheat before cattle are pulled and the crop is harvested.
Figure 10: Winter wheat field in the process of being grazed out

Figure 11: Grazed out winter wheat with cow presence evident (left). Winter wheat of same age that will be harvested (right)
Fallow refers to a field that has not grown a crop within the previous 12-month growing season (October 1 to September 30).

Figure 12: No-till cropland with fallow evident due to presence of grazed annual grass cover

10.1.12 Measure the width of the rows
Measure the width of tilled rows and the width between planted rows if the field is no-till or strip tilled.

10.2 Field Form Completion
Calculate tally sheet totals and complete and sign the field form. Draw on the map the location of the transect walked across the field (Figure 15).

Figure 13: Example of field transects drawn on a map

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 project proponents 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 methodology meets 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 review, site visit of selected acres, and desk audit of field data documentation provided for those acres. Site visits are necessary to assess operations, confirm the project boundary, and assess management techniques.

11.5 Data Quality
The OCP has trained quality assurance officers 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. Baseline carbon sequestration for tilled cropland is considered negative because tillage is a source of GHG emissions.

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). To-date, these rates have been deemed reasonable for use in Oklahoma by Oklahoma State University (OSU) researchers, as they are supported by small pools of historic and ongoing soil sampling data. OSU recommends the OCP not deviate from the regional values until there is sufficient data to recommend alternative rates (Warren. Email. 2010 Oct 14.).

Table 3: Sequestration rate of Oklahoma no-till fields

<table>
<thead>
<tr>
<th>Sector</th>
<th>Practice</th>
<th>Sequestration Rate (metric tons CO2/acre/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>No-till or Strip-till</td>
<td>0.2 – 0.6</td>
</tr>
</tbody>
</table>

**Calculation:** 
Price per ton x sequestration rate x acres = Payment to producer

**Example:** 
$3.50/metric ton CO2 x 0.4 metric tons/ac/yr x 300 acres = $420

Table 4: GHG Sources and sinks of no-till fields

<table>
<thead>
<tr>
<th>Source/Sink</th>
<th>GHG</th>
<th>Include (I) or Exclude (E)</th>
<th>Quantification Method</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil</td>
<td>CO2</td>
<td>I</td>
<td>Regional default values</td>
<td>Actions that result in less sequestration than anticipated are documented and considered in GHG credit accounting.</td>
</tr>
<tr>
<td></td>
<td>N2O</td>
<td>E</td>
<td>N/A</td>
<td>Not considered by this protocol at this time.</td>
</tr>
<tr>
<td>Equipment</td>
<td>CO2</td>
<td>E</td>
<td>N/A</td>
<td>Compared to emissions from managing marginal croplands, emissions are expected to decrease and are not accounted for.</td>
</tr>
<tr>
<td></td>
<td>CH4</td>
<td>E</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td></td>
<td>N2O</td>
<td>E</td>
<td>N/A</td>
<td></td>
</tr>
<tr>
<td>Leakage</td>
<td>CO2</td>
<td>I</td>
<td>Subjective</td>
<td>Possible if grazing pressure is found to have shifted to and negatively impacted other fields.</td>
</tr>
<tr>
<td>Fertilizer Production and Application</td>
<td>CO2</td>
<td>E</td>
<td>N/A</td>
<td>Indirect emissions or reductions are not accounted for by this protocol.</td>
</tr>
<tr>
<td></td>
<td>CH4</td>
<td>E</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>N2O</td>
<td>E</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

11.11 Quantifying Project Emissions

The OCP includes in the no-till management standard requirements that reduce or avoid project emissions. The monitoring protocol does not include the quantification of project-based emissions.

12.0 Verification Audit

The field monitors and 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.

[Place holder for step by step auditing process]

13.0 Reporting

[Place holder for reporting guidelines]

14.0 Works Cited


Coalition on Agricultural Greenhouse Gases. Updated C-AGG Proposal on Aggregation. 9 Dec 2013.


ISO 14065:2007. GHGes – Requirements for GHG Validation and Verification Bodies for Use in Accreditation or Other Forms of Recognition.


T-AGG Literature Review. Soil carbon sequestration rates of no-till and conservation tillage.


### 15.0 Resources


Matlock, Ken. NRCS. Email. 2009 Sep 1. Correspondence re no-till vs. strip-till.

Mustain, John. NRCS. Email. 2009 Aug 14. Correspondence re no-till vs. strip-till.

Mustain, John. NRCS. Email. 2010 Sep 24. Correspondence re irrigated no-till fields.
Warren, Jason. OSU. Email. 2010 Mar 8. Correspondence re Oklahoma soil carbon values.

Warren, Jason. OSU. Email. 2009 Aug 12. Correspondence re no-till vs. strip-till.

Warren, Jason. OSU. Email. 2010 Sep 24. Correspondence re irrigated no-till fields.


Warren, Jason. OSU. Email. 2013 Dec 12. Correspondence regarding grazing of winter wheat.

Appendix A: Field Forms
No-Till / Strip-Till

Oklahoma Carbon Program
Field Verification Report

Producer Name: ________________________________  Aggregator Contract # ___________

The practices you are verifying are planting methods commonly referred to as no-till and strip
till. The purpose of these practices is to manage the amount and distribution of crop
residue on the soil surface year round while limiting soil-disturbing activities to only those
necessary to place nutrients and plant crops.

Fields should be verified in late spring and late fall after crops have been planted, as follows:

Warm season crops - Spring:  April 15 to June 30
Cool season crops - Fall/Winter:  October 15 to Nov 30

*Dates represent ideal verification dates based on normal rainfall, planting time, and visibility after emergence.
At its discretion, the OCP may vary the annual verification dates based on seasonal fluctuations in rainfall,
planting time, and emergence.

Section A: Location Information
Did you receive verbal permission from the producer to access land?  Yes  No
Did the producer accompany you during verification?  Yes  No

<table>
<thead>
<tr>
<th>Field #</th>
<th>County</th>
<th>Legal Description (e.g. SW ¼ of NE ¼)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section B: Photos
Photos should document field conditions and
provide an accurate representation of the field. Include photos of crop residues as well as
growing crops when present. Avoid taking photos in headlands, end rows and other
overlap areas. Photos should also document questionable or contract compliance issues.

Take pictures of each field as follows:

A. Panoramic: Overview of field showing standing stalks and current growing crop.
B. Close up (taken at 5 to 10 feet): Ground surface, residue or lack of residue.
C. Close up (taken at 5 to 10 feet): Soil disturbance/tillage, evidence of burn,
graze-out, areas where seeding was missed, or other noteworthy areas.

Section C: Things to Remember

- Mark your transect on the map
- Take photos of each field
- Include notes, questions, explanations
- Sign the signature/attestation page
- Write clearly
Section D: Verifier Notes
Provide explanations of Section F below.

<table>
<thead>
<tr>
<th>Field #</th>
<th>Date Visited</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Section E: Verifier Signature / Attestation
The information in this report and accompanying photographs is true and accurate to the best of my knowledge and has not been intentionally misrepresented.

_________________________  ____________________________  _________________________
Field Verifier Signature   Field Verifier Name (printed)   Date

_________________________  ____________________________  _________________________
Internal Reviewer Signature   Internal Reviewer Name (printed)   Date
### Section F: Field Condition
Get out of the truck. All observations must be taken at least 50 feet inside the field boundary. Fill in every white box on this page.

How did you confirm the number of acres? *(Circle all that apply)*  
- GPS  
- Visual  
- Map  
- Other __________________________

<table>
<thead>
<tr>
<th>Field #</th>
<th>²Tillage type (NT, ST, or Full)</th>
<th>¹Acres in field</th>
<th>Irrigated (acres)</th>
<th>³Current growing crop (type)</th>
<th>³Previous Crop (type)</th>
<th>⁴Residue evenly distributed across field (acres)</th>
<th>⁵Evidence of full width tillage (acres)</th>
<th>⁶Residue or stubble burned (acres)</th>
<th>⁷Residue or stubble partially grazed (acres)</th>
<th>⁸Growing crop grazed out or hayed (acres)</th>
<th>⁹Fallow &gt;1 year (acres)</th>
<th>¹⁰Width of planted row (inches)</th>
<th>¹⁰Width between planted rows (inches)</th>
<th>Photo #</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
INSTRUCTIONS
Get out of the truck. All observations must be taken at least 50 feet inside the field boundary:

1/ Locate field and confirm number of acres.
   Look at field to determine that location and number of acres are consistent with the map and contract. Visually compare field boundaries to map.

2/ Determine whether field is no-till, strip-till, or conventional till, and note how many acres are irrigated.

3/ Identify and record the current growing and the crop grown previous to the current crop.
   Look at residues to identify previous crop type(s). Continuously planted, low residue producing crops like cotton, soybeans, beans, and peas require a cover crop be planted each year in order to meet residue requirements for no-till.

4/ Determine if residue and crop stubble is evenly distributed across the field.
   Loose crop residues remaining on the field after harvest should be uniformly distributed over the field. Examine the soil surface for any anchored crop stubble remaining (standing or angled) from the previous crop. Over time, no-till fields will build a surface mulch layer. A surface mulch layer is a layer of partly decomposed crop residue on or near the soil surface. It may be more apparent between rows of crops.

5/ Record evidence of full width tillage (w/chisel plow, sweeps, cultivator, disk, moldboard plow, etc.)
   Approved implements: no-till planters; no-till drills and air seeders; strip-type fertilizer and low disturbance manure injectors and anhydrous applicators.
   Unapproved implements: All other implements are considered to be full-width or capable of full soil disturbance and therefore not compatible with this practice. Any full-width tillage should be recorded on the form, regardless of the depth of the tillage.

6/ Is there evidence that crop residues or stubble has been burned?
   If yes, record the number of acres burned.

7/ Is there evidence that crop residues or stalks was removed by haying or grazing?
   If yes, record the number of acres.

8/ Is there evidence that the growing crop was grazed out and not harvested?
   If yes, record the number of acres.

9/ Is there evidence that the field has been fallowed for 1 year or more?
   If yes, record the number of acres.

10/ Record the width of the tilled, planted rows. (*Strip-till and Minimum-till fields only*)

10/ Record the width *between* tilled, planted rows. (*Strip-till and Minimum-till fields only*)
Appendix B: Progressive Management Crediting Matrix
## Continuous No-Till Progressive Management Crediting Matrix

<table>
<thead>
<tr>
<th>Mgmt Level</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil Health &amp; GHG Seq Mgmt</strong></td>
<td>Conversion of FSA “cropland” from conventional tillage to no tillage</td>
<td>At least 50% of soil covered with residue</td>
<td>Plants deep-rooted cover crop</td>
<td>Rotating high residue crops or</td>
<td>Use of continuous cover crops OR</td>
</tr>
<tr>
<td></td>
<td>Growing crop present</td>
<td></td>
<td>Adds legume cover crop</td>
<td>Adds additional crop to rotation or</td>
<td>Cover crop cocktail of at least 3 species</td>
</tr>
<tr>
<td></td>
<td>Residue present and evenly distributed</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anchored stalks present</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cover crops follow low residue crops</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Burning does not occur</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Grazing ends by 3/15</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fallow &lt;12 months</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hayed annual crops followed by high residue cover crop</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Nutrient Mgmt &amp; Avoided Emissions</strong></td>
<td>Conversion of FSA “cropland” from conventional tillage to no tillage</td>
<td>Soil test annually</td>
<td>In-season N incorporation/injection or</td>
<td>Applying fertilizer at variable rates through the use of electronic maps with a GPS receiver by using grid sampling or EC mapping</td>
<td>Uses sensor based variable rate application techniques such as NDVI sensing to apply nitrogen fertilizer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fertilizes according to soil test recommendations and</td>
<td>Slow release nutrients or</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Uses split N application, when applicable to crop</td>
<td>Nitrogen inhibitors or</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Use of N-rich strips</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Wildlife Mgmt</strong></td>
<td>Conversion of FSA “cropland” from conventional tillage to no tillage</td>
<td>Plants a cover crop and/or has implemented other contingencies or plantings specifically for improving wildlife habitat</td>
<td>Buffer strips exist around riparian areas</td>
<td>Leaves un-harvested strip around perimeter of field</td>
<td>Using a stripper header for harvesting</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Adds pollinator species to cover crop</td>
<td>Buffer strips exist along field edges that create corridors for wildlife movement</td>
<td>Buffer strips all at least 46 m wide along drainages</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Buffer strips all at least 30 m wide along drainages</td>
<td>Utilizes IPM for pest control</td>
</tr>
<tr>
<td><strong>Water Quality Mgmt</strong></td>
<td>Conversion of FSA “cropland” from conventional tillage to no tillage</td>
<td>If irrigated, an irrigation plan is adhered to</td>
<td>Riparian buffer is in place</td>
<td>Livestock excluded from buffer</td>
<td>Livestock excluded from stream</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fertilizing according to soil test recommendations</td>
<td>Filter strips established</td>
<td>Utilizing nitrogen injection</td>
<td>Has field border</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Applying split nitrogen applications</td>
<td>Applying nitrogen rich strip</td>
<td>GPS targeted pest spray</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>IPM plan in place</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Using precision equipment to apply nitrogen</td>
</tr>
</tbody>
</table>