PEER REVIEW RESPONSE DOCUMENT

FINAL Oct 2014

A methodology for ***Greenhouse Gas Emissions Reductions from Compost Additions to Grazed Grasslands*** was developed by Terra Global Capital, with support from the Environmental Defense Fund, Silver Lab at the University of California - Berkeley, and the Marin Carbon Project, and submitted to ACR for approval through the public consultation and scientific peer review process.

The methodology was formally submitted to ACR on October 18, 2013. ACR conducted its standard internal methodology screening and the authors submitted revised drafts on March 5 and April 11, 2014. The methodology was then posted for public comment from April 15 – May 21, 2014. Public comments and responses by the authors were finalized on June 19, 2014, and have been provided to peer reviewers. ACR does not require all public comments be incorporated, but does require that a response to each public comment be documented.

This template is organized by section of the methodology/module. Please insert your review comments in the table for the relevant section. In the first round of review, all peer reviewers should insert their comments in the first column, leaving the second column for methodology author responses. This will be followed by an abbreviated second round of review in which the reviewers comment on the authors' responses and methodology revisions, followed by a second round of responses from the authors.

Please add rows to each table as needed.

The numbering in the far left column of each table does not refer to sections in the methodology/module; it is only for tracking comments by number.

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0. General

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
0.1	Need to include the Svejcar et al. 2008 Rangeland Ecology and Management paper on carbon flux from western rangelands to showcase temporal aspects within a season as well as interannual variability	We have updated the introduction to include this reference.	Accepted.		
0.2	Carbon sequestration in soil needs to be delineated in terms of what depth in the soil. Recent work in Great Plains soils shows substantial carbon storage at depth.	It seems unlikely that compost application would have a significant impact on soil carbon at greater depths (~30 cm) when applied to the surface. Samples collected as part of monitoring (Section 10) are to reach a depth of at least 20 cm; however, 10 cm is commonly used as a depth at which 'sequestration' can be claimed if significant increases in soil C are observed, though samples going deeper, such as those defined in this protocol, may very well result in the	Soils in the top 20 cm will be very prone to loss of C under drought conditions (ingram et al. 2008 SSSAJ). Svejcar et al. 2008 REM paper also shows the high variability of C sink/source aspects for rangelands and shallow carbon.	This may well be true, but with adequate model validation for dry climate regimes there is no reason why this should be a barrier to developing a sound protocol for quantifying either positive or negative changes in soil C.	Accepted. Models, if accurately calibrated and validated so as to capture the spatial heterogeneity among the project area, should be sufficient.

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		detection of additional C sequestration. While it would be in the interest of producers to collect samples at greater depths, this is not required to demonstrate sequestration. It is considered conservative to demonstrate sequestration based on observed soil C increases at shallower depths.			
0.3	Need to include the recent model work of Zhai et al. in Soil Science Society of America Journal Vol. 78 No. 1, p. 238-247 doi:10.2136/sssaj2013.05.0180 Degradation Rate Model Formulation to Estimate Soil Carbon Sequestration from Repeated Biosolids Application Wenjuan Zhai[a], Demetrios J. Moschandreas[a],	This reference has been added.		This reference has been added.	

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	Guanglong Tian[b], Dhesikan Venkatesan [c]and Kenneth E. Noll [*c]				
0.4	Water quality issues associated with any application of compost provide problems for producers. Application of compost in any area prone to erosion by wind or water for eventual entry into waterways poses all kinds of issues that EPA would have issues with for producers. Need to set clear directions on slope that is permissible for application, as well as a well-defined boundary (e.g., filter strip) between the project application area and any	Leaching is not a significant concern, particularly with regard to the minimum biological/microbial content of the compost. N content would also likely not have a significant impact, and the rangeland ecosystem itself acts as a buffer strip. The protocol does not restrict compost application on any slope as it is currently written. We previously addressed a similar water quality concern as follows: "With regard to water quality specifically, one can expect some or all of the following as a result of compost application: 'Compost used as a soil amendment can improve soil structure, reduce compaction, and increase water infiltration, thereby decreasing soil erosion and the runoff of both soluble and particulate materials. Compost	Two authors maintain that this is not addressed, for example; Potential for runoff on slopes, especially of phosphorus. It is well documented in SE states the runoff from poultry litter-amended pastures can result in P runoff and surface-water degradation. The issue isn't potable water standards; it's eutrophication. Does not prevent the pretty decent likelihood that surface application of biosolids could reach waterways through surface runoff if high intensity rainfall (or	While we appreciate the reviewers' concern, we feel this is more of an issue in other parts of the country than in California. We maintain the right place to handle this is in the context of a consultation with a QE. Compost is on the same order as others (manure, inorganic fertilizer) to the extent that it contains P. However, compost BMPs listed by the EPA for regions where rainfall is common and often significant use	Reviewers believe that water quality and runoff concerns are significant, especially in light of the EPA's proposed rule 'Waters of the United States', which will be decided on late fall 2014, or in 2015. Project developers and landowners in some locations very well may be uncertain, and unwilling to move on surface compost applications until this is resolved, as the proposed rule could cause runoff from compost to put a farm or grazing operation out of compliance with the Clean Water Act.

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	waterway or body of water	increases soil nutrient holding 5capacity, reduces the need for commercial fertilizers, and can bind heavy metals and degrade volatile organic compounds and complex organics. These attributes of compost application can help prevent water quality degradation.' http://www.mawaterquality.org/publications/documents/MAWQPCompostingResourceDirectory_revSep2010.pdf" There is evidence that compost application helps stabilize surface soil, reducing runoff and erosion (for example, Bresson et al 2001). However, the impacts of compost application on runoff appear to be quite contextual, and are affected by both the content/source of compost, as well as by plant community composition of the areas to which it is applied. However, there is evidence that even on severely degraded land and across multiple treatment types, municipal compost/biosolid application resulted in runoff with nutrient levels that were still within safe levels for potable water	snowfall followed by rapid melting) follows an application. There is a risk here that producers take on from EPA and state departments of environmental quality that is problematic.	compost to reduce the likelihood that "worse" agricultural runoff will enter waterways. Peer review literature seems to indicate that the greatest risk of nutrient loading (P, K) is associated with manure-based compost. There are not any 303b controls under the Clean Water Act regarding on-site composting and runoff. Compost is also cited as helping states meet TMDL requirements, including in West Marin here in California. There do not currently appear to be any CEQA precedents for	Recognizing this, the reviewers see no need to amend the protocol further on this topic. Although the QE opinions could be variable depending on experience and qualifications, the reviewers agree that the consultation with a QE, along with the regulatory compliance requirement, and the ACR requirements to report on any net environmental impacts in the GHG Project Plan are sufficient for the protocol language.

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		(for example, Meyer et al. 2001). From a practical perspective, it seems to be recommended that an expert, in this case the QE or extension agent, is consulted to determine maximum appropriate slope for application.		compost application and water quality, though this seems to be a likely avenue for regulation. It seems challenging to make the case against compost as a non-point source of surface water pollution versus the much higher influx of more runoff resulting from more widespread and commonly used agricultural products.	
0.5	This protocol can only be used within the California annual grassland region. Only one of the two sites even within this region had significantly positive results so this protocol is over extrapolating. Use of	The protocol is based on more than just one peer-reviewed study examining two sites. To make this more apparent, we previously updated the Introduction (Section 2) to include a more thorough review of the relevant literature on compost additions to grazing lands and the documented impacts on soil C and plant growth.	Again – the reviewers observe that this is just two sites in California (Central Valley and a Coast Range site) and one in Patagonia. Very limited geographic scope remains here.	We are not sure that the reviewers saw the previous revisions. The text covers more than just these cases, as follows: "A number of peer-	Accepted. While recognizing that these practices are not appropriate for all rangeland or grazed grassland systems, the requirements for model calibration and validation are sufficient.

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	the protocol beyond this geographic region has to be contingent on additional research projects that are implemented on perennial-dominated rangelands, both grass and shrub. One possible avenue is to explore the newly created Long-Term Agro-ecosystem Research (LTAR) network (htpp:ars.usda.gov/ltar) which has rangeland sites in the western US including: Boise, ID/Burns, OR; Las Cruces, NM; Tucson, AZ; Mandan, ND; Nunn, CO; El Reno, OK; and Temple, TX	We also agree that geographic variations in climate and precipitation will play a large role in determining plant productivity and the rate of soil C decomposition. This is why the protocol requires that the process-based models be validated for local environmental conditions and why periodic monitoring of soil C at the site is required (see Section 9.2 – Quantification and Section 10 – Monitoring).		reviewed studies involving the application of compost or composted biosolids to temperate grasslands have been carried out over both short-term (0-5 yrs) and long-term (5-14 yrs) experimental periods. At two Mediterranean grassland sites in California, Ryals et al. (2014) measured C sequestration years after a single compost addition. Compost amendment resulted in a significant increase in bulk soil organic C content at a Central Valley site, and a similar but non-	

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				significant trend at a Coast Range site. Compost additions also significantly increased plant growth as measured by net primary productivity at both the Central Valley and Coast Range sites (Ryals and Silver 2013). Likewise, in a three year study conducted at a semi-arid steppe site in northwest Patagonia, the application of composted biosolids (40 t ha^{-1}) also increased plant growth and soil organic matter relative to an untreated control (Kowaljow et al. 2010). More	

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				importantly, several long-term grassland experiments have also found that the effect of compost application on plant growth and soil C can persist for more than a decade (Sullivan et al. 2006; Ippolito et al. 2010; Walton et al. 2001). For instance, at a semi-arid grassland site in Colorado differences in plant growth (Sullivan et al. 2006) and total soil C (Ippolito et al. 2010) were still detectable 14 years after applying compost 6 rates (0, 2.5, 5, 10, 21, and 30 t ha^{-1}). Similarly Walton et al. (2001) found that 32% of applied biosolids	

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				remained as particles greater than 2mm 18 years after application to an arid rangeland site in New Mexico. The above-mentioned studies and others in the broader peer-reviewed literature provide evidence that compost application to grasslands can facilitate long-term soil C sequestration and improved plant growth, and thus form the scientific basis for the current methodology.”	
0.6	Positive benefits of applying compost to increase soil water holding capacity (and thus, increasing resilience of the lands to increased	Additional text added/text clarified.	ok		

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	intensity of precipitation, slower onset of drought conditions, etc.) are probably in need of more text. Currently undervalued in one reviewer's opinion here.				

1. **Abbreviations**

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1.1					

2. **Introduction**

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2.1	Grazed grasslands needs to be clearly defined. What about rangelands?	"Rangeland" encompasses a variety of landscape types that include but are not limited to (grazed) grasslands. We have updated the protocol to include a definition. The introduction now reads as follows: Grazed grasslands are defined by the	Accepted		

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		Natural Resource Conservation Service (NRCS) of the United States Department of Agriculture (USDA) as "land on which the vegetation is dominated by grasses, grass-like plants, shrubs and forbs." This definition includes land that contains forbs, shrubland, improved pastureland, and improved rangeland for which grazing is the predominant use (NRCS 2009).			
2.2	Need to address the C:N ratio of the applied compost in relation to soil C:N and the effect on nutrient cycling	Section 10 (Monitoring) requires measurement of C and N in the compost, as the content of these will vary from source to source.	Accepted		
2.3	What is the pH of the compost and what is the effect of this on high vs. low pH soils?	The protocol does not require the pH of compost to be measured, and this will obviously vary by source. We don't expect the application of compost to have a large long term effect on soil pH.	Comment that pH will matter when applying to semi-arid rangelands. Should this be considered for certain types of rangeland?	We now require regular measurement of the pH of both the compost and the soil. See additions to the compost and soil sections of Monitoring Section 10.	Accepted
2.4	What is the intended application rate of	The project proponent is required to monitor application rates, and these	Some agreement though protocol remains quite		

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	compost (and how long between repeat applications)?	rates are likely to differ from site to site. The protocol does not require reapplication and currently stipulates that repeat applications not occur in intervals of fewer than three years in order to allow for evaluation of potential impacts to the ecosystem caused by compost application. This may also include a consultation with a QE. However, the 30 year lifespan of the project makes it likely that reapplication would need to occur somewhere during the 20-30 year period.	vague		
2.5	Missing the connective text that a short-term increase in forage production can result in longer-term actual soil carbon sequestration. Assumptive here, and needs concrete examples	Just to clarify the reviewer's statement somewhat, we expect that the long term increase in soil carbon would come directly from the carbon in the compost itself and indirectly from increased forage production. Regarding the link between higher forage production and soil C sequestration, the meta-analysis by Conant et al. (2001) examines 115 studies within this context. They don't evaluate compost specifically but they do document the relationship between higher forage production and C sequestration. The	If compost application rates are low and once-only or very infrequent, then it is unlikely to stimulate forage productivity enough to further drive more C sequestration beyond ephemeral responses. Additionally it is problematic that the C being applied here is very shallowly "stored"	More research is always needed. We think the reviewer may be overlooking the work of Sullivan et al., in which SOC was detectable 14 years post-application. The Walton study also shows similar visibility of particles over time, though in these cases	Accepted.

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		individual studies in Conant's analysis are also likely to be good sources to cite. See Below: Conant, Richard T., Keith Paustian, and Edward T. Elliott. "Grassland management and conversion into grassland: effects on soil carbon." *Ecological Applications* 11.2 (2001): 343-355.	and subject to release back to atmosphere. More "permanent" soil C storage will be deeper in profile and less subject to environmental loss	compost/biosolids were surface applied, not incorporated. Ryals also looked at C migration through the soil profile, to some extent. We do not feel this is as easily dismissed.	
2.6	What happens when the compost addition occurs and drought subsequently hits, thereby reducing grazability of that land due to applied compost, and possible nutrient overloads/toxicity in dry conditions?	We feel that excessive nutrient loading/and phytotoxicity is highly unlikely at economically feasible compost application rates. None of the of the studies that have looked at the short and long term effects of compost application to rangelands indicate that phytoxicity from high nutrient loads poses an undue risk to grazability. See Ryals and Silver 2013; Sullivan et al. 2006; Ippolito et al. 2010; Walton et al. 2001	Reviewer maintains that this is problematic and likely to happen. Has sufficient work been done to dismiss?	While we appreciate the reviewers' concern, we feel this is more of an issue in other parts of the country than in California. We maintain the right place to handle this is in the context of a consultation with a QE. Compost is on the same order as others (manure, inorganic fert) to the extent that it contains P.	Accepted. Although the QE opinions could be variable depending on experience and qualifications, the reviewers agree that the consultation with a QE, along with the ACR requirement to report on any net environmental impacts in the GHG Project Plan is sufficient for the protocol language.

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				However, compost BMPs listed by the EPA for regions where rainfall is common and often significant use compost to reduce the likelihood that "worse" agricultural runoff will enter waterways. Peer review literature seems to indicate that the greatest risk of nutrient loading (P, K) is associated with manure-based compost. There are not any 303b controls under the Clean Water Act regarding on-site composting and runoff. Compost is also cited as helping states meet TMDL requirements,	

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				including in West Marin here in California. There do not currently appear to be any CEQA precedents for compost application and water quality, though this seems to be a likely avenue for regulation in California. It seems challenging to make the case against compost as a non-point source of surface water pollution versus the much higher influx of more runoff resulting from more widespread and commonly used agricultural products	
2.7	Application of compost in perennial dominated grasslands/rangeland	Higher variability in precipitation is an assumption that the determination of stocking rate accounts for in the	Predictive forecasts of seasonal precipitation are not robust enough to effectively match forage	We agree. Our protocol makes no attempt to match forage availability	Accepted.

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	s is more problematic given the high variability in precipitation amount and distribution to start plant growth.	protocol.	availability and forage demand	and demand based on predictive forecasts of seasonal precipitation. Rather, it calls for simply modeling emissions based in part on actual precipitation records for a given region.	
2.8	The scope of "grazed grasslands" is unclear. Assuming the authors meant all types of grazed grasslands in the U.S. that meet their definition (p. 6), then an extremely wide range of grassland types, compositions, and managements are included. Authors ignore removal of forage hay and silage. Hay and silage harvesting can occur	-	-	As long as participating parcels/fields remain no till, the removal, whether hay or silage, shouldn't be a problem to model as long as the relevant data is collected. We agree that making hay/silage will happen from time to time (though likely a minor portion of activities occurring	Agreed

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	on their defined grazed grasslands if the majority if forage removal (defoliation) is via grazing. The definition says grazing is the "primary means of forage removal." In much of the U.S., grasslands are subjected to a combination of grazing and haying in a given year, and the proportion of the two depends on forage supply (rain) and animal demand in that year. Some grazed grasslands are on annual plants, either volunteer or seeded. Are those included here? Most grasslands are perennials in undisturbed soils, therefore applied compost is applied to the soil surface and			at a site). For the sake of record keeping, both historical and current records on those types of activities should be included. This data need has been addressed in the Monitoring section (Section 10). We are also unsure when the reviewer read the protocol vs. the time that this comment was received – we hope the updated definition is acceptable. Annual plants are included, though there is technically not much distinction between annual and	

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	not incorporated. That practice greatly reduces the movement of C and nutrients into the soil and leaves the compost very vulnerable to runoff losses from the site. In short, the premise of this methodology for grazed grasslands is very weak. In the Introduction, authors provide inadequate support for assertion that adding compost to grazed grassland effectively increases soil C sequestration and increased forage growth. Also, in the first paragraph reference to global degradation of grassland soils. Sure that exists, but what's the connection here? Compost application can reverse that. In			perennial. We are not disturbing soil/incorporating compost into the soil. Any tillage that occurs would remove a parcel from eligibility. Models, if calibrated correctly, should be able to give us a good measure of SOC. With regard to the degradation of grassland soils, we agree it can reverse this, or at least partially alleviate/slow down degradation. It remains to be seen	

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	fact, in much of the U.S. grasslands, soils are not degraded; indeed have built up SOC and soil structure back to or nearly to pre-tillage state. Authors make no allowance for the state of topsoil/SOC recovery or maintenance in that when a well-managed grassland is at steady state with respect SOC, adding more compost doesn't keep building up SOC. The soil then just blows off more CO2.			to what extent accumulation of soil carbon occurs more in degraded versus well-managed grasslands. We think this is an open question as to the extent of improvement of soils based on prior management/degradation. Some of this not really in the scope of what the protocol is about.	

3. Sources

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
3.1	One reviewer was concern about the appropriate scientific	There is a precedent for using CDM tools in other offset methodologies, and ACR also accepts methodologies	Accepted with note from one reviewer to consider the recently released	Authors have reviewed and considered the	Accepted. More on CDM tool for avoided methane from landfill

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	rigor and review of the CDM sources as they appear not to be peer-reviewed.	and tools approved for use by the CDM that meet appropriate applicability and other standards.	USDA technical document on quantifying GHG fluxes in agriculture http://www.usda.gov/oce/climate_change/estimation.htm	recently released USDA technical document on quantifying GHG fluxes in agriculture. The USDA technical document, however, does not include methods to quantify all of the emissions sources that are within the boundary of this methodology (see Section 3-Sources). In this methodology, the CDM tools are used for three calculations: (1.) determining methane emissions avoided from disposal of dumping waste at a solid waste disposal site, (2.) determining emissions from road	below.

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				transportation of freight, and (3.) determining CO_2 emissions from fossil fuel combustion. These emissions sources are outside the scope of the USDA document. On page 1-11, the USDA document states: "The source categories covered in the report are specific to the agriculture and forestry sectors (e.g., croplands, grazing lands, managed wetlands, animal agriculture, and forestry). The report does not approach emissions from these sources from a life-cycle perspective. In other words, the report does **not**	

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				include source categories that are associated with management activities related to certain agriculture and forestry activities (e.g., transportation, fuel use, heating fuel use), upstream production (e.g., animal feed production, fertilizer manufacture), or downstream (e.g., wastewater treatment, pulp and paper manufacture, or landfills). As a result, the report does **not** provide GHG accounting methods for sectors including: energy and industrial processes (e.g., fertilizer production).” An explanation for the inclusion of emissions within the	

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				baseline and/or project boundaries is included in methodology Section 7.2- Greenhouse Gas Boundaries and Table 1- Overview of included Greenhouse Gas sources.	

4. Summary Description of the Methodology

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
4.1	Regarding the direct increase in SOC content – this has to happen with the application of compost which is high in C. Concern is that this is only an	A certain fraction of C in compost will certainly decompose, but the current body of literature (as cited in the introduction of the protocol) shows repeated application of compost increases SOC in both grasslands over the long term. The fact that the	Reviewer observed that this is likely not to be "permanent" in the upper 20 cm of the profile with these rangelands (see Svejcar et al 2008 and Ingram et	More research is always needed. We think the reviewer may be overlooking the work of Sullivan et al., in which SOC was detectable 14	Accepted.

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	ephemeral increase and that permanence is not achieved.	protocol does not allow for any sort of tillage further ensures permanence.	al 2008). Lots of carbon fluxes (sink/source changes within and across seasons)	years post-application. The Walton study also shows similar visibility of particles over time, though in these cases compost/biosolids were surface applied, not incorporated. Ryals also looked at C migration through the soil profile, to some extent. We do not feel this is as easily dismissed.	
4.2	To what depth of higher SOC content is the achievable goal? With only surface application of compost, one cannot expect any substantial increase in SOC with depths >10 cm and this upper soil surface is most prone to	It seems unlikely that compost application would have a significant impact on soil carbon at greater depths (~30 cm) when applied to the surface. Samples collected as part of monitoring (Section 10) are to reach a depth of at least 20 cm; however, 10 cm is commonly used as a depth at which 'sequestration' can be claimed if significant increases in soil C are observed, though samples going	Reviewer observed that this is likely not to be "permanent" sequestration in the upper 20 cm of the profile with these rangelands (see Svejcar et al 2008 and Ingram et al 2008). Lots of carbon fluxes (sink/source changes within and	More research is always needed. We think the reviewer may be overlooking the work of Sullivan et al., in which SOC was detectable 14 years post-application. The Walton study also shows similar	Accepted.

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	carbon losses due to respiration and wind/water erosion.	deeper, such as those defined in this protocol, may very well result in the detection of additional C sequestration. While it would be in the interest of producers to collect samples at greater depths, this is not required to demonstrate sequestration. It is considered conservative to demonstrate sequestration based on observed soil C increases at shallower depths.	across seasons)	visibility of particles over time, though in these cases compost/biosolids were surface applied, not incorporated. Ryals also looked at C migration through the soil profile, to some extent. We do not feel this is as easily dismissed.	
4.3	The 40 year period is not backed by soil science or credible results/findings of added C from compost staying in the soil (and again, at what depths?). Quite problematic for this protocol.	The protocol currently attempts to strike a balance between policy integration/matching with policy precedent and scientific rigor. The two literature reviews listed (Trumbore 1997 and Adams *et al*.) provide a conceptual framework that allows the methodology to use the 40 year project period. It is fair to say that the 40 year period is more of an operational definition rather than something that is tied to field experiments carried out over the full 40 years. In the introduction (Section 2) we cite	Reviewer identified Conant et al 2001 paper that used a 20 year horizon for sequestration. Is there a strong enough scientific (and not administrative) basis to support 40 years.	We don't disagree – there simply aren't very many longitudinal/40 year studies. If these types of studies are required, that sets the bar pretty high for the protocol.	Accepted. Conant et. al paper suggests a steady state equilibrium to occur around 20 years after management changes (15-30 years). This suggests that if management practices are continued over the project term, avoiding reversals, the carbon increases are likely to be 'permanent'.

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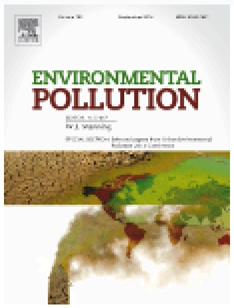
		several long-term grassland experiments show persistent effects of compost application on plant growth and soil C over more than a decade (Sullivan et al. 2006; Ippolito et al. 2010; Walton et al. 2001). Soil sequestration rates are likely to be greatest in the earlier years following compost application, and they decrease over time. It is possible that sequestration could occur initially at one ton/ha for multiple years, eventually dropping to a lower rate. This sequestration rate is not unreasonable, and the DayCent model has predicted that rates on the order of ~one ton/ha/year could persist for decades (Ryals and Silver 2013). It seems unlikely that compost application would have a significant impact on soil carbon at greater depths (~30 cm) when applied to the surface. Samples collected as part of monitoring (Section 10) are to reach a depth of at least 20 cm; however, 10 cm is commonly used as a depth at which ‘sequestration’ can be claimed if significant increases in soil C are observed, though samples going			

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
		deeper, such as those defined in this protocol, may very well result in the detection of additional C sequestration. While it would be in the interest of producers to collect samples at greater depths, this is not required to demonstrate sequestration. It is considered conservative to demonstrate sequestration based on observed soil C increases at shallower depths. Please see Ryals et al. for more. As with other novel agricultural offset protocols, it is the hope that additional projects will be developed, particularly for arid and semi-arid grasslands, in order to improve the scientific rigor of future protocols.			
4.4	Model predictions for changes in SOC in western rangelands/grasslands are quite poor. For example the Brown et al. 2010 article (see citation below) clearly demonstrates this for arid and semi arid rangelands.	When various models are validated for a new environment, there is an inherent upfront workload required to get good parametric data for model inputs. A model is only as good as its input parameters. Model input values must be adapted to local scenarios/circumstances. The protocol is intended to spur context- and site-specific development/enhancement of	Again, it was observed by reviewers that the model predictions are very poor in semiarid systems. DayCent is derived from Century which was developed for eastern Great Plains (mesic systems).	DayCent has been used in cropping systems in California in more arid contexts, and a number of papers are available. The Century model is also applicable well beyond the Great	Accepted. Model, if accurately calibrated and validated so as to capture the spatial heterogeneity among the project area, should be sufficient.

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	Joel Brown, Jay Angerer, Shawn W. Salley, Robert Blaisdell, and Jerry W. Stuth (*2010*) Improving Estimates of Rangeland Carbon Sequestration Potential in the US Southwest. Rangeland Ecology & Management: January 2010, Vol. 63, No. 1, pp. 147-154.	biogeochemical models.		Plains, hence the need for local validation/calibration of the model. This comment is somewhat vague – what constitutes poor, and why are they considered poor?	
4.5	Moreover, statements from the Booker et al. 2013 paper clearly illustrate the lack of positive carbon results associated with management in arid and semi-arid rangelands. From the paper: On the arid and semi-arid sites typical of rangelands annual	If there is not already a lot of NPP, C may come more from the compost application itself rather than enhancement of soils resulting directly from grass growth, as a lack of moisture constrains growth and, ultimately, C buildup.	Hard to envision systems with low productivity (<1500 kg/ha) enhancing C sequestration due to inherently low production, high soil respiration (more bare ground present when precipitation does fall to stimulate microbially-mediated losses through respiration)	This is true. In really dry areas, even with lots of C added via compost, without soil moisture, why would productivity increase? Modeling which is based on actual climate data would likely predict low productivity as well since water availability would constrain forage	Accepted, it is generally agreed that there are many rangeland and grazed grassland systems for which these project activities may not be a wise investment. These choices are left up to the project developers. As this is a voluntary, market mechanism, only places that promise a return on investment

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	fluxes are small and unpredictable over time and space, varying primarily with precipitation, but also with soils and vegetation. Carbon uptake on arid and semi-arid rangelands is most often controlled by abiotic factors not easily changed by management of grazing or vegetation. Additionality may be impossible to achieve consistently through management on rangelands near the more xeric end of a rangeland climatic gradient. From Global Environmental Change 2013, Volume 23, pp 240-251. What can ecological science			growth. However, this does not mean that the protocol will not be a useful tool in many locations.	to set up these kinds of complex projects will come to fruition. With strict requirements for the model, along with calibration and validation guidelines, we should be able to capture only the permanent carbon increases.

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	tell us about opportunities for carbon sequestration on arid rangelands in the United States? Kayje Booker[a], , Lynn Huntsinger[a, ,] , James W. Bartolome[a], , Nathan F. Sayre[b], , William Stewart[a],				
4.6	How many soil samples and field measurements are needed for validation of models in specific project parcels? And to what depth? This could be very labor and laboratory intensive for sure. Rangeland/grassland soils are very heterogeneous. For example, see the following citation. This could be very	Section 10 of the protocol (Monitoring) indicates three samples per stratum are to be collected. However, we recognize that this may not be an appropriate sample size, and have updated the protocol to reflect this number of samples as the minimum number required, with more samples collected based on the heterogeneity of soil resources. More samples are also encouraged in order to improve model runs. Section 10 indicates that samples are to be collected to a depth of at least 20 cm.	A reviewer felt that 3 samples were very low. Another observed the impracticality and cost of a large number of samples may be a barrier to producers staying with the program.	There is no doubt a balance between the cost of more samples and enough data for sufficient rigor. We feel the text gives adequate guidance for soil sampling and highlights the value of collecting more samples if cost effective. The added section detailing soil sampling in Section	Accepted

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	problematic for producers Environmental Pollution Volume 116, Issue 3, March 2002, Pages 445–455  Spatial heterogeneity of aggregate stability and soil carbon in semi-arid rangeland S.B. Bird[a], J.E. Herrick[a, ,], M.M. Wander[b], S.F. Wright[c]	We also appreciate the reviewers' concerns about high transaction costs/challenges for producers in gathering this data. This challenge seems inherent in novel agricultural offset protocols, particularly when producers were not already 'early adopters' of the practice.		10 Monitoring reads as follows "Project developers may choose to take more and deeper samples than this minimum requirement, which is beneficial in improving both model runs and the potential for demonstrating carbon sequestration at greater depths."	
4.7	Ten year periodic monitoring of soil samples for model	The introduction has been updated to include this reference, as well as Svejcar	This makes it difficult to determine if C sequestration (if it does	This may be true, but such challenges shouldn't dissuade	Accepted.

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	validation and calibration is highly influenced by climatic/weather conditions. For example, see the marked changes in soil C over 10 year increments in the Ingram et al. 2008 paper. Also comes back to the intra-annual and inter-annual fluctuation of C in dry grasslands (the Svejcar et al. 2008 paper as well). Soil Science Society of America Journal Vol. 72 No. 4, p. 939-948 doi:10.2136/sssaj2007.0038 Grazing Impacts on Soil Carbon and Microbial Communities in a Mixed-Grass Ecosystem	et al. 2008.	occur) is due to "favorable environmental" conditions or if losses are mostly attributed to dry period preceding the sampling	people from making an effort to distinguish these possible effects if possible.	

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	L. J. Ingram [*a], P. D. Stahl[a], G. E. Schuman[b], J. S. Buyer[c], G. F. Vance[a], G. K. Ganjegunte[d], J. M. Welker[e] and J. D. Derner[b]				
4.8	Application of compost does not reduce the risk of wind erosion in grassland/rangeland as this is a function of plant cover and spatial arrangement of plants.	Conversations with Whendee Silver and colleagues have allowed us to determine that this claim is not pivotal to the protocol, so references to potential decreased wind erosion have been removed. We explored the possibility of elaborating on decreased wind erosion as a product of plant cover/spatial arrangement, but this would have required additional monitoring, and we were unable to support this as a general claim using existing data.	Wind erosion is going to be a factor in many of the semiarid rangelands however	This may be true in certain locations. Evaluating the risk of wind erosion would best be addressed during consultations with a local Certified Expert which are already required by the protocol in Section 6.	Accepted. Although the QE opinions could be variable depending on experience and qualifications, the reviewers agree that the consultation with a QE, along with the regulatory compliance requirement, and the ACR requirements to report on any net environmental impacts in the GHG Project Plan are sufficient for the protocol language.
4.9	Application of compost does increase the rise of	Leaching is not a significant concern, particularly with regard to the minimum	Multiple reviewers were not convinced of this.	While we appreciate the reviewers’	Accepted. Reviewers believe that water

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	water quality issues	biological/microbial content of the compost. N content would also likely not have a significant impact, and the rangeland ecosystem itself acts as a buffer strip. We previously addressed a similar water quality concern as follows: "With regard to water quality specifically, one can expect some or all of the following as a result of compost application: 'Compost used as a soil amendment can improve soil structure, reduce compaction, and increase water infiltration, thereby decreasing soil erosion and the runoff of both soluble and particulate materials. Compost increases soil nutrient holding 35capacity, reduces the need for commercial fertilizers, and can bind heavy metals and degrade volatile organic compounds and complex organics. These attributes of compost application can help prevent water quality degradation.' http://www.mawaterquality.org/publications/documents/MAWQPComposting	Runoff of P from sloping soils can definitely be a hazard in the form of eutrophication of nearby surface water bodies. It doesn't take much slope to cause a runoff problem. High intensity rainfall events will clearly increase the probability of moving biosolids from locations of application to waterways - a huge concern from producers related to EPA and others	concern, we feel this is more of an issue in other parts of the country than in California. We maintain the right place to handle this is in the context of a consultation with a QE. Compost is on the same order as others (maure, inorganic fert) to the extent that it contains P. However, compost BMPs listed by the EPA for regions where rainfall is common and often significant use compost to reduce the likelihood that "worse" agricultural runoff will enter waterways. Peer review literature seems to indicate	quality and runoff concerns are significant, especially in light of the EPA's proposed rule 'Waters of the United States', which will be decided on late fall 2014, or in 2015. Project developers and landowners in some locations very well may be uncertain, and unwilling to move on surface compost applications until this is resolved, as the proposed rule could cause runoff from compost to put a farm or grazing operation out of compliance with the Clean Water Act. Recognizing this, the reviewers see no need to amend the protocol further on this topic. Although the QE

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		ResourceDirectory_revSep2010.pdf" There is evidence that compost application helps stabilize surface soil, reducing runoff and erosion (for example, Bresson et al 2001). However, the impacts of compost application on runoff appear to be quite contextual, and are affected by both the content/source of compost, as well as by plant community composition of the areas to which it is applied. However, there is evidence that even on severely degraded land and across multiple treatment types, municipal compost/biosolid application resulted in runoff with nutrient levels that were still within safe levels for potable water (for example, Meyer et al. 2001).		that the greatest risk of nutrient loading (P, K) is associated with manure-based compost. There are not any 303b controls under the Clean Water Act regarding on-site composting and runoff. Compost is also cited as helping states meet TMDL requirements, including in West Marin here in California. There do not currently appear to be any CEQA precedents for compost application and water quality, though this seems to be a likely avenue for regulation. It seems challenging to make the case	opinions could be variable depending on experience and qualifications, the reviewers agree that the consultation with a QE, along with the regulatory compliance requirement, and the ACR requirements to report on any net environmental impacts in the GHG Project Plan are sufficient for the protocol language.

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
				against compost as a non-point source of surface water pollution versus the much higher influx of more runoff resulting from more widespread and commonly used agricultural products.	
4.10	Application of compost should be added to most Grazed Grasslands – will need buffers around waterways, bodies of water, and slopes will be problematic for erosion.	The protocol does not currently restrict compost application on certain slopes. We were unable to locate any restrictions by the NRCS on applying compost to slopes above a certain grade. There is evidence that compost application helps stabilize surface soil, reducing runoff and erosion (for example, Bresson et al 2001). However, the impacts of compost application on runoff (and thus surface erosion) appear to be quite contextual, and are affected by both the content/source of compost, as well as by plant community composition of the areas to which it is applied. From a practical perspective, it seems to be recommended that an	A risk analyses would be quite beneficial here. With the National Climate Assessment clearly showcasing increased frequency of high intensity precipitation events, there is greater risk to producers for compost to end up in waterways Has this been considered?	While certainly beyond the scope of this protocol, such a risk analysis could be instructive to rangeland managers. To our knowledge nothing like this has been carried out at this point in time.	Reviewers believe that water quality and runoff concerns are significant, especially in light of the EPA's proposed rule 'Waters of the United States', which will be decided on late fall 2014, or in 2015. Project developers and landowners very well may be uncertain, and unwilling to move on surface compost applications until this is resolved, as the proposed rule could

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		expert, in this case the QE or extension agent, is consulted to determine maximum appropriate slope for application.			cause runoff from compost to put a farm or grazing operation out of compliance with the Clean Water Act. Recognizing this, the reviewers see no need to amend the protocol further on this topic. Although the QE opinions could be variable depending on experience and qualifications, the reviewers agree that the consultation with a QE, along with the regulatory compliance requirement, and the ACR requirements to report on any net environmental impacts in the GHG Project Plan are sufficient for the protocol language.
4.11	Line 96: A significant portion of the added	-	-	Line 96: At least half of the C is going to	Accepted

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	C might not end up in stable C pools if the surface soil horizon is already at its maximum steady state for that environment. There would have to be excellent micro/mesofaunal activitity (worms, insects, burrowing small mammals) to incorporate that compost down into the soil. Line 123: Validation and calibration are thrown together here. They are independent activities, not using the same material to sample. Lines 136-139: This paragraph paints a highly optimistic general picture of the benefits of compost application to grazed			decompose, if not more. But that's not the point of the protocol – some of the carbon will remain and accumulate over time. Line 123: You are correct. The word "calibration" has been removed.	

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	grasslands, which is poorly or not substantiated. It's not clear why the emphasis is on grazed grasslands as opposed to hay meadows. Grazing brings in so much more complexity and variation.				

5. Definitions

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
5.1	The native grassland definition of Stromberg et al 2007 is quite poor (only 10% of cover by perennial plants)	We requested additional clarification from the reviewers to see if they have a preferred source/definition. We chose this definition as it was the best one we could find and improved on the definition previously employed in earlier drafts of the protocol.	Agreed.		
5.2	I wish that the definition of "compost" were more explicit		-	In terms of monitoring, we are requiring a project proponent to keep	Accept

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	considering that it is the main focus of this methodology. This is key because the source materials for compost are highly variable, C:N ratios differ, and they may be in different stages of maturity (decomposition or stabilization). See my comment in section 2.8 above about defining grazed grasslands. To add, does this method apply to all ecoregions of the U.S.? Does it include grazing of winter wheat, much of which does not get harvested for grain? This section			records of compost analysis/compositio n. C and N are already stipulated as two of the data parameters required for monitoring. However, we have explicitly added that C:N ratios are to be calculate in the monitoring section. This is a valid question. The protocol should be applicable to a variety of ecoregions. It would not be applicable to crop types such as winter wheat that would be cultivate in mixed-use pasture that would alternately be grazed and sown	

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	defines native grassland, but keep in mind that much, or maybe even most, grazed grasslands in the U.S. contain introduced plants and naturalized plant communities.			with grain, etc. It would also not be applicable to permanent pasture/grasslands that are not tilled. Most grasslands contain other species – we recognize this.	

6. **Applicability Conditions**

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
6.1	Stocking rates are bureaucratic here. They need to adaptive to current conditions and employ flexibility within and among years to achieve the desired use and balance forage availability with forage demand.	"Year-to-year" variation in stocking rates may occur as ranchers adapt their management to many external factors (e.g. rainfall, forage production, market variations). Typically this is done based on historical use and experience. If a rangeland consultant is involved, it is based on an assessment of available forage, recommended end of season Residual Dry Matter requirements, available water and other and management considerations (eg, year-	Accept, however authors could add to their criterion for SR that residual dry matter, ground cover, and regeneration ability/ vigor of the desirable plants are not degraded below QE-assessed limits. Additionally, it was		

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		long vs seasonal grazing, etc).	observed that few land managers are using this sort of flexible stocking		
6.2	What are the ramifications of drought management here regarding stocking decisions? What is the flexibility here?	The stocking rate determination procedure defined in the protocol is inclusive of both wet and dry years. The goal is not to reach/maintain the average stocking rate each year, but to recognize the potential for high annual variability in the stocking rate due to these types of factors. We feel that the protocol is adequately flexible to accommodate management decisions resulting from abnormally dry or wet years.	How about extended drought/dry years (ie California)? This has been seen in SE Colorado, and panhandles of Oklahoma and Texas to many year droughts.	This may well be true. Dry periods will obviously result in lower biomass production and grazing. It may also result in C losses. But with adequate model validation for dry climate regimes there is no reason why this should be a barrier to developing a sound protocol for quantifying either the positive or negative changes in soil C.	Accepted, it is generally agreed that there are many rangeland and grazed grassland systems for which these project activities may not be a wise investment. These choices are left up to the project developers. As this is a voluntary, market mechanism, only places that promise a return on investment to set up these kinds of complex projects will come to fruition. With strict requirements for the model, along with calibration and validation guidelines, we should be able to capture only the permanent carbon

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					increases.
6.3	Soil texture needs to be verified for project parcels – how to handle the variability in this within a parcel? Fundamentally key for the model validation and accuracy.	Section 10 (Monitoring) addresses soil texture as follows: • **Soil**. At least three soil samples shall be taken within each stratum representing at least 0-20 cm. If the relative standard error among the three samples is greater than 20%, more samples shall be taken until the relative standard error is less than 20%. Project developers may choose to take more and deeper samples than this minimum requirement. Samples shall not be composited. The following measurements shall be conducted on the soil samples: ○ Soil carbon ○ Soil texture ○ Soil bulk density Note that the project developer is allowed to measure the soil carbon at the start of the project *after* compost application on reference locations within the	Clarification - what is the *a priori* knowledge of soil texture?	We have searched the entire document and can find no mention of "a priori knowledge of soil texture. As such, we are unclear what the reviewer is referring to.	Accepted

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
		Project Parcels that did not receive the compost application. The latter is feasible when reference locations are shielded from compost application by putting a tarp at that location and removing the compost that is deposited on the tarp before soil carbon analysis.			
6.4	If the compost cannot be added to intact, healthy native plant communities (what is meant by this? This has to be clearly defined and articulated), then most of the best producers will not be involved. Clear disconnect here in that prior poor managers are targeted for this protocol.	The "health" of a native plant community (defined by the NRCS as any plants that pre-date European settlement in the US) is best determined in consultation with a qualified expert, since "native plant communities" are defined by their geography and will be impacted thusly by location-specific conditions. The text has been updated to reflect this.	Agreed.		
6.5	Regarding the minimum stocking rate being set to not negatively affect	We have updated the text to remove the assumption that compost amendment will always result in improved soil quality. With regard to	Agreed.		

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	plant species composition in response to soil quality improvement following compost addition is clearly ambiguous. First, it is assumptive that soil quality (defined as what as this a very nebulous term) increases with addition of compost. Second, what data exists to showcase that grazing during drought (when plants are dormant and not growing anyways) is detrimental? It is the grazing following recovery of drought that is most influential here for plant communities. See the Heitschmidt et al. 2005 paper	the second point, can the reviewer please clarify if they were referring to any specific text in the applicability condition section? As it is written currently, no reference is made to grazing during drought being detrimental to plant communities.			

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	R. K. Heitschmidt, K. D. Klement, and M. R. Haferkamp (*2005*) Interactive Effects of Drought and Grazing on Northern Great Plains Rangelands. Rangeland Ecology & Management: January 2005, Vol. 58, No. 1, pp. 11-19.				
6.6	Line 220 – is 2 months the minimum for regularly flooded soil or just guidance?	Two months is guidance, not prescriptive.	Agreed.		
6.7	Lines 173-174: One can't set the stocking rates (SR) and maintain them in such a narrow range over a 10-yr period. SR will have to change between wet and dry years and market cycles more than 3%. Then on Line 181, the points about min and max SR are really trying to get at carrying	-	-	We appreciate the reviewer's comment but feel they may not have read the text on stocking rate determination closely enough. The text reads as follows: The annual, minimum and maximum Stocking	Accepted

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	capacity and degree of forage utilization. The min level is probably not important to state, but max level is important and appropriately stated here. But I would replace "rangeland" with "grassland." Humid grasslands with mostly introduced species are pastures, not rangeland.			Rate shall be determined via consultation with a Qualified Expert (see definitions – a Certified Rangeland Manager, NRCS Soil Conservationist or Qualified Extension Agent) and duly justified by the Project Proponent. Justification for the annual Stocking Rate should include a calculation of the historical Stocking Rate averaged over a 10 year period prior to the start of the Project, and an assessment of whether or not the forage productivity and quality of the parcel can sustainably support the historical	

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				Stocking Rate[1]. In some cases the conditions of the parcel will justify using the historical Stocking Rate as the annual, while in other cases the Qualified Expert may set an annual Stocking Rate that differs from the historical Stocking Rate. Validation of the GHG project plan will include a review of the criteria used by the Qualified Expert to ensure annual Stocking Rates during the Project lifetime are sustainable, and will not lead to erosion	

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
				or negatively affect species composition; subsequent verifications will review changes to the annual Stocking Rate and ensure that a Qualified Expert was properly consulted. The maximum Stocking Rate shall be set so that rangeland utilization remains sustainable, taking into account an increase in forage production and any changes in the percentage of grazer feed coming from purchased sources after the start of the crediting period.[2]	

[2] This approach is fully compatible with a rotational grazing strategy.

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				The minimum Stocking Rate shall be set to ensure that plant community species composition does not change toward a less desirable plant community in response to soil quality changes following compost application.	
6.8	Perhaps more importantly than stating max %N would be to set a C:N floor.		-	We have updated the protocol to reflect monitoring of C:N ratio in addition to C and N compositions of the compost. See section 10 Monitoring.	Accepted

7. **Project Boundary**

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
7.1	By encouraging combining project parcels spread over a large geographic region (defined as what?) does this not increase the costs of application due to mileage and negate practicality of this for producers?	The local availability of compost material is a limiting factor/constraint, not parcels spread over a large geographic region.	With high fuel prices and transportation costs per mile, reviewer disagreed. Transportation costs are certainly a limiting factor.	Perhaps, but this is the domain of the project proponent and/or the rancher and not the protocol developers. There may well be situations where the local availability of compost and the large geographic area of the land being managed will limit the protocol's practicality for certain producers. That is of course up for them to decide based on their site specific knowledge.	Accepted.
7.2	By dividing heterogeneous project parcels into smaller units, the protocol is creating a train wreck for	From a modeler's perspective, there needs to be a certain amount of discretion in how to assemble the data set required in order to validate the PBM and delineate a useful parcel size	Dividing into parcels is wise modeling and monitoring purposes however this could be a burden (and barrier) to	We agree it could be a burden to producers.	Accepted. ACR notes that project developers who may have a large homogenous area (a single parcel), could

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	record keeping and producer interest due to huge variability in soils, topography, ecological sites, plant communities, prior and current and future management, etc.	for validation. Ultimately, we feel the bar needs to be set high for modeling to promote the greatest accuracy.	producers.		have trouble spreading compost over the entire parcel at once due to time, equipment, and compost limitations. This would probably require splitting what could be a homogenous single parcel into multiple parcels for monitoring purposes. The authors could choose to add a requirement that each distinct parcel must have compost applied in one single application, over a limited period of time.
7.3	Historical rangeland management practices will be an accounting and verification nightmare on many places	We understand the reviewer's concern and feel that with novel agricultural offset protocols, achieving critical mass is essential to the process of later being able to refine and improve data collection/accounting and verification for future project instances.	Very limiting then in terms of the few producers that may want to participate here	This is possible, but participation in this protocol is up to them.	Accepted
7.4	By treating each	We understand the reviewer's concern	Very limiting then in	This is possible, but	Accepted

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	identified stratum separately, this will be hugely problematic for producers – accounting nightmare	and feel that with novel agricultural offset protocols, achieving critical mass is essential to the process of later being able to refine and improve data collection/accounting and verification for future project instances.	terms of the few producers that may want to participate here	participation in this protocol is up to them.	
7.5	Determining background losses of SOC with modeling is a crapshoot at best. Again see the high ineffectiveness of models for soil carbon in arid and semiarid grasslands in the Brown et al. 2010 paper above	When various models are validated for a new environment, there is an inherent upfront workload required to get good parametric data for model inputs. A model is only as good as its input parameters. Model input values must be adapted to local scenarios/circumstances. The protocol is intended to spur development/enhancement of models.	Is it appropriate to rely on model development to drive this	Opinions on this may differ, but it remains possible that existence of a protocol like this may provide an incentive for more data collection and model development which is no doubt needed.	Accepted
7.6	Determination of baseline aboveground non tree biomass could be highly impacted by recent drought	This is true, and the way the baseline is currently determined accounts for both abnormally wet and dry years.	Accepted.		
7.7	Need to know what depths of soil that are expected to increase in SOM (but I thought the	Please see earlier comments regarding depth. This change in terminology is likely due to multiple authors working on the draft and should read SOC. This	Accepted.		

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	emphasis here was SOC – so why the change in terminology here?).	has been clarified.			
7.8	Where is the rationale or scientific evidence for a three year interval between compost applications? How does drought impact this?	There is not a particular scientific rationale supporting the "three year rule." Three years is based on the assumption that that is a long enough time to permit and observe any negative impacts/ecosystem responses resulting from the first compost application (in consultation with a QE). It is important to note that the protocol does not require re-application at the three year mark, but the relatively long-term modeled lifespan of the practice indicates that compost should probably be reapplied at least in the 20-30 year range. While this decision should ultimately be based on a soil evaluation by a QE, we believe the protocol is flexible enough as written to accommodate variations in re-application times.	Have you considered that livestock manure is often annually applied on crop fields, and less frequently on hay fields or native vegetation?	This may be true, but we don't see it as being a major impediment to this protocol. Nationally there is a great need for strategies to spread livestock manure on a much wider land base than is done presently in order to minimize water quality issues. Our composting protocol could even help spread manure on a wider land area.	Accepted
7.9	Table 1: baseline, project parcels soil: CH4 and N2O are likely to be small, but the change is even	Regarding N2O and other emissions, please see the following from the introduction of the protocol:	Reviewer observed that this response does not address concerns about Table 1 and the	Comment 1 .In an earlier round of edits the terms for soil N2O and the	Comment 1: Accepted Comment 2: Reviewers agree that in the interest of

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	more likely to be smaller Ruminants: if compost is expected to increase forage production, wouldn't increased ruminant emissions be a direct outcome? The key word here is "direct." Not clear where this is going… Soil is mentioned, but table 2 requires biomass measurements; also, no description of how to quantify changes in biomass or how to use these in the emission calculations Low rates of leaching seems reasonable. Are there data to back this up? Not including this is not inherently conservative. Same comment for N2O emissions… Also,	Adding compost to Grazed Grasslands has the potential to increase GHG emissions from secondary sources. Specifically, N_2O emissions from soils are produced due to nitrification and de-nitrification of the available N added through the compost addition (Box 1). These processes further require a carbon source, which is readily available after compost addition. Indirect emissions from nitrate leaching may also occur but GHG emissions resulting from the leached nitrate are expected to be insignificant, at the rate compost is applied in projects under this methodology based on findings reported by DeLonge et al. (2013) for California grasslands. In addition to soil N_2O emissions (from de-nitrification), all emissions from fuel that was used to create, transport, or apply the compost is included in the quantification procedure. Under this methodology, soil N_2O emissions are quantified using an applicable Tier-2 Empirical Model, or a calibrated PBM. The GHG emissions from increased fuel use must be quantified using standard emission	associated text describing which fluxes/pools are to be included in the baseline and in the project. 1. Soil N2O is included in the baseline, but not the project. This implies the assumption that composting will not lead to increased N2O fluxes from soil+compost compared with soil N2O plus the alternative fate of the composted material. This contradicts the introductory text pasted here and the text preceding table 2.	change in SOC were mistakenly removed from the project emissions. The terms have now been returned to the equations which corrects the inconsistencies highlighted by the reviewer. See edited Equations 5-7 in Section 9.3. Comment 2. In the protocol a key part of the rationale that average stocking rates must be maintained within a narrow range over the 10 yr crediting period is to avoid increasing ruminant emissions. Comment 3. The methods of	conservativeness, it is prudent to add the quantification for increased enteric emissions due to increased stocking. This can be done by using the GLLM Microscale tool to estimate enteric emission changes between project and baseline, using IPCC Tier 1 and 2 values. We suggest that the baseline stocking rate be set by averaging at least three of the last five years of herd size to get the most representative herd size. Any changes in this baseline stocking rate will need to be documented and verified. Also, please consider

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	justification there doesn't match. The potential to include baseline landfill CO2 emissions (depending on whether the composting facility claims them or not) while also including change in litter (which includes compost) seems likely to lead to double counting (if the composting facility isn't claiming ERTs)	factors.	2. The argument that increased ruminant emissions are not a direct emission source is not justified. Any justification should carefully consider what makes these emissions not "direct" and not included while emission reductions associated with reduced importation of forage are included. 3. This response does not address the fact that biomass is listed in table 2 as an included pool, but there is no	quantification (Equations 1-7) calculate the change in SOC for the baseline and project emissions. These either come from the empirical equation or the model. These methods of assessing the change in SOC include Biomass pools and thus are not being ignored. We just can't see everything captured in the model or empirical equations that will be developed. These would have to be inclusive of above- and below-ground biomass. Also in the monitoring requirements	removing the language in the methodology-project scenario section 7.2 "avoided emissions related to the lack of transportation associated with importation of forage" if we believe that better reflects the projects, since these emissions are not included in the baseline or listed as a source of emissions in Table 1. (This has been completed by the authors – 9/30/14) Comment 3: Biomass C is not part of soil C (SOC). Thus quantifying SOC does not produce information about biomass C. If biomass C stocks are an important component of ecosystem C stocks that

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			description of methods of quantification. 4. This is going to be a tough one for producers to get their hands around.	(Section 10), we require periodic assessment of forage productivity Comment 4. Agreed. Educating producers on how models are developed and what processes and pools they involve remains an ongoing and needed exercise.	must be quantified (table 2), quantifying change in SOC is not sufficient. (This has been completed by the authors – 9/30/14)
7.10	Lines 253, 254: Change "rangeland" to "grassland" to be consistent with defined target land use. Stratification according to management can include annual vs. l for characterizationpere nnial forage species, season of grazing (e.g. winter vs. summer) degree of		-	Rangeland has been changed to grassland. Lines 225/6/7: We don't really go into that level of detail in terms of using a local soil survey, though such a survey could be useful for characterization of	Accepted

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	hay harvesting. Lines 255, 256: include criterion of soil mapping unit, which will cover the soil and hydrology characteristics mentioned. Line 257: Degradation status can be gauged by comparison to benchmark soils identified by the local soil survey as to thickness of A horizon and SOC level of the A horizon, if known.			hydrological aspects. We have updated Section 7.1.3. (stratification) to include consideration of an official soil series description as a parameter, as available. Line 257: Soil degradation compared to what? It would have to be another A horizon in a similar/homogeneous area. This is likely too detailed for the purposes of this protocol, which is why some degree of latitude is left up to the QE (in consultation with the project	

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				proponent).	
7.11	Lines 260-263: Here and elsewhere, very onerous data collection and monitoring. The data burden would probably discourage anyone from actually trying to claim ERT credits from grazed grasslands. Simplification is encouraged.		-	We understand the reviewer's concern and feel that with novel agricultural offset protocols, achieving critical mass is essential to the process of later being able to refine and improve data collection/accounting and verification for future project instances.	Accepted
7.12	Line 275: But many grasslands are gaining C or at near steady state depending on where they are on the soil regeneration or degradation scales.		-	Some research states that many grasslands are losing SOC, while others may be gaining or at a steady state. This is inconsequential since we're just looking at background changes (and "background losses" in the text	Accepted

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
				has been clarified to "background changes.")	
7.13	Table 2: Change "non-tree" to "non-woody." The stimulation of forage yield depends on quality of compost and precipitation to move nutrients below the surface. How will the project proponent know yield response? Above and below ground responses depend heavily on pre-application soil fertility levels. Soil OM increases will depend on how far below steady state that soil is. Changes will occur slowly and not deeply because of nonincorporation.		-	Non-tree changed to non-woody as applicable. Yield response could be gauged through simple visual observation, or through more rigorous data collection. In the monitoring section (Section 10), we have made values of primary production required in order to help determine yield response. Additionally, we would ideally want an exclusion area in the project site where livestock cannot get in to	Accepted

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				consume grass. This way, primary productivity can be measured in dry matter/unit area. We have indicated that this should be required for plant community monitoring in section 10.	
7.14	Page 15: Footnote 16 is missing.		-	We are not sure where this occurred due to differences in page numbers.	Accepted

8. Procedure for Determining the Baseline Scenario and Demonstrating Additionality

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
8.1	Stocking rates 3 years prior to start of project can be highly influenced by occurrence of drought? How is this accounted for?	The stocking rate determination as described in the protocol currently accounts for both abnormally wet and dry years. However, we have updated the protocol on page 18 to reflect a 10 year period prior to	Strong Agreement with response.		

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
		project start rather than three.			
8.2	For Tier -2 Empirical model, where does the data from at least 5 sites across two years come from? Currently, there are only 2 sites in CA.	This is intended to be a future activity to be carried out by local scientists.	Perhaps make that more clear in the document.		Accepted
8.3	Applicability of compost addition is also dependent on topography, and slope, as well as distance to a waterway or body of water			We don't disagree. Establishing a setback distance is not a bad idea, though this should be done in consultation with a QE due to variability in local conditions and compost composition. We have added a sentence stressing that application will need to be in accordance with local/state regulations regarding	Reviewers believe that water quality and runoff concerns are significant, especially in light of the EPA's proposed rule 'Waters of the United States', which will be decided on late fall 2014, or in 2015. Project developers and landowners in some locations very well may be uncertain, and unwilling to move on surface compost applications until this is resolved, as the proposed rule could cause runoff from

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
				application and water quality concerns.	compost to put a farm or grazing operation out of compliance with the Clean Water Act. Recognizing this, the reviewers see no need to amend the protocol further on this topic. Although the QE opinions could be variable depending on experience and qualifications, the reviewers agree that the consultation with a QE, along with the regulatory compliance requirement, and the ACR requirements to report on any net environmental impacts in the GHG Project Plan are sufficient for the protocol language.
8.4	For model validation, at least 10 measurements of the variable in	The text has been updated to remove overly specific requirements for the PBM validation and to reflect the	Some agreement but observation that even if flat topographically, the		

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	question within 50 km of the project parcel? What about the huge differences in soils, weather, topography, management, etc associated with this?	need for some judgment to be left to the model validator in order to determine what is adequate for local circumstances. In very heterogeneous conditions this may not be a sufficient number of samples, but in areas that are flat, it could be.	soils can be quite heterogeneous.		
8.5	Line 363: insert "to" between "approach" and "demonstrate"	Updated.	Thanks. Accepted.		
8.6	There were a number of comments regarding the 3 prong additionality tests – some reviews thought all three must be satisfied. Refer to section 9.2 – the methods to calculate baseline emissions for both landfill and manure management require parameters which are specific to the landfill and/or farm manure management conditions which indirectly require the first option to be	Producers just need to satisfy one of the three prongs. Any loopholes that exist are not a problem of the protocol but rather the way that the American Carbon Registry approaches additionality.	Clarify that only one option is required to be met. Generally the reviewers didn't like the use of the word prong. Can the ACR staff please address the original comment and potential for loophole in additionality test. Also address how the methodology requires specific knowledge of landfill and/or manure	In the current draft we have replaced "prong" with "option" and underscored the requirement for only one option. It now reads as follows: "Project proponents shall use ACR's three-option prong approach to demonstrate additionality. Specifically, in cases where ERTs from	The reference to the three prong approach seems to be a misunderstanding. Please use ACR Standard language, and switch 'option' back to 'prong'. The reviewers were reacting to the three bulleted options for landfill diversion. The three options listed (lines 385-394) do not take into account the fact that many landfills in the US are capturing

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	satisfied. The fact that someone could use options 2 and 3 in the event that they could not satisfy option 1 creates a loophole for cases where statistically there is a baseline but not in the case of the specific waste being managed.		management but does not require that they are considered for additionality.	landfill diversion are obtained, it must be demonstrated that the source material used for composting was diverted from a landfill or anaerobic manure storage by at least one of the approaches detailed below."	methane. The authors could add discount factors to represent the amount of landfills in the US that capture methane, and the average effectiveness of these landfill gas capture devices. Otherwise, the authors could stipulate that project proponents are only eligible for avoidance of anaerobic decomposition if they can identify the landfill that their compost would have ended up at, and show evidence to a verifier that this landfill was not capturing fugitive methane gas. The reviewers also pointed out that the CDM tool used to calculate methane emissions avoided from disposal

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					(line 506) requires definition of the effectiveness of fugitive gas collection at the landfill. This will require specific knowledge of the baseline landfill. Additionally, if the compost contains manure, the project proponent would need to demonstrate to a verifier that the baseline site of manure disposal did not include treatment in an anaerobic digester. (This has been completed by the authors – 9/30/14)
8.7	Line 324: I would replace "prong" with "option." Three-prong normally means that all prongs will be used at the same time. But		-	Updated.	Accepted. After further discussion with the reviewers, ACR requests that the document use the ACR Standard terminology – please

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	here, the authors are offering options, of which the proponent may use as few as one.				change back to Three-prong approach.
8.8	Line 343: What are the units for SR? The best would be animal-unit days/ha within a calendar year. Whether the SR exceeded the reasonable carrying capacity would important to know. Also need to know here how much hay was harvested and removed. Haymaking has not been and should not be precluded from the definition of grazed grassland.		-	The protocol is currently written as: Livestock units (also known as animal units) are a standardized measure used by the UN Food and Agriculture Organization to quantify Stocking Rates for multiple animal types and growth stages based on an estimate of the metabolic weight of the animals. A livestock unit is measured as livestock unit/time/hectare. More information on the quantification of	Accepted.

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				livestock units for grazing systems in North America can be found at: http://www.lrrd.org/lrrd18/8/chil18117.htm	

9. Quantification of GHG Emission Reduction and Removals

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
9.1	Looking at soil total carbon or just soil organic carbon?	Just SOC. There may be calcium carbonate in the soil, in which case it will be eliminated from the analysis of the soil sample(s).	OK		
9.2	Lines 444: uncertainty for input parameters is not clear. Which input parameters? What if some (e.g., climate, soils, land use history, etc.) are unavailable or unknowable? Line 445-: this procedure seems to describe an approach	For climate parameters as required by the protocol, we feel there is no uncertainty. Uncertainty related to soil is manageable through monitoring – please see the section on soil monitoring on page 26. Changes in SOC can be confirmed to some extent, but not N2O.	One reviewer commented that the authors clearly agree that the uncertainty for some input parameters can be estimated, but for others (e.g., climate data) it cannot. Guidance on which to inputs to include in the	Of course soil is an input parameter. The protocol requires an initial soil test giving us info about soil bulk density, soil C, etc. There will be an error range around the mean, etc., and	Accepted.

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	for validating a model's ability to predict the baseline, not the change in SOC/N2O. The ability of the model to do the latter may not be represented by an evaluation of the former.		uncertainty assessment are necessary for evaluating the approach taken by project proponents. Soil is not an input parameter, so I am not clear on how soil monitoring can be used to inform input uncertainty (though it is clear that observed changes in soil C stocks can be used to assess model structural uncertainty). Another reviewer concluded that the uncertainty related to soil is highly underestimated here. Tremendous variability due to plants, plant life/growth forms, small-scale erosion/deposition, etc.	there is additional monitoring of data and parameters available at validation. Perhaps we aren't understanding the reviewer's comment. We are trying to capture the heterogeneity at the parcel level, not the entire US.	
9.3	Line 447: why do models have to be validated if the model	Structural uncertainty exists within the model itself and thus still	Data used for evaluation of model structural	We totally agree that data used for	Accepted

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	structural uncertainty is estimated? Isn't this a demonstration of how valid a model is? Lines 467: uncertainty for input parameters is not clear. Which input parameters? What if some (e.g., climate, soils, land use history, etc.) are unavailable or unknowable?	requires ground truthing with real-world data. When various models are validated for a new environment, there is an inherent upfront workload required to get good parametric data for model inputs. A model is only as good as its input parameters. Model input values must be adapted to local scenarios/circumstances. The protocol is intended to spur development/enhancement of models.	uncertainty should be independent of data used to parameterize a model. If the intent is to spur model development, this should certainly be clearly stated in this methodology.	evaluation of structural uncertainty should be independent of data used to parameterize the model. The text of the protocol does not contradict this.	
9.4	Only 3 samples for the 0-20 depth? Huge variability in rangeland/grassland soils that must be accounted for with more robust sampling.	We have updated the text to remove overly specific language and clarify the sampling requirements based on the heterogeneity of conditions and the discretion of the validator.	Accept Ok		
9.5	Line 471: insert "landfill" between "avoided" and "emissions"?	Updated.	Thanks		
9.6	Lines 485 – 488: the CDM tool for determining methane emissions avoided from	We have made this change to the text.	Thanks		

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	disposal of dumping waste… is not sufficient to calculate Section 7.2 Line 307 – (eg manure management systems) – suggest reference to calcs in ACR livestock methodology for baseline determination. To use such a calculation method you would need to have on farm specific data on manure management which is inconsistent with the Additionality test options 2 and 3 in Section 8.1 – you could only develop a baseline using option 1.				
9.7	In CDM tool for determining methane emissions avoided… parameter f (see below) requires specific knowledge of the landfill that waste would have gone to in order to quantify the amount of gas that would/may be collected by landfill gas	Can the reviewers please clarify this comment?	The CDM tool is designed to calculate the amount of fugitive methane that would have been emitted from a landfill. In the US it is highly likely that the organic material would have been sent to a landfill that had some degree of landfill gas	We agree that this is a comment for ACR to weigh in on.	The reviewers were reacting to the three bulleted options for landfill diversion. The three options listed (lines 385-394) do not take into account the fact that many landfills in the US are capturing methane. The authors

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	collection system. This is not typical in CDM because projects are in Annex II countries (developing) however in the US the majority of large landfills will have some gas collection – as a result parameter f is going is applicable and material. This approach (knowledge of the specific landfill and waste management of the organic waste) is inconsistent with the Additionality test options 2 and 3 in Section 8.1 – you could only develop a baseline using option 1. From CFM tool - Data / parameter: f Data unit: - Description: Fraction of methane captured at the SWDS and flared, combusted or used in another manner Source of data: Written		collection – meaning that some material amount of the CH4 emissions would have been collected and combusted in the baseline. As a result – the specific landfill contemplated in the baseline has to be considered when applying the CDM tool. This is at odds with the 2 of the 3 options under the additionality test which do not require knowledge specific waste management practices. Perhaps the ACR staff can comment here.		could add discount factors to represent the amount of landfills in the US that capture methane, and the average effectiveness of these landfill gas capture devices. Otherwise, the authors could stipulate that project are only eligible for avoidance of anaerobic decomposition if they can identify the landfill that their compost would have ended up at, and show evidence to a verifier that this landfill was not capturing fugitive methane gas in the baseline scenario. The reviewers also pointed out that the CDM tool used to calculate methane

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	information from the operator of the solid waste disposal site and/or site visits at the solid waste disposal site Measurement procedures (if any): - Monitoring frequency: Annually				emissions avoided from disposal (line 506) requires definition of the effectiveness of fugitive gas collection at the landfill (parameter f). This will require specific knowledge of the baseline landfill. Additionally, if the compost contains manure, the project proponent would need to demonstrate to a verifier that the baseline site of manure disposal did not include treatment in an anaerobic digester. (This has been completed by the authors – 9/30/14)
9.8	Says 5 years here of historical stocking rates, but was 3 years in prior part of document. Which is correct?	Can the reviewers please point out where this text occurs in the Quantification section?	No reviewer response.		

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9.9	Line 492: according to table 1, shouldn't CO2 emissions from composting be included here too? Also, A(i) and many of the subsequent variables aren't included in this equation. A significant component of the calculations is missing here.	The reviewer is mistaken in this case. In line 492 we present the equation for $BE_{landfill}$ under the "Baseline Emissions" general equation where the organic waste material is initially directed to the landfill. Any emissions related to composting and compost application would only be relevant to include in the "Project Emissions". These are described in detail in Section 9.3. Also, the equation for $BE_{landfill}$ does not require an area term (i.e. A(i)) since it is based on a discrete mass of organic waste and all the degradable C contained therein quantified prior to application to the project parcel.	A reviewer observed that the author has mistakenly looked at some other version of the manuscript than the one we were asked to review. The original comment refers to line 492 – [EQ5]. In peer review version 2.0, this falls on line 508. This equation is followed by definitions of several terms that are not used in EQ5. There is no mention in the project emission calculations of changes in C stocks, N2O emissions, etc – only fuel and compost CH4. The baseline equations clearly specify emissions for baseline only. Where are the soil C and N2O emissions accounted for in the project emissions?	In an earlier round of edits the terms for soil N2O and the change in SOC were mistakenly removed from the project emissions. The terms have now been returned to the equations which corrects the inconsistencies highlighted by the reviewer. See edited Equations 5-7 in Section 9.3.	Accepted
9.10	What about use of prescribed fire for	Fire is excluded. Models available do not yet have the capacity to account	Ok		

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	beneficial management by producer? Can this be incorporated into protocol or is all fire excluded? Not seeing any difference in production aboveground in semiarid parts of the Great Plains with prescribed fire. See Augustine and Derner 2014 Controls over the strength and timing of fire–grazer interactions in a semi-arid rangeland David J. Augustine[1,*] and Justin D. Derner[2] Article first published online: 20 DEC 2013 DOI: 10.1111/1365-2664.12186 © 2013 The Authors. Journal of Applied	for fire as a management practice.			

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	Ecology © 2013 British Ecological Society **Issue**  Journal of Applied Ecology Volume 51, Issue 1, pages 242–250, February 2014				
9.11	Lines 429-430 in box: The 44/7 for N2O doesn't seem correct. Shouldn't it be 44/28?	-	-	This has been corrected to 44/28	Accepted
9.12	Page 23 on "Annual indirect change…": How would one separate forage growth from forage intake be the - grazers?	-	-	Given that stocking rates (and thus the grazing intensity) will be maintained within a known range, there is no reason why additional forage	Accepted

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				growth can't be estimated independently using the proponent's chosen PBM.	
9.13	Page 25: Leakage of what? Compost? Emissions?	-	-	The following sentence clarifying our definition of leakage was added to section 9.5. "Emissions leakage refers to instances where activities to reduce emissions from a project parcel may result in increased emissions due to activities and market shifts occurring at locations beyond the project boundaries."	
9.14	Line 486: Hard to expect that the grassland will remain grazed every year for 10 years, esp.	-	-	We appreciate the reviewer's comment but feel they may not have read the	Accept

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	within the 3% tolerance prescribed earlier. Herd sizes and grazing-days vary within and across years. A potentially more important variable in this whole project is degree of forage utilization by the cattle, as opposed to actual stocking rates.			text on stocking rate determination closely enough. The text reads as follows: The annual, minimum and maximum Stocking Rate shall be determined via consultation with a Qualified Expert (see definitions – a Certified Rangeland Manager, NRCS Soil Conservationist or Qualified Extension Agent) and duly justified by the Project Proponent. Justification for the annual Stocking Rate should include a calculation of the historical Stocking Rate averaged over	

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				a 10 year period prior to the start of the Project, and an assessment of whether or not the forage productivity and quality of the parcel can sustainably support the historical Stocking Rate[3]. In some cases the conditions of the parcel will justify using the historical Stocking Rate as the annual, while in other cases the Qualified Expert may set an annual Stocking Rate that differs from the historical Stocking Rate. Validation of	

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				the GHG project plan will include a review of the criteria used by the Qualified Expert to ensure annual Stocking Rates during the Project lifetime are sustainable, and will not lead to erosion or negatively affect species composition; subsequent verifications will review changes to the annual Stocking Rate and ensure that a Qualified Expert was properly consulted. The maximum Stocking Rate shall be set so that rangeland utilization remains sustainable, taking into account an	

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				increase in forage production and any changes in the percentage of grazer feed coming from purchased sources after the start of the crediting period.[4] The minimum Stocking Rate shall be set to ensure that plant community species composition does not change toward a less desirable plant community in response to soil quality changes following compost application.	

10. Monitoring

[4] This approach is fully compatible with a rotational grazing strategy.

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
10.1	Line 516: understand the desire to reduce complexity associated with leakage calculations, but exclusion of this potential source of emissions is not conservative. The rationale that increased stocking rates are not a direct outcome of the increase in forage production is weak and seems to contradict the applicability condition that stocking rates account for an increase in forage production. As one of the previous reviewers pointed out, the potential to increase stocking rates to consume increased forage (40-70%!) is a strong incentive for producer participation. Other methodologies have constrained changes in stocking rates or ruminant	We recognize that a significant increase in forage may encourage ranchers to increase stocking rates, possibly to an extent significant enough to negate C storage. However, we also acknowledge that there are other factors acting on ranchers that will influence stocking rate decisions. Most notable among these are market forces driven by increasing global demand for beef. In this context, it makes sense that if stocking rates are going to increase anywhere, it is preferable that this is done in an intensive manner in a low C context. This has raised the issue of needing some kind of "GHG intensity metric," though that is outside the scope of this particular protocol. We would like to pose a question back to the reviewers. It is possible that stocking rate is not the best indicator due to the myriad factors that affect SR determination. Is there another proxy? What other opportunities exist for finding better metrics?	Stocking rate seems to be the most easily-measured indicator of herd methane emissions (though it's obviously a function of diet). An increase in stocking rate proportional to the increase in forage supply seems unlikely to lead to soil C losses, but will increase methane fluxes on-site. Thus exclusion of the SR impacts on soil C may be conservative but impact on CH4 fluxes likely not.		Reviewers agree that in the interest of conservativeness, it is prudent to add the quantification for increased enteric emissions due to increased stocking. This can be done by using the GLLM Microscale tool to estimate enteric emission changes between project and baseline, using IPCC Tier 1 and 2 values. We suggest that the baseline stocking rate be set by averaging at least three of the last five years of herd size to get the most representative herd size. Any changes in this baseline stocking rate will need to be documented and

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	emissions, but it seems that approach was removed at the previous review stage. This revision seems to have weakened the protocol in an attempt to address concerns about the +/- 3% stocking rate and interannual variability. Why not use long-term average stocking rates? Another solution might be to take a more conservative approach initially and study the impacts of compost additions on stocking rates and make adjustments in the future.				verified. Also, please consider removing the language in the methodology-project scenario section 7.2 "avoided emissions related to the lack of transportation associated with importation of forage" if we believe that better reflects the projects, since these emissions are not included in the baseline or listed as a source of emissions in Table 1 (This has been completed by the authors – 9/30/14)
10.2	Line 587: are there guidelines to evaluate whether a model was used and parameterized correctly? What are the requirements for documenting model	As far as we know, this has not been a requirement of other protocols. Ideally, model input parameters should be provided in some form, such as a DNDC input file. Other biogeochemical models may also have some similar input files that	Many protocols do not provide for user parameterization - this should be considered as it will come up in validation/verification. Can ACR provide	Can ACR provide guidance here?	Accepted. Parameterization of model must be documented sufficiently to be verified by a VVB.

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	version, parameters, etc.?	might be used to document the parameterization of the model.	guidance?		
10.3	Line 546: three samples per project? Per field? Per stratum?	Three samples per parcel. This has been clarified.	Thanks.		
10.4	Multiple reviewers observed that more clarity is necessary on the required monitoring.	We have requested clarification on how we can improve the content of the monitoring section/what the reviewers had in mind specifically.	This was a general comment which may now be retired with clarity on other comments.		
10.5	Lines 509-513: Calculate C:N ratio	-	-	We updated the monitoring section to require calculation of C:N.	Accept
10.6	Page 26: Seems that quality of the compost important in predicting release of C and N and then their effects on GHG emissions and forage growth. Not clear how these measurements aim at compost quality. How about the lignin concentration? Line 514: change content to	-	-	Page 26: we feel this is unnecessarily granular. Line 514: done. And regarding bulk density – of course it does, but it is still necessary. The number of samples is context specific. We changed the	Accept

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	concentration. Bulk density of compost depends so much on how compost was handled and stored just before sampling. Line 523: Three samples is hardly adequate, but then the whole data collection design of such a project is very onerous. One soil sample can consist of several (3-6) bulked cores within 1 m of a sampling site. Line 528: Does soil C include carbonate, or just SOC? Line 529: Can simply record soil mapping unit using NRCS soil survey, and check site for map faithfulness. Line 530: BD is difficult to do at 20 cm depth.			protocol during the last round as follows: "The nature of geographic variability in conditions requires that some degree of judgment to be left to the model validator in order to determine the number of field measurement that will be adequate for local circumstances. Heterogeneous conditions may require more samples, while flatter or otherwise homogenous scenarios may require fewer." Whether or not soil C is inclusive of carbonate depends on the lab running	

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				the sample. However, we want to remove carbonate to get at SOC (and for modelling purposes we are only looking at SOC). Line 529: Not a bad idea, could do it with an iPhone app for soil survey using GPS to tell soil stories.	
10.7	Historical management: Need to also know what degree and/or yields of hay-making there's been. Is the pasture chronically overgrazed or at its carrying capacity? Record of past fertilization and liming. Status of soil A horizon in comparison with benchmark soil data. Line 549: Natives only? How about introduced species and improved	-	-	We think this is worthwhile in the historical data, and that the balance between grazing and haymaking is similarly important as that between fertilization and liming. The soil horizon seems too vague – we don't see any real utility.	Accept

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	varieties? Page 27, Line 560: is “ton” a metric ton? The SI unit for metric ton is Mg for megagram. I would state this as metric ton/ha.			Line 549: No. Can readily add percent cover of native and non-natives. Yes, metric ton. SI units are important for strictly academic/peer reviewed work, but we are trying to strike a balance between acceptability to the general public and scientists because this is a practitioner’s document. We’d prefer not to mix units.	

11. Permanence

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
11.1	Page 28, line 598: Is tillage a reversal? Isn’t		-	Yes tillage is considered a	Accepted

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
	tillage allowed for annual pastures such as wheat pastures? If not, then state up front that annual cultivated pastures are not included in definition of grazed grassland. Line 608: grazed grassland is a type of "agriculture." What you really mean is "arable crop."			reversal in this protocol. As such any parcel where tillage is used in establishing an annual pasture would make that parcel ineligible to participate. See paragraph 2 of Permanence Section 11. The term "annual arable crops" has been substituted for "agriculture".	

12. References

	1st Review	Author Response	2nd Review (accept author response or require more)	Author Response	3rd Round Comments (ACR and Reviewer discussion)
12.1					