December 23, 2024

Sara del Fierro
Climate Mitigation Lead
Natural Resources Conservation Service
U.S. Department of Agriculture
Re: NRCS-2024-0015 89 FR 88719

Dear Ms. Sara del Fierro and the NRCS team:

We, the undersigned, commend the Natural Resources Conservation Service's efforts to improve Conservation Practice Standards (CPS) to maximize their climate benefits, as underpinned by peer-reviewed scientific literature. We are writing in response to the recent *Request for Public Input About Implementation of the Conservation Practices to Support Climate-Smart Agriculture* to recommend the evaluation and incorporation of enhanced weathering as a Climate-Smart Agriculture conservation practice. This practice is included as a variance of interim CPS 805 Amending Soil Properties with Lime, currently being used as part of a USDA Partnerships for Climate Smart Commodities grant through Yale University.[1]

Enhanced Weathering (EW) is an uncommonly promising climate-smart agriculture and durable carbon dioxide removal (CDR) solution. It begins with finely crushed mineral feedstocks, often leftover material at quarries, that have high $CO_2$ removal potential, defined as net carbon removal after accounting for life cycle emissions. These minerals are spread onto agricultural fields to accelerate a natural reaction between the minerals, water, and atmospheric carbon dioxide. This interaction converts carbon dioxide from a gas in the air to stable bicarbonate forms. Atmospheric $CO_2$ captured by EW is stored for thousands of years as bicarbonate ions in waterways and the ocean. This also enhances the soil's pH and buffering capacity, which is beneficial for many agricultural soils. Due to high agricultural liming costs, large areas of farmland in the U.S. are below extension recommended pH levels.[2]

Due to its dual carbon removal and soil pH benefits, EW aligns closely with USDA's objectives of promoting practices that contribute to climate mitigation while providing agronomic benefits to farmers. We encourage NRCS to consider the following actions:

1. Adopt interim CPS 805, including the variance that incorporates alkaline weathered rock amendments, as a national conservation practice standard
2. Evaluate CPS 805 for designation as a Climate-Smart Agriculture practice

In making this decision, we recommend that USDA consult the growing body of scientific literature on EW. In particular, we recommend referencing a recent community-wide resource

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[1] USDA (2024). Partnerships for Climate-Smart Commodities Projects: Yale University; Note EW can include both carbonate and silicate feedstocks as long as there is net carbon removal which will be location-specific. Carbonate feedstock is commonly referred to as agricultural lime, and is already a widespread practice among U.S. farmers to counteract soil acidification.

[2] Oregon State University. Soil pH Map of Conterminous USA

developed through a coordinated effort by approximately 50 academic scientists, 20 EW project developers, and not-for-profit organizations. This resource provides a technical overview for quantifying carbon dioxide removal in enhanced rock weathering deployments, summarizing the best available science and providing guidance to practitioners.[3] For a more comprehensive bibliography, the academic community has also collated existing publications with a primary focus on EW on croplands.[4]

Some highlights from recent publications are included below:

**EW Climate Benefits:**
- The pH increase driven by weathering can lead to lower $N_2O$ emissions from both the nitrification and denitrification pathways.[5]
- An estimated 0.3-1.1t $CO_2$ (dependent on feedstock and deployment conditions) can be sequestered per tonne of rock applied on cropland.[6]

**EW Agronomic Benefits:**
- Optimizing pH levels through agricultural lime is a well-studied practice that has been shown to improve yields by an average of 29%.[7] Silicate-based EW also has shown promising yield benefits, but additional studies are needed.[8]
- Some EW feedstocks provide essential nutrients for crops.[9]
- Silicate EW supplies crops with increased amounts of soluble silicic acid, which has been known to improve stem strength and increases plant resistance to pests and diseases in crops such as soybean and wheat.[10]

**EW Other Environmental Benefits:**
- Boosts silica fluxes to rivers and oceans, thereby potentially increasing nutrient/nitrogen use efficiency (NUE) which could prevent eutrophication.[11]
- Alkalinity from EW flows to coastal areas and the open ocean, where increased alkalinity will help counteract the effects of ocean acidification caused by rising atmospheric $CO_2$ levels.[12]

Like many soil amendments, there are real but mitigatable risks in EW applications. Careful consideration is needed to identify, mitigate, and monitor potential negative impacts, such as heavy metal accumulation in soils and respiratory risks from dust during spreading. These risks vary across feedstocks, soils, and deployment contexts, so it is important for operators to develop environmental health and safety risk assessment plans and an associated monitoring

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[3] Mills et al. (2024). Foundations for Carbon Dioxide Removal Quantification in EW Deployments, Cascade Climate.
[4] Jesper Surhoff (2024). ERW Bibliography
[5] Chiaravalloti et al. (2023). https://doi.org/10.3389/fclim.2023.1203043
[6] Strefler et al. (2018). http://doi.org/10.1088/1748-9326/aaa9c4
[7] Zhang et al. (2023). http://doi.org/10.1016/j.jenvman.2023.118531
[8] Skov et al. (2024) https://doi.org/10.1371/journal.pone.0295031
[9] Kantola et al. (2017). http://doi.org/10.1098/rsbl.2016.0714
[10] Beerling et al. (2018). https://doi.org/10.1038/s41477-018-0108-y
[11] Edwards et al. (2017). http://doi.org/10.1098/rsbl.2016.0715
[12] Hartmann et al. (2013). https://doi.org/10.1002/rog.20004

and mitigation plan. There is a growing body of research establishing target thresholds and monitoring and mitigation best practices that we recommend USDA refer to.[13]

Thank you for your consideration. We look forward to collaborating with NRCS and providing any additional information or references.

The undersigned,

**Carbon Removal Alliance**

**Cascade Climate**

**Dr. Noah Planavsky, Yale Center for Natural Carbon Capture**

**Dr. Christopher Reinhard, Georgia Institute of Technology**

**Bipartisan Policy Center**

**RMI**

**OpenAir Collective**

**4 Corners Carbon Coalition**

**Dr. Isabel Montanez, Director, California Collaborative for Natural Climate Change Solutions, University of California, Davis**

**Dr. Alex Woodley, North Carolina State University**

[13] Levy et al. (2024) https://doi.org/10.1021/acs.est.4c02368