Validation questionnaire

Enhanced Rock Weathering

Contents

Reference documents

This questionnaire is based on the following document(s). **A review of this reference material is encouraged before answering the questionnaire.**

- Puro Standard Enhanced Rock Weathering Methodology Edition 2022

1 Introduction

The **purpose** of this document is to **guide suppliers** of carbon dioxide removal certificates (CORCs) in their pre-validation journey. Along the pre-validation journey, compliance with the Puro Standard for Enhanced Rock Weathering is checked.

There are both open-ended and multiple-choice questions, and the answers provided will be assessed by our team. We may schedule a follow-up meeting if needed. The assessment opinion is delivered to you in a report. Your answers and the report may also be shared with potential buyers of removal certificates with your consent.

The questionnaire does not need to be filled in its entirety before returning, and missing information can be added at a later stage. In practical terms, the first stage in the pre-validation journey consists of a review of the project's proposed simulation and experimental validation approach. Therefore, the most important sections for early-stage projects to fill in are

- 2 Project eligibility;
- 3.1 Project operation;
- 4 Simulation approach; and
- 7 Experimental measurements and simulation validation.

Please fill in your answers to this document and send it to science@puro.earth.

In the questionnaire below, the relevant methodological requirements are indicated by compliance requirement numbers (REQ), which refer to the numbered paragraphs in the Puro Standard Enhanced Rock Weathering Methodology, Edition 2022.

2 Project eligibility

The Puro Standard Enhanced Rock Weathering (ERW) Methodology includes several requirements for suppliers of carbon dioxide removal certificates. The questions in this section are intended as an **early-stage check** for suppliers to ensure that the most fundamental requirements set out in the methodology are met. **Answering 'No' to any of the questions in this section indicates that changes to your project's operating procedures are likely required prior to its validation under the Puro Standard.**

2.1 General eligibility

Question	REQ.	Answer from supplier
Is your project capable of sequestering carbon dioxide via chemical weathering of rocks, minerals, alkaline wastes, or other similar materials?	4.1.1.	■ Yes ☐ No
Is the weathering material spread to the soil (as opposed to e.g. seas, lakes, rivers and other bodies of water)?	4.1.1.	■ Yes ☐ No

2.2 Simulation approach

Question	REQ.	Answer from supplier
Does your project include scientific simulations of expected weathering performance over the course of the project?	3.2.4.	■ Yes ☐ No
Is your simulation approach able to quantify expected carbon dioxide removal as a function of time?	4.6.3. 7.3.2.	■ Yes ☐ No
Does your simulation approach include any application site specific input parameters (e.g. mineral composition, soil properties, local climate conditions etc.)?	3.2.4. 4.6.6. 4.6.7.	■ Yes ☐ No

	7.3.1.	
Do any input parameters in your simulation approach result from experimental in-field measurements at the application site?	4.6.6. 4.6.7. 7.3.1. 7.3.4.	■ Yes ☐ No
Is your simulation approach capable of estimating the uncertainty of its outputs?	7.3.3.	■ Yes ☐ No
Does your project include any initial simulations of the specific ERW activity considered?	4.6.3.	■ Yes ☐ No

2.3 Experimental measurements and simulation validation

Question	REQ.	Answer from supplier	
Is your project able to reliably quantify the amount of carbon dioxide sequestered during the weathering process?	3.2.3.	■ Yes	☐ No
Does your project include a geochemical assay of the weathering material before its application?	4.6.5.	■ Yes	☐ No
Does your project include a soil analysis at the application site before the application of the weathering material?	4.6.6.	■ Yes	☐ No
Does your project include experimental validation of the simulated weathering results via in-field measurements at the application site?	3.2.3. 4.6.8. 7.3.4. 7.3.5.	☐ Yes	☐ No
Are the in-field validation measurements performed at least annually for the duration of the project?	4.6.8.	☐ Yes	☐ No

2.4 Social and environmental safeguards

Question	REQ.	Answer from supplier	
Does your project include an environmental risk assessment of the ERW activity considered?	4.4.4. 5.1.7.	■ Yes	☐ No
Does your project include any laboratory analyses of the weathering material and the soil for potentially toxic elements?	4.4.5.	■ Yes	☐ No
Does your project engage with the local community and other stakeholders to seek an informed consent of the ERW activity and to explain the potential risks involved?	4.5.2. 4.5.3. 5.1	■ Yes	☐ No

	.1. 5.1 .6.	

2.5 Financial additionality

Question	REQ.	Answer from supplier
Are the CO_2 removals resulting from your project additional (i.e. removals would not occur without carbon financing)?	4.2 .1.	■ Yes ☐ No

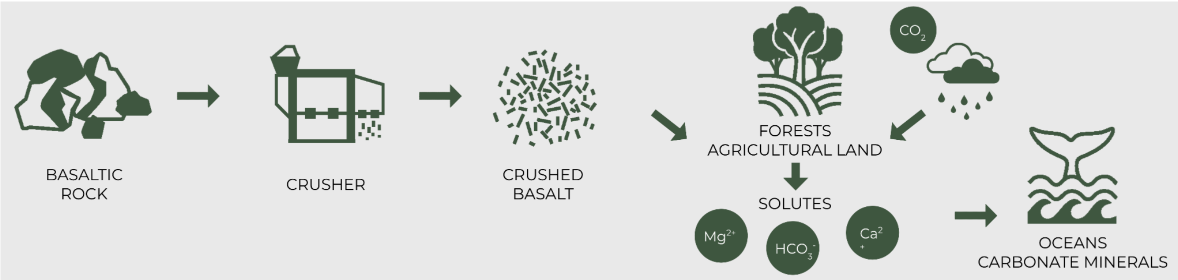
3 General information

This section includes more detailed questions about your project in general. The information provided will help to ascertain that your **specific project** conforms to the requirements set out in the Puro Standard Enhanced Rock Weathering (ERW) Methodology. This information will also help us adjust our services to the state of maturity of your activity/project.

3.1 Project operation

Question
Please briefly describe your project, including weathering material type and sourcing, application site, soil type and typical pH levels, as well as major devices/equipment, processes, and sources of emissions.
Enhanced rock weathering (ERW), the CDR technology being proposed, accelerates the natural processes of rock weathering thereby enhancing the rate at which carbon dioxide can be removed from the atmosphere. At its core, the process appears simple: we spread silicate rock sand on agricultural soils, but there is significant complexity in measuring the rate of weathering, quantifying the amount of carbon removal, and monitoring the supply chain for audit and LCA purposes. ERW is a high permanence (10,000 - 100,000+ years) solution with significant additional co-benefits such as improvement to soil health, crop health, and crop yield, as well as enhancing rural livelihoods. The advantage of ERW lies in its ability to utilise existing production, infrastructure, and delivery systems, allowing for rapid scaling and implementation. The aggregate and mining industries are already established to deliver at over 100 gigatonnes scale of rock movement per year, and global crop land has increased by 9% over the past two decades, covering an estimated 1.24 billion hectares of land. All cropland by its nature is worked and therefore accessible for spreading silicate rocks by one spreading technique or another. This makes ERW the only CDR solution to have demonstrated a credible annual gigatonne removal pathway that can be achieved in a short period of time, potentially as early as 2030. The physical and chemical breakdown of silicate rocks on the Earth's surface, i.e., weathering, is a fundamental process controlling atmospheric CO_2 levels and in turn, the climate. Over geological time scales, the natural weathering of rocks of basaltic composition alone sequesters ~180 million tonnes of CO_2 per annum (Dessert et al., 2003). Atmospheric CO_2 dissolves in rainwater to form weak carbonic acid, which in combination with soil CO_2 from microbial respiration and root exudates, dissolves silicate minerals such as wollastonite, olivine, pyroxene, plagioclase. This releases solutes such as bicarbonate (HCO_3^-) and carbonate (CO_3^-) anions, as well as cations such as calcium (Ca^{2+}) and magnesium (Mg^{2+}) into soil pore waters. These solutes can be precipitated as pedogenic carbonate minerals in soils (a short-term sink), or transported via rivers to the oceans, where CO_2 is permanently locked up by the precipitation of carbonates ($CaCO_3$) (Berner et al., 1983). Carbon is stored as carbonate minerals in soils, or dissolved bicarbonates and carbonates draining into surface waters that are eventually transported to the ocean. The contribution of bicarbonate to the ocean can counteract ocean acidification. UNDO takes this natural process and accelerates it, sourcing crushed Ca- and Mg-rich silicate rocks such as basalt and other silicate minerals like wollastonite, which are available as a by-product from existing quarrying activities, and spreading them on agricultural land. The

process of spreading rock with an increased reactive surface area has the potential to sequester gigatons of atmospheric carbon dioxide and help mitigate climate change (Hartmann et al., 2013). In addition to CDR, the application of fast weathering rock has extensive co-benefits to the soil, crop, yield as well as reductions on GHG emissions (Beerling et al., 2023)



Question

Which of the following land types best describes the site of weathering material application?

☐ Agricultural ☐ Commercial ☐ Forest

☐ Pasture/rangeland ☐ Recreational ☐ Residential

☐ Wasteland ☐ Wetland ☐ Other, please specify

Click or tap here to enter text.

Question

Please provide a short description of the general climate type at the weathering material application site, including typical rainfall and temperature ranges.

Click or tap here to enter text.

Question

Please provide an estimation of the total duration of the weathering process from time of application on-site (i.e. the approximate weathering time of your material).

Click or tap here to enter text.

3.2 Project maturity

Question

Have you already applied any weathering material to the ground at any scale in your current project? If yes, please provide a rough estimate of the amount (e.g. hectares of land treated and/or tonnes of material spread).

☐ Yes ☐ No

Click or tap here to enter text.

Question

Which of the following best describes the scale of weathering material application in your current project (focusing on material already spread on ground)?

☐ Idea / concept ☐ Pilot planned ☐ Pilot started

☐ Pilot completed ☐ Partly operational ■ Fully operational

Actual or expected start date of full-scale operation: Click or tap here to enter text.

Question

What is the volume of carbon dioxide removed in your project, in tonnes per year and/or tonnes per hectare (current or expected average)? Please also shortly describe how these values were obtained (e.g. whether based on ERW simulation or derived from mineralogy data).

Click or tap here to enter text. tonnes/year
Click or tap here to enter text. tonnes/hectare

Question

Is your project already fully funded?

☐ Yes ☐ No

3.3 Regulatory matters

Question

Which country's / region's laws and regulations are enforced at the site of application of the weathering material (i.e. where is the weathering material being spread)?

In terms of national and regional permits and permissions, we have worked with the relevant environmental regulatory bodies to ensure that our operational protocols conform with relevant legislation (The Sludge (Use in Agriculture) Regulations 1989 and The Mining Waste Directive updated 2010). We have also worked with our industry partners to ensure that they comply with the relevant agricultural directives and guidance (DEFRA's Rules for farmers and land managers to prevent water pollution and SEPA's Prevention of environmental pollution from agricultural activity: guidance).

All rock used for ERW by UNDO in the UK has been approved as suitable for use in both organic and biodynamic systems by the relevant national and regional certification bodies. This permits the use of UNDO's weathering fines for soil application across all of the United Kingdom. Certificates have been issued by:

- BDAA Biodynamic and Organic Systems - for biodynamic certification.
- Organic Farmers and Growers / The Soil Association / Scottish Organic Producers Association for organic certification.

All certificates can be found here.

In terms of application sites, UNDO secures contracts with landowners to allow spreading of crushed rock on their farmland. This is captured in our landowner contract (template for which can be found here) which we secure on a farm-by-farm basis prior to the point of application. This gives UNDO access to the land and ownership of the carbon sequestered as a result of enhanced weathering only. The landowner maintains complete ownership and control of their land, any carbon sequestered organically as a result of agricultural practice, and determination over their future cropping cycle.

Question	REQ.
Are there any local laws or regulations guiding the acceptable levels of potentially toxic elements at the site of application of the weathering material? Please elaborate below if necessary (e.g. if situation differs by region). ☐ Yes ☐ No	4.4.7.4.4.8.
There are no laws or regulations in any of the areas in which we work which are directly applicable to the practice of enhanced weathering. There are however laws which stipulate upper limits for potentially toxic elements (PTEs) in products other than the crushed rock fines used in enhanced weathering. In the UK we will operate within the limits set by the devolved nations for PTEs in sewage sludge.	

Question	REQ.
Please describe shortly how / to what extent local laws or regulations guide the acceptable levels of potentially toxic elements at the site of application of the weathering material.	4.4.7.4.4.8.

In case no such local legislation exists, please confirm that your project intends to follow EU thresholds (see Section 5.3. of the Enhanced Rock Weathering Methodology).	
In the absence of specific legislation for the use of crushed rock fines in enhanced weathering in any of the regions in which we will be operating, we will follow the EU thresholds for inorganic soil improvers (https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R1009&from=EN)	

3.4 Financial additionality

Financial additionality is a key aspect of sound carbon removal certificates. At a later stage, a more detailed additionality statement will need to be submitted based on a template provided by Puro.earth.

Question	REQ.
Is your project dependent on carbon finance? Please elaborate below if necessary ☐ Yes, exclusively ☐ Yes, partially ☐ No	4.2.1.
The project proponent (UNDO Limited) is making significant capital and operational investment in project research, development and operationalizing costs, which is a cost which would be avoided entirely if the project Is not implemented and thus is assuming considerable unnecessary costs. The Project activity is not common practice and in fact has never been implemented previously.	

Question	REQ.
What would happen if you do not get revenues from CORCs? Please briefly explain the counterfactual scenario(s) without CORC revenue.	4.2.3.
In the event that no revenue was generated through CORCs then there would not be a financial case for initiating the project and the project proponent would be unable to cover the costs outlined in the previous question. In this case, farming practices would continue in line with a business-as-usual scenario using alternative soil ameliorants.	

3.5 Marketing

To **avoid double counting** and double claiming of carbon capture removal, it is not permitted by the Puro Standard to advertise your capture process as a "carbon removal" if said removal is issued as CORCs (carbon removal certificates) and sold elsewhere. It is however permissible to mention that carbon removal certificates are issued under the Puro carbon crediting program and are visible in the Puro Registry.

At a later stage, more detailed evidence will be requested, such as e.g. images of product packaging; labels; invoices; product webpages and data sheets; purchase terms and conditions and other similar material.

Question	REQ.
Please describe briefly how you intend to ensure that the CORC (carbon removal attribute) is only used and retired once, and not by several parties in the supply chain. Please address both the **upstream** supply chain partners (e.g. weathering material suppliers) as well as **downstream** partners (e.g. land owners).	4.3.1 4.3.2 4.3.3
All CORCs will be allocated a unique ID upon generation, allowing UNDO to track which customer each one has been issued to and when. Once notified by the customer/Puro, UNDO will retire the specific CORCs requested (e.g. a specific volume from a specific year). Upstream and downstream supply chain partners hold no claim to ownership of the CORCs.	

4 Simulation approach

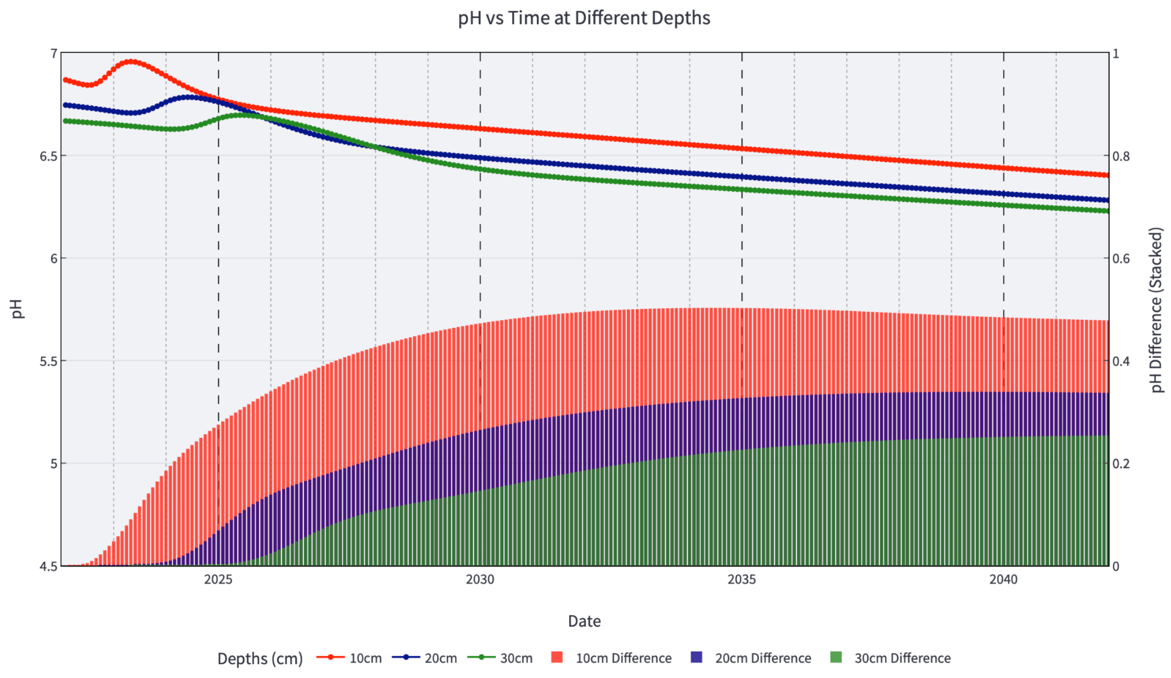
This section includes more detailed questions relating to the **simulation model utilized** to quantify expected weathering results. Due to the variability in the possible approaches to simulating chemical weathering, the suitability of a particular model for a particular project must be analysed on a case-by-case basis. The information provided in this section will help to determine whether the simulation approach utilized by your project specifically conforms to the requirements set out in the Puro Standard Enhanced Rock Weathering (ERW) Methodology.

Question	REQ.
Please provide a description of your simulation approach, including the most important inputs, outputs, parameters, modelled phenomena, and underlying assumptions (see also Sections 7.3., 7.4., and 7.6. of the Enhanced Rock Weathering Methodology)	4.6.2.

Model Output For Field Measurement

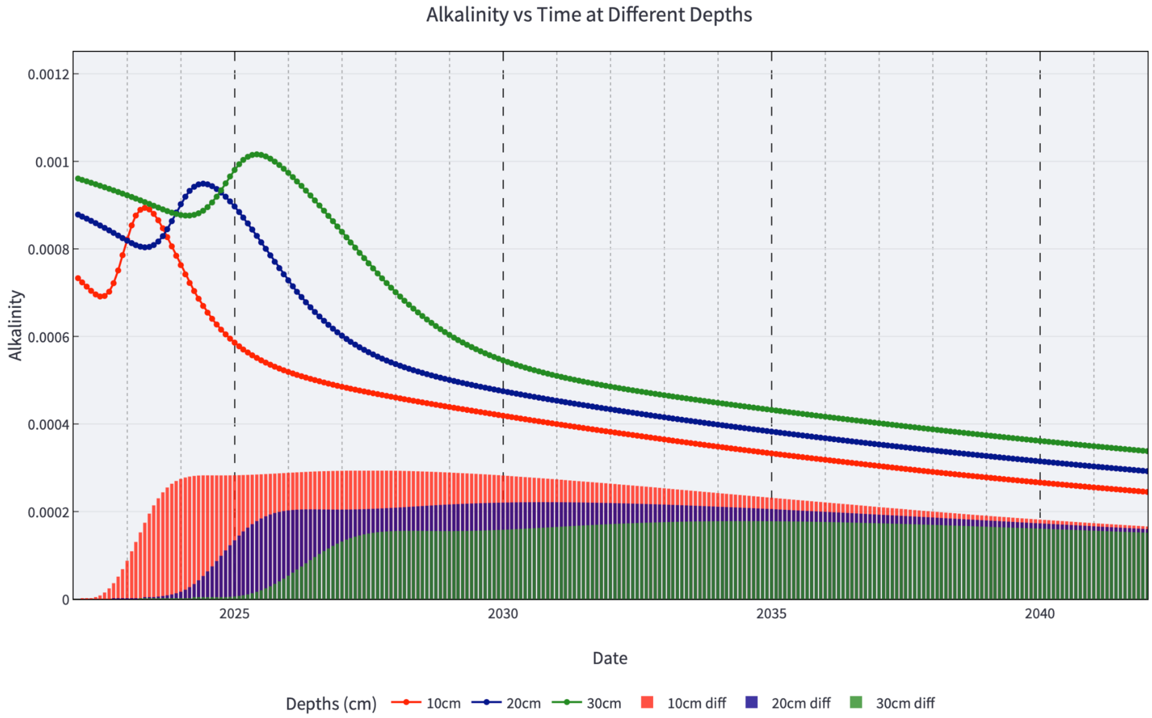
pH Comparisons

Soil pH is a measure of the acidity or basicity of soil. During silicate rock weathering protons are 'consumed', and Ca is released from the mineral structure. When the protons are consumed, the pH will rise. We will therefore monitor pH and use this as a proxy for weathering. The weathering model can simulate the pH response, as shown below. We can therefore compare the expected pH change from the model to the measured pH rise from the soil mesocosms and then use this to "true up" the model.



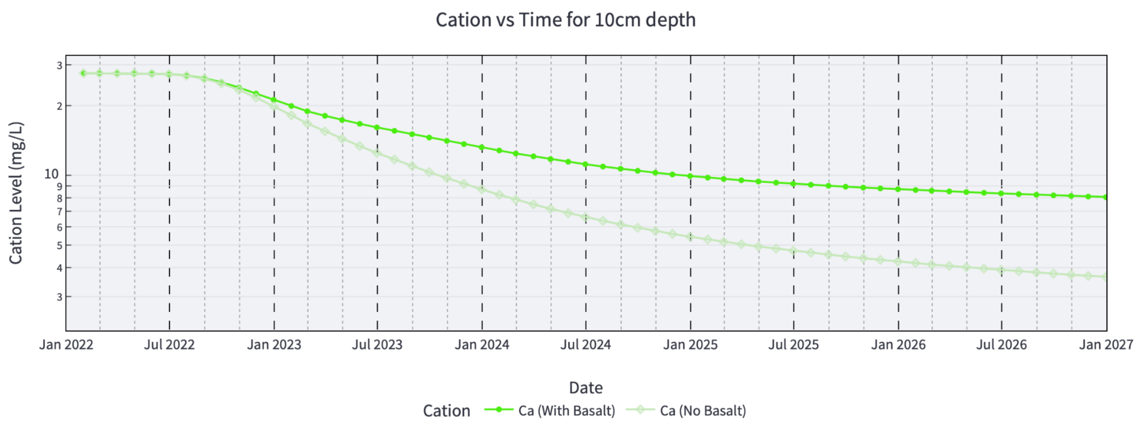
Alkalinity Comparisons

Alkalinity is a measure of an aqueous solution's ability to neutralise acidity, including soil pore water solutions. In soil pore water, most alkalinity is composed of bicarbonate and carbonate. During the carbon dioxide removal process, bicarbonates are produced, so therefore alkalinity can be used as a proxy for basalt weathering and carbon dioxide removal.



Cation Comparisons

Cations, which are positively charged ions such as calcium (Ca), sodium (Na), magnesium (Mg), and potassium (K), play a crucial role as essential nutrients for plants. As previously stated, these charged ions are also released from minerals during the process of weathering. Therefore, precise measurement of cation levels can serve as a proxy for assessing weathering, and can be utilised as a means of comparison between the mesocosm experiments and the weathering model.



To date we have collected and stored 291 rock samples which have been studied in detail to understand the mineralogical composition through XRD, XRF and ICP-MS measurements.

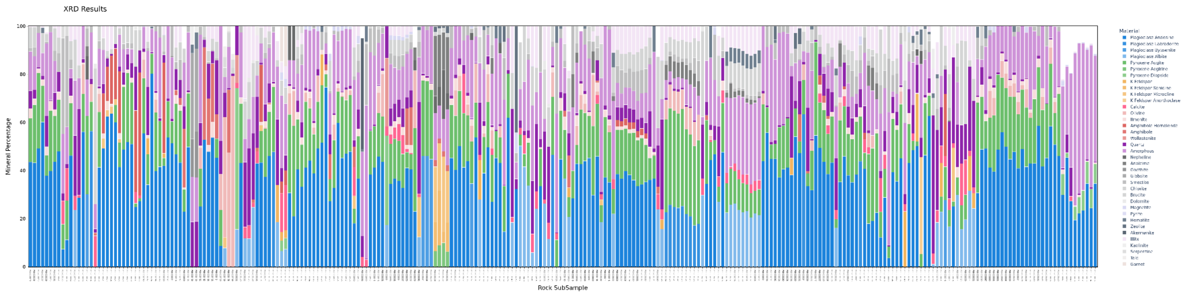
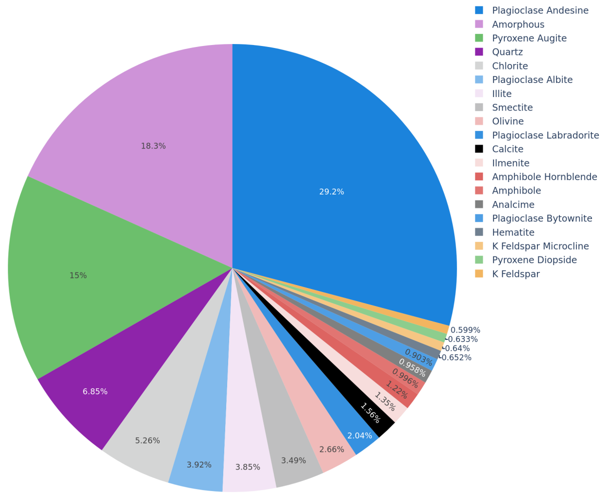
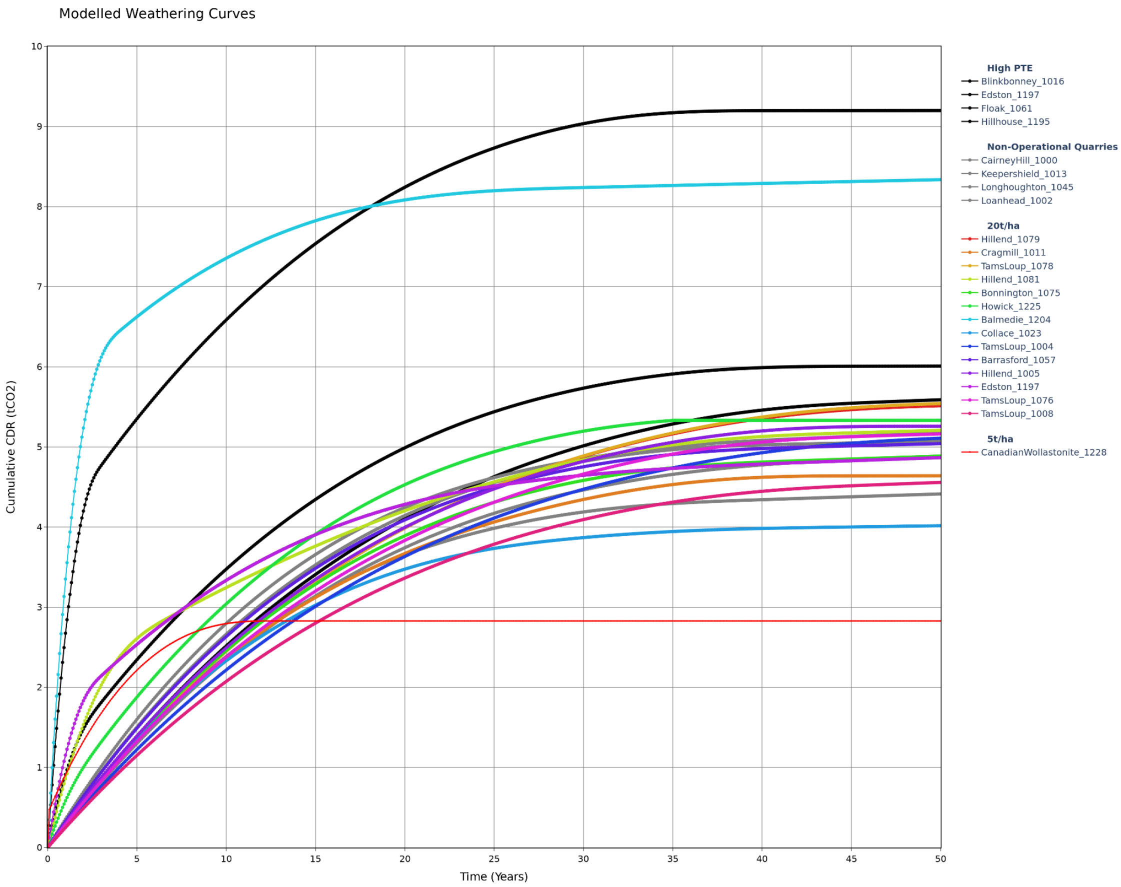


FIgure showing the mineralogical composition of all of the rock samples taken to date. High resolution copy attached as 'Section Surface Min And EW Weathering Curve.png'.

Combining all current data, the average mineral composition of all of the samples is as follows:



UNDO has a stringent screening and selection process to ensure only high quality and high CDR rocks are being spread on our agricultural lands. Our current operations and their associated variation in terms of weathering rates, as predicted using our geochemical model, and carbon dioxide removal potential are shown in figure below.



Question	REQ.
Please provide references to your simulation model (e.g. scientific publications and/or links to datasets, code repositories and similar)	7.3.6. 7.3.7.

We are using an open-sourced peer-reviewed, published one-dimensional geochemical reactive transport soil process basalt weathering model to estimate CO_2 removal and mineral weathering over multi-decadal timescales (Kelland et al., 2020; Vienne et al., 2022).

Detailed information of this model can be found in Kelland et al. (2020), but a brief overview of the model and its processes are listed below:

- Model concept: The 1D RTM soil column with a depth of 50 cm, split into 10 individual 5 cm-cells with basalt amended into the top 25 cm (or top 5 cells of the model).
- Model platform: The RTM was constructed with the PHREEQC platform (Parkhurst & Apello, 2013) using the T&H.dat geochemical reaction database (Appelo & Postma, 2005), with nitrogen species decoupled.

- Modelled processes:

  Basalt dissolution

  - Chemical dissolution of the minerals within the rock (kinetic inputs from Palandri and Kharaka (2004) and Flaathen, Gislason, and Oelkers (2010); saturation information from Blanc et al (2012) and Aradóttir, Sonnenthal, and Jónsson (2012)).
  - Changes in surface area, with weathering of material (shrinking core model, Rimstidt (2014)).

  Soil processes

  - Sorption of cations to solid phases (e.g.,cation exchange capacity of clay; sorption to organic matter and to hydrous ferric oxide).
  - Reversible precipitation-dissolution of several secondary mineral phases (amorphous $Al(OH)_3$, SiO_2 and $Fe(OH)_3$ and calcite).

  Biological processes

  - CO_2 respiration profile from a maize crop.
  - Linear uptake of elements released from the sorghum crop on a 120-day period.

Question	REQ.
Please provide a short description on what application site specific inputs are included in your simulation approach?	3.2.4.4.6.6.4.6.7.7.3.1.
Click or tap here to enter text.	
Question	**REQ.**

Please provide a short description on which experimentally measurable quantities (weathering signals) your simulation outputs and how are they utilized to quantify the carbon dioxide sequestered during the weathering process?	3. 2. 4. 4. 6. 3.
Click or tap here to enter text.	
Question	**R E Q .**
Please provide a short summary of the initial simulation results of the specific ERW activity considered, including estimates of expected carbon removals and other relevant outputs.	4. 6. 3.
Click or tap here to enter text.	
Question	**R E Q .**
What is the theoretical maximum amount of CO_2 that your weathering material can sequester (based on chemical composition, expressed in tonnes of CO_2 sequestered per tonne of weathering material spread)? Please also provide a literature reference or an explanation of how this value was obtained (e.g. equation used and assumptions made).	4. 6. 2.
Click or tap here to enter text. tonnes of CO_2 per tonne of material	
Question	**R E Q .**
Has your simulation approach undergone any experimental validation (by you or others) prior to the current ERW activity? If yes, please provide a short description of the type and extent of the validation (e.g. possible pot/field/mesocosm studies, own research, etc.). If possible, please also estimate the typical error ranges of the simulation outputs compared to in-field measurements. ☐ Yes ☐ No	7.3 .5.
Click or tap here to enter text.	

Question	REQ.
Please provide a short description of the most important sources of uncertainty in your simulation approach and how they are addressed.	7.3.3.

In order to comprehensively address the inherent uncertainty present in our predictive modelling, we have carried out a Monte Carlo-based sensitivity analysis. This approach is consistent with the guidelines recommended by the IPCC for Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories. The primary objective of this analysis is to account for variations in CO_2 sequestration stemming from fluctuations in model input parameters. These include, but are not limited to, crushed Ca- and Mg-silicate rock mineralogy and surface area, soil chemical and physical parameters, and various climate variables.

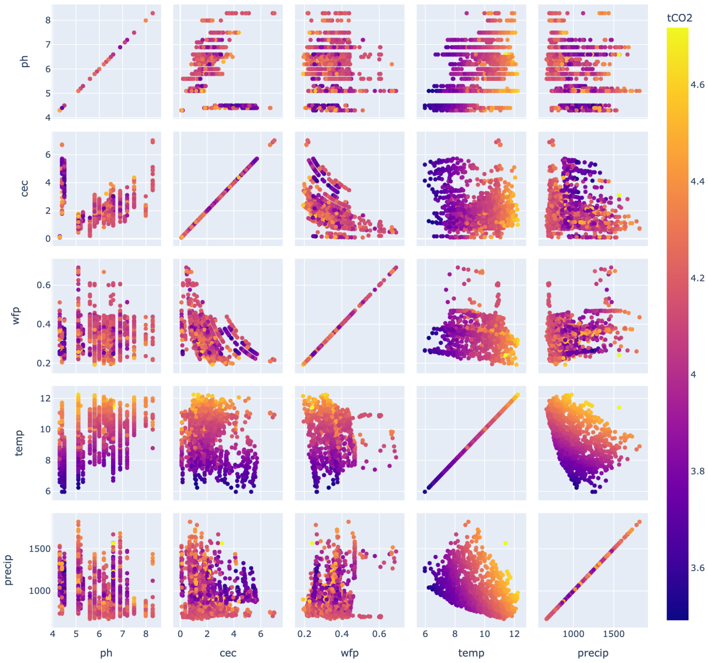
The Monte Carlo method involves assigning a probability density function (PDF) to each model input parameter. Each PDF is constructed using a mean value and a standard deviation. The weathering model is then run multiple times - each execution being referred to as a 'job'. For each job, the input parameters are selected at random from their respective PDFs.

To facilitate this sophisticated modelling approach, we've created a custom modelling framework. Originally, it was hosted on Amazon Web Services' (AWS) EC2. However, to gain improved orchestration for running thousands of jobs concurrently, we've transitioned to Microsoft Azure Batch. This automated, high-performance, and efficient system ensures a rapid and straightforward workflow for our modelling and analysis.

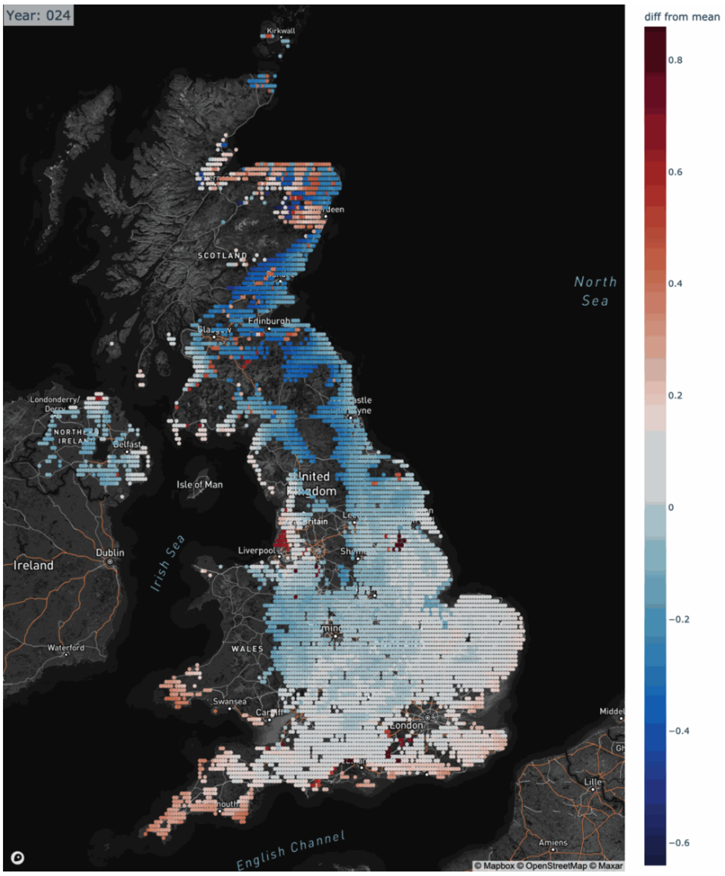
The data generated from each job is collated and used to create a two dimensional histogram, as shown in Figure 2. This plot illustrates the cumulative amount of CO_2 sequestered over time for all the modelling jobs, represented as a probability heatmap.

UK Wide Uncertainty Analysis

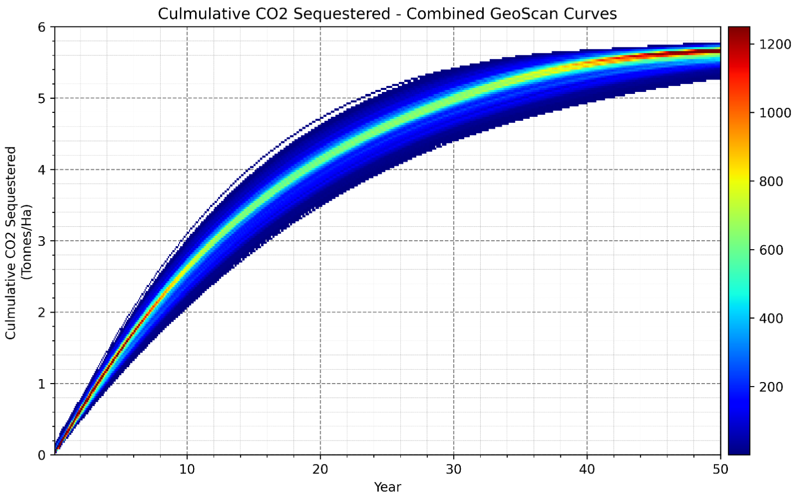
As well as carrying out Monte Carlo modelling analysis we also carried out a UK wide uncertainty analysis to investigate how modelling outcomes for a given rock source vary if deployed throughout the UK. We looped over every data point in our global datasets which fell inside the UK and carried out a model run for each point. This approach was chosen over doing a Monte Carlo based approach as there are inherent correlations between variables in this dataset, most understandable the relationship between temperature and precipitation, these correlations are shown in the pair plot below.



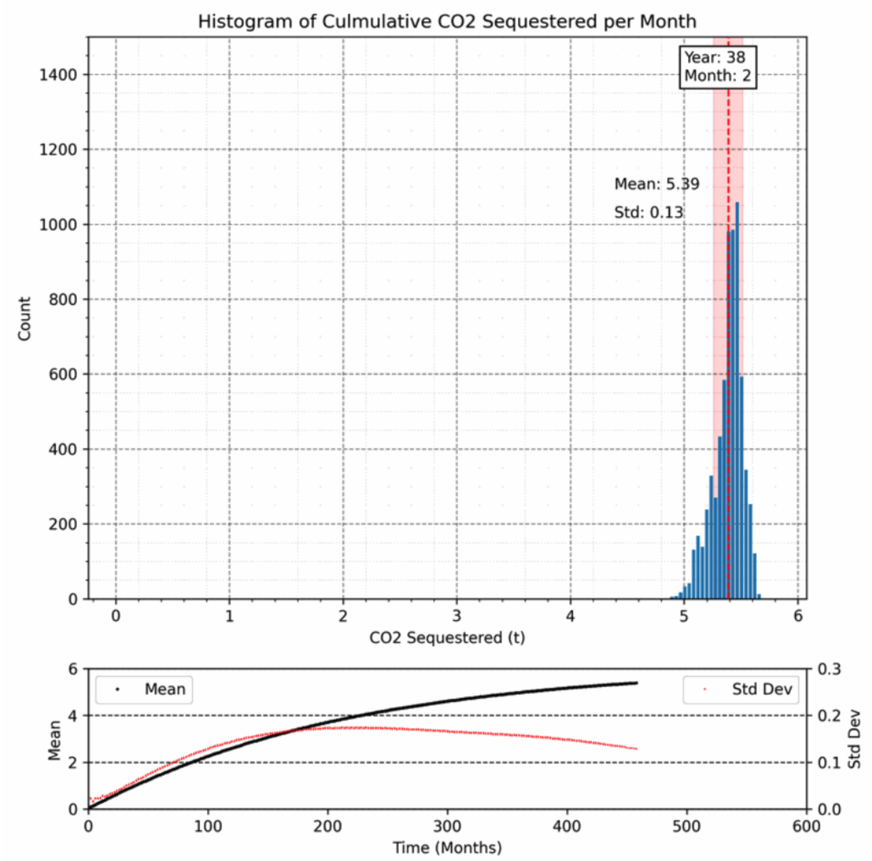
This 'GeoScan' resulted in many thousand CDR curves which can be visualised on top of a map of the region which was modelled. Here the colour denotes the difference from that point - at that point in time - to the UK wide mean for that time. This is showing the variation across the UK at Year 24 for a given rock source.



The data from each model run can be used to generate a weathering curve for each run, this can then be plotted on a 2D histogram to create a heatmap of weathering throughout the UK.



This then allows analysis to be carried out to show how much variation was present at each time step throughout the 50 year long simulation. To do this time slices were taken and the cumulative CDR at that time step can be plotted on a 1D histogram (shown below) which builds up a distribution that can beanalysed to find the mean and standard deviation of that time step. Doing this for every time step and plotting the mean and standard deviation for them all is presented in the bottom pane of the plot below. This results in the maximal standard deviation, of 0.18, being at approximately 150 months (12.5 years).



5 Environmental & Social Safeguards

All projects seeking to certify their carbon removal activity with Puro Standard are required to avoid—whenever possible—negative impacts to society and the environment. This section includes more detailed questions relating to the **environmental and social safeguards** that the project needs to implement, as well as the risk management measures that are put in place to adhere to the overarching principle of do no harm. The information provided in this section will help to determine whether the project complies with the community engagement and risk mitigation principles set out in the Puro Standard Enhanced Rock Weathering (ERW) Methodology.

5.1 Community Impact and Engagement

Question	REQ.
Please provide a description of the impact of the proposed ERW activity to the local community, as well as the measures undertaken to evaluate it (i.e. how was the impact evaluated in practice). Please address both the **benefits** and the potential **risks** to the local community.	4.5.1.
Click or tap here to enter text.	
Question	**REQ.**
Please provide a description of how your project plans to interact and engage with local communities and stakeholders throughout the project's lifetime. Please address both the manner and practicalities of engagement (i.e. how is the engagement realized in practice, what information is shared, how are community feedback or potential grievances addressed, etc.).	4.5.2. 5.1.1. 5.1. 4.5.1.6.
Click or tap here to enter text.	
Question	**REQ.**

Please provide a description of how your project plans to inform local and global stakeholders (e.g. local community, land owners, local municipality, investors, credit buyers) of the environmental risks associated with the project, as well as health risks and limits concerning toxic contaminants.	4. 5. 3. 5. 2. 2.
Click or tap here to enter text.	

Question	REQ.
Does your project operate on land that has been identified as culturally sensitive or result in the displacement of local communities? In either case, please describe shortly how your answer was obtained (i.e. how cultural sensitivity/insensitivity and potential to cause displacement were determined). ☐ No ☐ Yes	5. 1. 2.
Click or tap here to enter text.	

Question	REQ.
Please provide a short description of the measures undertaken to ensure a safe working environment and mitigate occupational health and safety hazards during operation of the ERW activity.	4. 5. 4.
Click or tap here to enter text.	

5.2 Environmental risk management

Please note that at a later stage, more detailed evidence will be requested, such as the complete **environmental risk assessment (ERA)** document.

Question	REQ.
Does your project apply weathering material to agricultural land or other land where crops will be grown during the ERW activity? If yes, please provide a description of how your project plans to follow the impact on crops after the application of the	5. 1. 5.

weathering material. Note that *crops* here refer to plants grown to be harvested for food, livestock fodder, fuel, or other economic purposes. ☐ No ☐ Yes, please elaborate below	
Click or tap here to enter text.	
Question	**REQ.**
Have you performed a conservative, independently reviewed environmental risk assessment of your ERW activity? See also Section 5.2. of the Enhanced Rock Weathering Methodology. ☐ Yes ☐ No, please elaborate below	4.4.4.4.4.6.5.1.7.5.2.4.5.2.6.5.2.7.
Click or tap here to enter text.	
Question	**REQ.**
Please provide a summary of the main findings of the environmental risk assessment, focusing on the specific risks and hazards encountered in the ERW activity considered, and the measures in place to mitigate them. Please also include a short outline of the overall coverage of the assessment (i.e. which factors / risks were considered).	4.4.6.5.2.8.
Click or tap here to enter text.	

Question	REQ.
What laboratory analyses or other scientific analyses were performed to support the environmental risk assessment?	4.4.5.
Click or tap here to enter text.	
Question	**REQ.**
Please provide a summary of the measured heavy metal concentrations in the soil and in the weathering material, together with the respective limit values followed in your project.	4.4.5. 4.4.7. 4.4.8. 5.3.1.
Click or tap here to enter text.	
Question	**REQ.**
Does the weathering material contain asbestos or asbestiform minerals above trace levels? ☐ No ☐ Yes, please elaborate below	4.4.5. 5.3.2.
Click or tap here to enter text.	
Question	**RE**

	Q.
Does the environmental risk assessment indicate any potential risks related to radioactive materials (e.g. elevated levels of radionuclides in the soil or weathering material)? ☐ No ☐ Yes, please elaborate below	4. 4. 5. 5. 3. 3.
Click or tap here to enter text.	

6 Net negative overall carbon footprint

Only **net negative CO_2 sequestration** is eligible for CORCs. In simple terms, *net negative* means that the project can store more carbon than it emits. More specifically, *net negative* means that the amount of CO_2 sequestered through carbon capture is larger than the emissions arising along the supply chain (e.g. weathering material extracting and processing, transportation, and application on site). This is determined by a **life cycle analysis (LCA)** following the system boundaries described in Section 6 of the Enhanced Rock Weathering Methodology. All energy emissions within the project boundary must be accounted for when quantifying the net CO_2 removal, but the energy used does not need to be fossil-free. Note that at a later stage, a detailed LCA report with the accompanying LCA data will need to be submitted to Puro.earth for verification.

Figure 1 illustrates the calculation of CORCs generated by an ERW project. In this context, net negativity means that E_{stored} is larger than $E_{SupplyChain}$. For additional information on the calculation method for the quantification of CO_2 removal, please see Section 7 of the Enhanced Rock Weathering (ERW) Methodology.

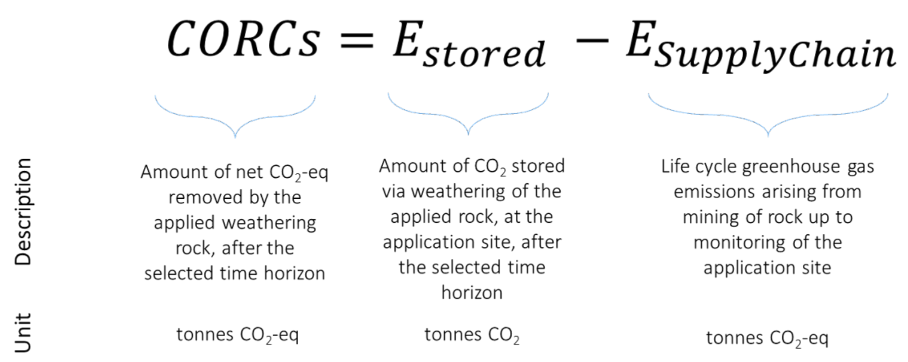


Figure 1: Overall equation to calculate the amount of CORCs generated by the ERW activity or project, over a selected time horizon.

Question	REQ.
Have you performed a carbon footprint calculation or a life cycle assessment (LCA) of your carbon capture activity? See also Sections 6 and 7.2. of the Enhanced Rock Weathering Methodology. ☐ Yes ☐ No, please elaborate below	6.1.1.
Click or tap here to enter text.	
Question	

Please provide an estimation of the total amount of CO_2 sequestered in your project during its lifetime (E_{stored})
Click or tap here to enter text.
Question
Please provide an estimation of the total amount of greenhouse gas emissions arising from your project ($E_{SupplyChain}$)
Click or tap here to enter text.
Question
Please provide an estimation of the approximate energy consumption per tonnes CO_2-eq sequestered in your project, including a description of which types of energy are required and where.
Click or tap here to enter text.

7 Experimental measurements and simulation validation

This section includes more detailed questions relating to the **experimental methods** utilized to quantify the carbon dioxide sequestered during the weathering process. Due to the variability of local conditions and the lack of a scientific consensus on the best approach to measure the results of enhanced weathering in the field, the suitability of a particular experimental validation approach must be analysed on a case-by-case basis. The information provided in this section will help to determine whether your project conforms to the requirements set out in the Puro Standard Enhanced Rock Weathering Methodology.

Question	REQ.
Which experimentally measurable quantities (weathering signals) are utilized to validate the simulated weathering results (see Section 7.5. of the Enhanced Rock Weathering Methodology)? ☐ Total alkalinity ☐ pH ☐ Electrical conductivity ☐ Ion concentrations ☐ Isotope ratios ☐ Total inorganic carbon ☐ Other, please specify below	3.2.3.4.6.8. 7.3.4. 7.3.5.
Click or tap here to enter text.	
Question	**REQ.**
Please provide a short description of the experimental monitoring and validation process utilized in your project to quantify the carbon dioxide sequestered (e.g. what is measured; which analysis techniques are used; how and how often are samples collected; are control measurements on unamended land performed; how are uncertainties due to spatial and temporal variability addressed; etc.)	7.3.4. 7.3.5.
Click or tap here to enter text.	
Question	**REQ.**
Is the experimental monitoring and validation process utilized by your project capable of discerning weathering leading to CO_2 sequestration (i.e. due to carbonic	3.2.

acid) from other weathering (e.g. due to strong acids in the soil; see Sections 1.4. and 7.5. of the Enhanced Rock Weathering Methodology)? If necessary, please elaborate below. ☐ Yes ☐ No	3.4.6.8. 7.3.4. 7.3.5.
Click or tap here to enter text.	
Question	**REQ.**
Please provide an estimation or a short description of the level of anticipated experimental uncertainty in the amount of carbon dioxide sequestered in your project (e.g. typical quantification errors of the experimental techniques, local conditions that might significantly affect measurement accuracies, etc.).	3.2.3.4.6.8. 7.3.4. 7.3.5.
Click or tap here to enter text.	