Marine Anoxic Carbon Storage Methodology

Public Consultation feedback summary and detailed comments

17 April 2025

Public Consultation: Marine Anoxic Carbon Storage (previously Ocean Storage of Biomass) methodology

Context

Puro.earth held a public consultation on its proposed Marine Anoxic Carbon Storage (MACS) methodology.

This initial public consultation was announced on Puro's homepage on the 15th of January 2025 and in Puro Newsletter on the same day. The time frame for the consultation spanned from the 15th of January 2025 until the 5th of February 2025.

The proposed draft with the title **Marine Anoxic Carbon Storage** (previously Ocean Storage of Biomass) included eleven (11) Sections. The feedback received includes over 158 comments from more than 13 organizations. This document summarises the feedback received during the public consultation, responses, and the revisions included by Puro.earth because of the comments.

We want to thank all participants for your time and contributions to helping us improve the Puro Marine Anoxic Carbon Storage methodology to better serve this growing ecosystem.

General Observations

1. The Public Consultation showed a **significant engagement** in the number of participants (13) and their comments (158).
2. Many valuable improvements and clarifications were incorporated into the methodology because of the public consultation process.
3. As the methodology is brought into operation, some suggestions received during public consultations may still be considered in the future.

Detailed Comments and Responses

In the following tables, we will share the comments received and the responses provided by the Puro.earth Team. Comments are shared anonymously. The comments are grouped per Section in the consulted version of the **Puro Geologically Stored Carbon** methodology and the **Puro Biomass Sourcing Criteria**.

All comment were addressed, and changes incorporated to the final draft. We want to thank all participants warmly for improving the rules and the integrity of Voluntary Carbon Markets (VCM) in general.

Public Consultation feedback and responses

Comment no	Rule or part	Comments	Puro response	Action
1	General; Durability	Concerns were raised on the durability claim of a 1000+ years. While permanence of 1000+ years may be reached in specific locations, the are concerns on the capability of current ocean models to predict changed within such a long timescale.	We thank for the comments, and after a careful review agree that the durability claim needs to be reconsidered. The current understanding is that nevertheless, this approach can securely store carbon for several centuries, and therefore a new CORC label 200+ was created in order to take the conservative approach, ensuring scientific rigor and robustness of the durability claim.	Durability claim changed from 1000+ years to "several centuries", with a new CORC label 200+ created. The new label does not impact any other aspects of the requirements in this methodology.
2	General	I would sincerely hope you can explain how your concept could be acceptable under the London Protocoll? My understanding is: The London Protocoll forbid dumping / releasing of any material into any ocean (inkluding the Baltic sea) or into it`s bottom, when the purpose is to get rid of or permanently store the material.	Thank you for your comment. We agree that the London Protocol is absolutely necessary and important to prevent negative consequences of human activities to the ocean. The Puro Standard and this methodology also sets strict safeguards for environmental safety for national waters within national jurisdictions. Furthermore, all operations under this methodology have to be permitted by an appropriate local, regional, national or international authority.	No change.
3	General	Would it make sense to remove lignin from biomass prior to sinking? There are multiple potential uses for ligning for example as frame material for electric car batteries, decreasing the battery weight and therefor the weight of the car, decreasing enegy consumption. The lignin in for example common reeds is significantly harder than in woody biomass. In the archipelago sea,an area of appx. 20 000 hectares contains 15 tonnes/ha of common reed. Each tonne of common reed includes ca. 400 kg of lignin.	Thank you for your comment. Lignin is a key component to ensure the durable carbon storage, contirbuting to the recalcitrance of the deployed biomass. Therefore, it is not within the scope of this methodology to remove lignin from the biomass feedstock prior to deployment.	No change.
4	General	Include all forms of biomass except marine biomass for OSB (1.3: Eligible biomass). Biomass of all kinds contains carbon. High lignocellulosic biomass is recalcitrant under specific conditions, but anoxic conditions eliminate recalcitrance. Over the past five decades, global organic carbon (OC) transport by rivers has significantly declined due to human activities such as damming, deforestation, grassland clearing, and the burning of agricultural fields. This trend is particularly evident in India. Historically, tropical and subtropical river plains and deltas were covered with grasslands, which have since been replaced by cereal agriculture. Sediment analysis from deep seas reveals that grasses were a dominant biomass buried in tropical seas since the Paleocene-Eocene Thermal Maximum (PETM) and the Holocene across marine sediments brought by tropical rivers. Grasses, particularly those from the Poaceae family, contribute significantly to the phytolith assemblages found in the marine sediments of the Bay of Bengal. Phytoliths derived from grasses, such as bilobate, saddle, and cross-shaped morphotypes, dominate these sediments due to the extensive grasslands historically present in the region and along river catchments. These phytoliths are transported from terrestrial sources through major river systems like the Ganges and Brahmaputra, which deposit large volumes of sediment into the Bay of Bengal annually. While specific quantitative percentages vary across studies, grass phytoliths are recognized as key indicators of past vegetation dynamics and terrestrial carbon inputs into the marine ecosystem. Their abundance in sediments highlights the ecological importance of grasses in shaping the biogeochemistry of the Bay of Bengal over time. It is proposed that PURO expand its protocol to include all terrestrial biomass, excluding marine biomass, to enhance carbon sequestration efforts. There should be no restrictions on lignin cellulose content for strongly anoxic basins.	We thank the reviewer for the comment. We are open to studying other biomass sources in the next version, when the methodology is updated. It requires a detailed understanding of the feedstock type, which is not possible in this timeframe.	No change.
5	General	Include biomass transport through rivers as an option. Historically large amounts of biomass were transported by rivers into seas and oceans. Asian rivers transport approximately 85% of global sediment and 60% of organic matter, most of which originates from terrestrial organic carbon (OC) in the form of plant biomass and soil carbon. However, intentional carbon sequestration through the deposition of agricultural byproducts into deep-sea sediments has received little attention. Studies from the Bay of Bengal, Gulf of Mexico, Black Sea, and South China Sea indicate that sequestering terrestrial grass crop residues in anoxic and euxic zones could remove biomass from the active carbon cycle. This method, known as Crop Residue Ocean Permanent Sequestration (CROPS), could mitigate up to 15% of current annual anthropogenic CO_2 emissions. Over the past five decades, riverine OC transport has declined significantly due to human activities such as dam construction, deforestation, grassland clearing, and the burning of agricultural fields. This trend is particularly evident in South Asia. Current assessments of global carbon sources and sinks fail to consider the effects of lateral soil OC transfer and rising riverine carbon emissions, resulting in uncertainties and "missing" carbon stocks, estimated at 0.60 PgC annually. This omission underestimates global carbon stocks and complicates future climate modeling. The lateral movement of terrestrial OC is likely the main contributor to the "missing carbon sink." Today, only 30–35% of marine sediment OC originates from terrestrial sources, a stark contrast to earlier geological epochs. Monsoonal rivers play a crucial role in transporting soil-derived OC to the oceans, serving as regulators of the global carbon cycle. Peninsular Indian rivers flowing east into the Bay of Bengal (BoB) maintain stable water and sediment discharge levels. The semi-enclosed BoB receives substantial freshwater input, particularly from the Ganga-Meghna-Brahmaputra (GMB) system, which contributes 82% of its water volume. This highlights the critical role of these rivers in carbon transfer and the potential for enhanced carbon sequestration strategies. It is proposed that PURO includes projects that aid in the transportation of biomass via rivers leading to enhanced biomass burial at sea.	We thank the reviewer for the comment. We consider biomass transport through rivers to have different characteristics and require different safeguards and rules. Therefore, we do not see biomass transport through rivers as part of the scope of this methodology.	No change.
6	General	A large proportion of the organic carbon found in sediment cores originates from algal biomass settling on the lake floor(1). This biomass undergoes degradation processes spanning many years: In the selective preservation pathway, recalcitrant macromolecules, such as algaenan in cell walls, are directly preserved in the sediments and form kerogen without severe degradation (Vandenbroucke and Largeau, 2007). The algaenan in algae and cyanobacteria accounts for about 2–5 % of the ash-free dry weight (Biller et al., 2015; Kong et al., 2022; Zhang et al., 2019), much higher than the preservation rate (about 0.1 %) of organic matter in the oceans (Tissot and Welte, 1978). Given its intrinsic resistance to decomposition, algaenan should be a critical precursor of kerogen (Vandenbroucke and Largeau, 2007). Due to its inert nature, algaenan contributes to the oceanic biological carbon pump. When shed from phytoplankton, it sinks into the deep ocean, sequestering carbon to form kerogen, which can transform into petroleum and natural gas over geological timescales. As a result, over millions of years, the buried organic carbon undergoes physiochemical processes such as condensation, mineralization, and compaction, ultimately transforming into stable hydrocarbon structures, commonly known as kerogen- precursors of oil and gas deposits.(2) References: 1) Regnier et al., (2023) Production and composition of extracellular polymeric substances by a unicellular strain and natural colonies of Microcystis: Impact of salinity and nutrient stress. Environmental Microbiology Reports 15:783–796; Chen et al (2019) Extracellular polysaccharide synthesis in a bloom-forming strain of Microcystis aeruginosa: implications for colonization and buoyancy. Scientific Reports, 9, 1–11; Xiao, M., Li, M., Duan, P., Qu, Z. & Wu, H. (2019) Insights into the relationship between colony formation and extracellular poly-meric substances (EPS) composition of the cyanobacterium Microcystis spp. Harmful Algae, 83, 34–41). 3)Wang, Xiaomei, et al. "From cyanobacteria to kerogen: A model of organic carbon burial." Precambrian Research 390 (2023): 107035. 2) Zhao, et al., (2017). Variation of bacterial communities in water and sediments during the decomposition of Microcystis biomass. PLOS ONE, 12:e0176397; Huang, R, et al., (2023). Variations in trihalomethane formation potential of Microcystis aeruginosa under different growth conditions: Phenomenon and mechanism. Science of The Total Environment, 892:164440; Yao, et al., (2022). Characteristics of extracellular organic matters and the formation potential of disinfection by-products during the growth phases of M. aeruginosa and Synedra sp. Environmental Science and Pollution Research, 29:14509. Zhang, et al., (2023a). Geochemical characteristics of n-alkanes in sediments from oligotrophic and eutrophic phases of five lakes and potential use as paleoenvironmental proxies. Catena, 220:106682; Zhang, et al., (2023b). Anthropogenically driven changes to organic matter input in sediments of Lake Chaohu, Eastern China, over the past 166 years. Catena, 231107285. 4)Bobrovskiy, Ilya, et al. "Impact of aerobic reworking of biomass on steroid and hopanoid biomarker parameters recording ecological conditions and thermal maturity." Geochimica et Cosmochimica Acta 364 (2024): 114-128. 5)Zhang, Dainan, et al. "Occurrence of aliphatic biopolymer in chlorophyceae algae and cyanobacteria-rich phytoplankton." Organic Geochemistry	We thank the reviewer for the comment. We are open to studying other biomass sources in the next version, when the methodology is updated. It requires a detailed understanding of the feedstock type, which is not possible in this timeframe.	No change.
7	General	General: what experts tare reviewing the submitted plans, and what criteria will they use for "best practices"? Best practice pH for an academic might have a 0.001 precision, in industry best practices is 0.1 precision. When is it important to use true best practices, and when is a value sufficiently high quality to use? Recommend defining practical uncertainty needs by parameter.	Thank you for your comment. We have clarified the text throroughly, and when possible, detailed whether industry best practices or peer-reviewed scientific protocols/practices must be used.	Requirements for "best practices" have been revised in rule 9.3.8. and within the document, adding clarifications where possible.

Comment no	Rule or part	Comments	Puro response	Action
8	General; Title	The title needs to much more closely reflect what is covered in the text e.g., "Ocean Storage of Terrestrial Biomass - Methodology for CO_2 Removal in Anoxic Basins".	Thank you for the comment. We agree that the methodology name was too broad, and in its original form was easily misinterpreted to include various types of biomass feedstocks and/or multiple storage site types. We have revised the name based on the feedback received and discussions between the community behind this approach. We believe the new name better matched the contents of the methodology.	The methodology name has been changed to "Marine Anoxic Carbon Storage", or MACS. (draft name was Ocean Storage of Biomass)
9	General; Title	The name should be changed: it is too broad and can easily be mistaken to include other types of biomass feedstocks and storage types.	Thank you for the comment. We agree that the methodology name was too broad, and in it's original form was easily misinterpreted to include various types of biomass feedstocks and/or multiple storage site types. We have revised the name based on the feedback received and discussions between the community behind this approach. We believe the new name better matched the contents of the methodology.	The methodology name has been changed to "Marine Anoxic Carbon Storage", or MACS.
10	Glossary	In the definition of 'biomass', "organic municipal waste, organic waste from paper and alcohol/ethanol production, and others" should be deleted as they are banned from dumping under the London Convention and London Protocol.	Thank you for noting this. It was an unfortunate copy-paste error. As you can see in section 3, the eligible biomass feedstocks are strictly limited to residual agricultural biomass, residual forestry biomass and landscape management and green waste. These restrictions were made to ensure safety to the environment, as well as ensuring the preservation of the biomass in anoxic conditions. Additionally, the methodology sets stricy criteria to ensure the biomass feedstock does not contain harmful compounds, which could negatively affect the marine life. Therefore, it is ur understanding that the requirements do not conflift with the London Protocol.	Revised the definition of biomass to match the eligibility criteria: Biomass – Organic matter recently derived from the biosphere, including forestry residue, agricultural residue and biomass originating from landscape management and green waste.
11	Glossary	Under 'Dissolved Inorganic Carbon (DIC)', the CO_2 is usually referred to as 'CO_2(aq) i.e., aqueous, so dissolved not in the form of gas (as for dissolved oxygen).	Thank you for the comment. This was likely a typing error, and he have revised the definition based on the comment.	Revised the definition of DIC: free CO_2 (aq) instead of free CO_2 (gas).
12	Glossary	Under 'Dissolved Organic Carbon (DOC)' I am surprised to see a pore size of 0.7 µm mentioned. I would expect the largest pore size to be 0.45 µm equivalent to a GF/C filter.	Thank you for pointing this out. The definition of DOC varies, and both 0.45 µm and 0.7 µm are commonly used as the upper threshold value. Since 0.45 µm is more generally accepted in aquatic sciences (as determined e.g. by Danielsson, 1982), the definition in this methodology has also been revised.	Definition of DOC has been revised to "organic carbon... able to pass through a filter with a pore size between 0.22 and 0.45 µm."
13	Section 1, Section 3	Add the bolded part: "Thus, the eligible biomass is limited to lignocellulosic biomass due to its high lignin or **carbonaceous** content, which support durability in anoxic conditions (Benner & Maccubbin, 1984)."	We thank the reviewer for the comment. We are open to studying other biomass sources in the next version, when the methodology is updated. It requires a detailed understanding of the feedstock type, which is not possible in this timeframe.	No change.
14	Section 1, Section 3	Add the bolded part: "Important variables for evaluating the biomass recalcitrance include: ● The cell wall structure; complex matrices of lignin, cellulose, and hemicellulose contribute to plant biomass recalcitrance (Himmel, 2008; Yousuf et al., 2020). ● The chemical composition of the biomass; especially carbon:nitrogen (C:N) ratio or carbon:nitrogen:phosphorus (C:N:P) (Johnson et al., 2007). ● The physical structure of the biomass; for example, finely divided materials decompose more rapidly than coarse materials. The biodegradability of lignocellulosic materials is directly influenced by the accessible surface area of the substrate, which determines the extent to which cellulases can interact with cellulose (Xu et al., 2019). **● The composition of phytoplankton, especially coccolithophores with spherical cells about 5–100 micrometres across, enclosed by calcareous plates called coccoliths, which are about 2–25 micrometres across. Each cell contains two chloroplasts that surround the nucleus. These contribute to carbon sequestration and biomass recalcitrance."**	We thank the reviewer for the comment. We are open to studying other biomass sources in the next version, when the methodology updated. It requires a detailed understanding of the feedstock type, which is not possible in this timeframe.	No change.
15	Section 1, Section 3	Add the bolded part: "Lignin is a complex organic polymer found in the cell walls of vascular plants, including many terrestrial and aquatic plants. It played a crucial role in the evolution of vascular plants by providing structural support and enabling them to withstand the compressive forces of gravity. The composite structure of cellulose, hemicellulose and lignin provides plant cell walls their strength and capacity to resist degradation (Cosgrove, 2005), but the ratio of the individual components varies between different biomass feedstock types (Pauly & Keegstra, 2008; Yousuf et al., 2020) (Table 1.1). A comprehensive list of physical and chemical factors influencing recalcitrance of lignocellulosic biomass may be found in (Zoghlami & Paës, 2019), but overall, the chemical composition and the structure of lignin have a strong impact. Due to its high molecular weight, relative insolubility and complex aromatic structure, lignin is highly recalcitrant against degradation (Vishtal & Kraslawski, 2011; Zhang et al., 2021). Additionally, lignin serves as a physical barrier, which blocks the access of enzymes to cellulose, further enhancing the recalcitrance of the lignocellulosic biomass (Monties & Fukushima, 2001; Zoghlami & Paës, 2019), particularly in oxygen-depleted environments. Calcium carbonate crusts of phytoplankton that sink to the ocean sediments after a plankton bloom play a key role in slowing down the acidification of oceans and degrade slowly in oxygen-depleted environments enabling long-term carbon sequestration and storage."	We thank the reviewer for the comment. We are open to studying other biomass sources in the next version, when the methodology updated. It requires a detailed understanding of the feedstock type, which is not possible in this timeframe.	No change.
16	Section 1, Section 3	Add the bolded part: In anoxic conditions, anaerobic organisms have a limited capacity to degrade lignin-containing **and carbonaceous** biomass (Marchand et al., 2005). As the aim of an ocean storage of biomass approach is to prevent or limit the degradation of the stored biomass to ensure durable carbon removal and mitigate environmental impacts, eligible biomass is restricted to lignocellulosic biomass, mainly woody materials and mature or lignified crop residues, which have a combined lignin and cellulose content of 60% (see rule 3.6.5) and a minimum C:N ratio of 50:1 (see rule 3.6.6). A C:N ratio of 50 means that there is 1 g of nitrogen for every 50 g of carbon, i.e. a nitrogen content of roughly 2% of the mass of carbon present.	We thank the reviewer for the comment. We are open to studying other biomass sources in the next version, when the methodology updated. It requires a detailed understanding of the feedstock type, which is not possible in this timeframe.	No change.
17	1.1.	Preservation of organic material depends on the interaction of biomass with **microbes** under specific environmental conditions. The environmental conditions just limit the extent of microbial function	We consider that the term "environment" includes both biotic (living) and abiotic (non-living) components. This means it encompasses not only physical factors like water, air, and soil/sediments, but also all the organisms that interact with the biomass.	No change.
18	1.1.	I would remove the durability claim from the overview and scope. We may want to use the same protocol but for lower durability claims if we disagree about the 1000 year durability	The durability for this methodology has been set for 1000 years. As iwith all Puro methodologies, there is no option for two separate durability claims within one methodology. Therefore, in the context of this methodology, the project must evicende that their intended project can store carbon for a minimum on 1000 years to be eligible.	No change.
19	1.1.	Would it be worth saying that after gaining practical experience with this methodology, use of non-lignocellosic biomass could be considered?	We thank the reviewer for the comment. We are open to studying other biomass sources in the next version, when the methodology updated. It requires a detailed understanding of the feedstock type, which is not possible in this timeframe.	No change.
20	1.2.	Similar to above, degredation occurs primarily through microbially mediated chemical pathways	Thank you for your suggestion. In this instance, in order to improve the readability of the document we have included "microbially mediated" to the text.	To improve the readability of the document we have included "microbially mediated" to the text.
21	1.2.	Wood decomposition from bivalves is too specific and not generalizable. I.e. Baltic Sea lack of wood degrading organisms.	We consider that it is possible to generalize stating that wood-boring bivalves are present in marine oxic waters. For instance, Teredo narvalis is present in the Baltic Sea: https://doi.org/10.3389/fmars.2017.00331	No change.

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22	1.2.	I'm not sure why it's important that elevated atmospheric CO_2 increases photosynthesis rates. This protocol does not address additional biomass growth due to increased atmospheric CO_2	Thank you for the comment. This sentence was originally added in to highlight how the increased amount of natural biomass could result to increased emissions when that biomass decomposes, if left to decompose. However, it is also true that increased quantity of biomass has the capacity of increasing the CO_2 capture by plants.We agree, that this methodology does not directly address increasing biomass growth, and therefore the sentence can be removed.	Edited the paragraph by deleting the sentence "Elevated atmospheric CO_2 concentrations increase the photosynthesis rates in most plant species, leading to an increased plant growth and thus an increasing amount of natural biomass (Thompson et al., 2017)".
23	1.2.	This reference may be of interest - Burdige (2005) Burial of terrestrial organic matter in marine sediments: A re-assessment. https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2004GB002368	Thank you for the comment. We were aware of this paper, and decided to clarify the paragraph by adding a sentence referring to this study, as well as another one by Bradley et al. 2022. This should clarify that the riverine transport and consequent burial effeciency or organic matter into the seafloor is not uniform, highlighting that only a fraction of the organic matter is naturally stored in the deep sea sediments.	Added a sentence to paragraph 2 of section 1.2, p. 10: However, only a fraction of the suspended organic matter in rivers is naturally deposited in deep-sea sediments , and the transfer efficiency varies globally due to e.g. varying sedimentation rates, post-depositional reworking of the sediment as well as depth.
24	1.3.	C:N values of 50:1 are needlessly high given the secondary requirement of 60% lignocellulosic material...does this account for things such as inorganic nutrient deposition/dust? Or washed biomass?	Thank you for your comment. The C:N ratio of 50:1 and the 60% lignocellulose requirement were selected as a precautionary measure based on current literature to ensure the recalcitrance of the biomass and minimize the risk of degradation in marine anoxic environments. However, we acknowledge that ongoing research may provide new insights, and we remain open to revisiting these thresholds and incorporating additional considerations (such as the mentioned impact of inorganic nutrients and pre-treatment processes like washing) in future methodology updates based on robust scientific evidence.	No change.
25	1.3.	Table 1.1: This is unclear...is this the proportion of classes against all organics in the material? Or the overall dry weight?	Thank you for your comment. To improve clarity, we have updated the table heading.	1.3.
26	1.4.	Euxinic basins don't necessarily need high H_2S, just any free sulfide	Thank you for pointing this out. The sentence has been revised, and hydrogen sulfide is given as an example.	Revised the sentence to include all sulfides and include hydrogen sulfide as an example: "Certain anoxic basins may also be euxinic, which refers to anoxic conditions where the absence of oxygen is accompanied by high concentrations of dissolved sulfides (e.g. hydrogen sulfide (H_2S)), typically resulting from intense sulfate reduction and organic matter decomposition (Meyer & Kump, 2008)."
27	1.4	Not sure about rules but anoxic basins are defined by dissolved oxygen concentrations. However, there is more oxygen at the bottom of the ocean, such as SO_4. The presence of oxygen that is not dissolved poses a major risk of carbon degradation once material accumulates at the seabed - including the generation of H_2S. This is why this form of carbon removal we have stayed far away from as it poses major environmental risks that cannot be substantiated.	Sites with NO_2 and NO_3 concentrations that exceed 0.04 mg/L are not eligible due to the increased risk of nitrous oxide production (see rule 3.9.5). Concentrations on nitrate and nitrite shall be monitored annually, and if concentrations exceed 0.04 mg/L for two consecutive monitoring periods than the site is no longer considered eligible. The risk of production and subsequent transport of sulfides, nitrous oxide, and methane are required to be included in the environemtnal risk assessment (see section 4.5). Furthermore, bottle incubations are required to understand production of sulfide, nitrous oxide, and methane in specific site location prior to deployment (see rule 9.4.3). We thank the reviewer for the comment.	No change.
28	1.4	Could also mention the Cariaco Basin off the coast of Venezuela - https://en.wikipedia.org/wiki/Cariaco_Basin	Thank you for the comment. Cariaco Basin was not originally listed here due to uncertainties related to the durability of its storage capacity, although it is seen as a potential site for biomass deployment (see Raven et al. 2024). However, since this section is a general introduction to anoxic basins, we have decided to add it as an example with appropriate references.	The sentence was revised to add Cariaco Basin as an example of an anoxic basin: "Anoxic basin may either be a brine-filled depression in a larger water body, such as the Orca Basin in the Gulf of Mexico or the Cariaco Basin off the coast of Venezuela, or extend basin-wide, such as in the Black Sea (Hurtgen et al., 1999; Stanev et al., 2018; Stewart et al., 2007; Tribovillard et al., 2008; Van Cappellen et al., 1998; Zhang & Millero, 1993).
29	1.6	Should there be a quantitative threshold around the % of the feedstock by weight that could be classified as contaminants using this definition? This may be addressed by 3.6.9 - if so, ignore	Thank you for the comment. Harmful impurities must be removed entirely, and rule 3.6.9 does not set any quantitative restriction for innocuous contaminants. It is up to the project to choose their feedstock, knowing that to be eligible the biomass needs to comply with the requirements in the methodology	No change.
30	2.2.4	Please provide a definition of the Crediting Period. Does this mean that credits can only be sold 1 year after biomass is placed (First monitoring period) until 15 years after the first monitoring period? (5 years plus 2x 5 year renewals) Why can credits only be sold 15 years after biomass is placed? If this is the case, is the Credit Period rolling? (where biomass placed over a total of 5 years will have different credit periods). Or, as a different person understood it, is the Crediting Period the period where the facility is in operation under the production audit? Said differently, when and after which steps are we allowed to sell a credit?	Thankyou for the question. CORCs can be issued within the Crediting Period, but this not limit when they can be sold. Crediting Period is determined in the Puro Standard General Rules, which is available in the Puro Standard document library. Crediting period is "the period in which verified CO_2 removal Output attributable to a certified Production Facility can result in the issuance of CO_2 Removal certificates (CORCs)". For this methodology, each Crediting Period is set as five years, starting from the first date of the Monitoring Period (see also rule 5.2.1). The Crediting Period may be renewed twice, if the project succesfully undergoes a new Production Facility Audit.	No change.
31	Section 3	Oxygen not in dissolved form must be incorporated into this method or else negative environmental impacts can take place, such as the formation of hydrogen sulfide in the water column making the situation worse - not better.	Thank you for the comment. See the response above for comment no. 26 (copied below): Sites with NO_2 and NO_3 concentrations that exceed 0.04 mg/L are not eligible due to the increased risk of nitrous oxide production (see rule 3.9.5). Concentrations on nitrate and nitrite shall be monitored annually, and if concentrations exceed 0.04 mg/L for two consecutive monitoring periods than the site is no longer considered eligible. The risk of production and subsequent transport of sulfides, nitrous oxide, and methane are required to be included in the environemtnal risk assessment (see section 4.5). Furthermore, bottle incubations are required to understand production of sulfide, nitrous oxide, and methane in specific site location prior to deployment (see rule 9.4.3). We thank the reviewer for the comment.	No change.
32	3.1	The London Protocol (LP) is not a conventional protocol to a convention but a separate treaty that will eventially replace the London Convention (LC) entirely. So, the LP should not be referred to as a protocol to the LC.	Thank you for the comment. The list has been revised accordingly.	Changed the terminology from "Protocol to the Convention, 1996" to "The London Protocol, 1996".
33	3.2.	How should/shall the Supplier coordinate with puro.earth prior to bringing the production facilty online?	Thank you for the question. The Suppliers coordinate with Puro.earth's account managers, who provide guidance on practical matters on the Puro certification journey. Prior to submitting final documentation for the Production Facility Audit, the Supplier can opt to engage to a preliminary assessment. More information can be found on our website.	No change.

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34	3.2.5.	Why can biomass storage can take only place within a states EEZ or extended continental shelf?	Thank you for the comment. Operations are limited within the Exclusive Economic Zone to ensure the project is overseen by an appropriate authority or a regulatory body, such as an environmental agency or similar, from whom the CO_2 Removal Supplier shall apply for all necessary permits prior any operations (see rule 3.2.3). International waters are excluded due to the complexity of regulations, which may fall under various sovereign state's legislations as well as international treaties. Therefore, obtaining permits and overseeing the operations would not be as straightforward. Essentially, this is a safety precaution to ensure, that all operations are conducted following applicable legislative reguirements, with appropriate governmental oversight.	No change.
35	3.6.1.	"Biomass should be sourced sustainably"...does this mean the acquisition of biomass should be sustainable? Or the generation of biomass? If a non-sustainable industry can produces waste material that is high in lignocellulosic biomass...is that eligible to be a sustainable source if the biomass can be obtained sustainably? Or is it disqualified?	Thank you for the comment. The biomass sources eligible under this methodology are limited to three options: forestry residues, agricultural residues, and landscape management and green waste (rule 3.6.2). Further details on the sustainable sourcing criteria for these categories are found in section 3.8. of the methodology, as well as the Puro Biomass Sourcing Criteria, which sets the standard to ensure sustainable sourcing of biomass for any of the Puro Standard methodologies utilizing one or multiple biomass feedstock types. If the biomass feedstock does not comply with all of the criteria set in the Puro Standard General Rules, Puro Biomass Sourcing Criteria and the requirements set in this methodology, it is considered ineligible.	No change.
36	3.6.2(b)	The inclusion of non-food crops grown on marginal lands is both noted and supported.	We thank you for the supportive feedback.	No change.
37	3.6.2	Consider adding the word "waste" before residues to ensure that the biomass was not grown specifically for the purpose of deep sea burial. This is implied but could be made more explicit	Thank you for the comment. The term "waste" may be defined in multiple ways. For regulatory purposes, waste is considered as something unsafe which needs to be treated to not harm the environment. From an economic perspective, waste may not be valuable for its producer, and the producer then pays to get rid of it. On the other hand, waste can be something that has a value, and can be sold to create income. The meaning for a specific "waste feedstock" may also change depending on the market evolution. Importantly, in the case of this methodology, the term "waste" can easily be interpreted as feedstock which has negative environmental impacts. While the eligibility criteria (section 3) and risk assessment criteria (section 4) ensure that the residual biomass feedstocks do not harm the environment, using easily misinterpreted terminology would likely allow for confusion and/or doubt on the environmental safety of this approach, or other CDR approaches in general.	No change.
38	3.6.2	Is there a reason that non-terrestrial (e.g., aquatic) biomass has been excluded? Is this a separate Puro protocol?	Thank you for the comment. Eligible biomass feedstocks were selected to include certain terrestrial sources only due to the added chemical and physical structure, which prevents biomass decomposition (lignin-content, carbon to nitrogen ratio). During the methodology development process, other feedstock options were also considered. However, as this is the first approach to deploy biomass into the deep oceans, Puro chose to start with the safest option, which included deployment of terrestrial biomass into oxygen-depleted deep ocean conditions, as together these conditions minimise negative environmental impacts and ensure that the carbon is durably stored (e.g. local seafloor ecosystems limited to microbial life only, leading to decreased degradation of the biomass to grazing). We are open to discuss extending the eligible biomass feedstock categories in the following updates to the methodology.	No change.
39	3.6.3	How does this work in the case of agricultural residues such as bagasse? These have undergone significant processing; removal of labile organics is why the residues are good candidates for burial. What defines the initial state of a bagasse? What is an acceptable amount of degredation?	Thank you for the comment. Agricultural residues like sugarcane bagasse can be suitable for carbon storage in marine anoxic environments, provided they meet specific stability criteria. The key factor is the extent to which labile organic compounds, such as simple sugars and proteins, have been removed during processing. Bagasse undergoes significant extraction of fermentable sugars during sugar production, leaving behind a lignocellulosic structure that is more resistant to microbial degradation compared to unprocessed plant material. As a result, bagasse may be considered eligible for storage if it meets the methodology's requirements.	No change.
40	3.6.3	All biomass has decomposed - "significant" must be defined. Decomposition is not necessarily negative and could help reduce e.g. early DOM leaching. Recommend greater flexibility on decomposition state.	Thank you for the comment. The term "significant" is indeed not straightforward. We carefully revised this rule, and decided to remove it, as the requirements for C:N ratio and lignin and cellulose content are essentially the criteria that matter to determine the eligibility of the biomass. We also clarified other requirements in this section which relate to this topic.	Rule 3.6.6 removed. Amendments made to other rules in section 3, which tie to this change.
41	3.6.3	This rule potentially creates confusion. The terms, “undergone significant decomposition or degradation” is undefined. Here are two scenarios were there’s a potential for decomposition that violates this rule: 1. A pile of post-processed material at an agricultural processing facility. (E.g. a SAF plant or any bio-refinery). The material may have been decomposing, but any material collected from it for sequestration would be measured, on a lot-by-lot basis for its carbon content. Because the biomass has been processed, does this rule still apply? 2. A farmer collects the residual biomass e.g. waste trimmings after the harvest. These excess stalks and leaves sit on the field. Previously they would have been burned creating a major air quality impact, now they may be later collected for sequestration. The harvest takes the available truck and labor capacity in the region, so we cannot collect this material immediately. Instead, we’ll collect these piles for months after the harvest. The environment is wet and hot, so some decomposition will occur. Is there a numeric criteria where this rule comes into effect? All biomass collected for sequestration will have its carbon content measured. I’d love to understand the scenarios this rule is meant to prevent and if they clash with the above two scenarios. Is there criteria to measure, "significant decomposition or degradation?” Recommendation: Explicitly allow waste biomass sourced from an agricultural processing facility. And allow residual biomass sourced from agricultural fields up to one year old. In both cases the biomass will be measured for carbon content and be in accordance with all other rules.	Thank you for the comment. The term "significant" is indeed not straightforward. We carefully revised this rule, and decided to remove it, as the requirements for C:N ratio and lignin and cellulose content are essentially the criteria that matter to determine the eligibility of the biomass. We agree that a certain amount of degradation is likely to happen even in the case of fresh biomass, and therefore amended the requirements, which now do not disquality biomass, that has gone through some decomposition. We also clarified other requirements in this section which relate to this topic.	Rule 3.6.6 removed. Amendments made to other rules in section 3, which tie to this change.

Comment no	Rule or part	Comments	Puro response	Action
42	3.6.4.	The text says "This analysis shall be performed for a statistically appropriate sample". Given the potential volume of material, I don't see how a single sample could ever be representative. At the very least, a composite sample derived from multiple different samples is needed.	Thank you for the comment. The sampling procedure is included in section 10.5., which set the requirements for obtaining representative samples following ISO 18135:2017. Furthermore, section 10.6. includes requirements for measurement uncertainty, determining that the confidence interval for each measurement must be approximately 95%. These requirements aim to ensure that the sample(s) obtained represent the whole batch or lot of biomass. We edited this rule to ensure consistency across this and other sections in the Methodology.	Edited rule 3.6.4.: "This analysis shall be performed for a statistically representative sample...".
43	3.6.5	The requirement for lignin + cellulose is too high and not achievable by grassy crop residue (would disquality sugarcane and corn stover as well as landscaping waste). Perhaps this refers to the sum of lignin + cellulose + hemicellulose exceeding 60%? Otherwise this is only trees (want to avoid). Recommend revision to "sum of lignin+ cellulose + hemicellose >60%"	Thank you for the comment. The treshold of >60% includes lignin and cellulose only, as lignin and cellulose enhance the degradation resistance of the biomass, whereas hemicellulose is less rigid and prone to hydrolysis. We are open to reconsider changing the treshold value when the methodology is updated, pending that peer-reviewed scientific evidence shows that either biomass with lower lignin-cellulose content, or the lignin-cellulose-hemicellulose content of >60% does not alter the preservation of the biomass in anoxic conditions. However, we revised the rule to include this exception, if such evidence can be provided by the CO_2 Removal Supplier.	Rule 3.6.5. revised to include the possibility to provide peer-reviewed scientific evidence for lower lignin and cellulose content: Biomass shall have a high lignin and cellulose content, ensuring slower decomposition in anoxic environments. Biomass shall have a combined lignin and cellulose content of at least 60% (by dry weight). **Biomass with a lower percentage of lignin and cellulose may be considered as eligible if additional peer-reviewed scientific evidence demonstrates its suitability for long-term carbon storage in anoxic environments, such as relevant pilot studies, pending approval by the Issuing Body.**
44	3.6.5.	in the following rule: "Biomass shall have a high lignin and celulose content, ensuring slower decomposition in anoxic environments. Biomass shal have a combined lignin and celulose content of at least 60% (by dry weight)", We suggest adding the words "or a biomass containing high content of aliphatic nonhydrolyzable biopolymers (algaenan, above 1.5% of TOC) with a high Phycocyanin content (>10ug/L) , typical of recalcitrant cyanobacterial biomass (ref 3-5)."	We thank the reviewer for the comment. Eligible biomass is currently limited to terrestrial sources only (forestry residue, agricultural residue and landscape management and green waste). Aquatic biomass, such as cyanobacteria, is considered ineligible. We are open to studying other biomass sources in the next version, when the methodology updated. It requires a detailed understanding of the feedstock type, which is not possible in this timeframe.	No change.
45	3.6.5	Does hemicellulose count towards the the 60% threshold along with lignin and cellulose? My assumption is that it does (i.e hemicellulose adds toward the 60% threshold), but the rule lists only lignin and cellulose. To accept a more appropriate diversity of biomass types, we recommend this being changed to include hemicellulose in the threshold. In other words, the fraction of lignin+cellulose+hemicellulose should be adjusted to >60%.	Thank you for the comment. The treshold of >60% includes lignin and cellulose only, as lignin and cellulose enhance the degradation resistance of the biomass, whereas hemicellulose is less rigid and prone to hydrolysis. We are open to reconsider changing the treshold value when the methodology is updated, pending that peer-reviewed scientific evidence shows that either biomass with lower lignin-cellulose content, or the lignin-cellulose-hemicellulose content of >60% does not alter the preservation of the biomass in anoxic conditions. However, we revised the rule to include this exception, if such evidence can be provided by the CO_2 Removal Supplier.	Rule 3.6.5. revised to include the possibility to provide peer-reviewed scientific evidence for lower lignin and cellulose content: Biomass shall have a high lignin and cellulose content, ensuring slower decomposition in anoxic environments. Biomass shall have a combined lignin and cellulose content of at least 60% (by dry weight). **Biomass with a lower percentage of lignin and cellulose may be considered as eligible if additional peer-reviewed scientific evidence demonstrates its suitability for long-term carbon storage in anoxic environments, such as relevant pilot studies, pending approval by the Issuing Body.**
46	3.6.6.	This C:N value is probably too high, esp. given the secondary constraints in rule 3.6.5....would probably recommend lowering to 30:1	Thank you for your comment. The requirement includes the possibility for the CO_2 Removal Supplier to show evidence for the suitability of biomass with lower C:N ratio. The requirement has been revised to include the type of evidence required, ensuring that the lower C:N ratio does not impact the biomass feedstock's preservation in anoxic conditions. We are open to reconsider changing the treshold value when the methodology is updated, pending peer-reviewed scientific evidence.	Rule 3.6.6. revised to clarify the type of ecidence required for accepting biomass with lower C:N ratio: Eligible biomass shall have a carbon-to-nitrogen (C:N) ratio of at least 50:1. This ensures a low nitrogen content, which reduces the risk of microbial decomposition in anoxic conditions. Biomass with a lower C:N ratio may be considered eligible if additional **peer-reviewed scientific** evidence demonstrates its suitability for long-term carbon storage in anoxic environments, such as relevant pilot studies, pending approval by the Issuing Body.
47	3.6.6	The requirement for C:N is also too high and would exclude many crop residues (range from 39 to 60 in our data). There is no need for this to be so high for storage or environmental risk purposes. Recommend revision to C:N >30	Thank you for your comment. The requirement includes the possibility for the CO_2 Removal Supplier to show evidence for the suitability of biomass with lower C:N ratio. The requirement has been revised to include the type of evidence required, ensuring that the lower C:N ratio does not impact the biomass feedstock's preservation in anoxic conditions. We are open to reconsider changing the treshold value when the methodology is updated, pending peer-reviewed scientific evidence.	Rule 3.6.6. revised to clarify the type of ecidence required for accepting biomass with lower C:N ratio: Eligible biomass shall have a carbon-to-nitrogen (C:N) ratio of at least 50:1. This ensures a low nitrogen content, which reduces the risk of microbial decomposition in anoxic conditions. Biomass with a lower C:N ratio may be considered eligible if additional **peer-reviewed scientific** evidence demonstrates its suitability for long-term carbon storage in anoxic environments, such as relevant pilot studies, pending approval by the Issuing Body.
48	3.6.6	Similar to 3.6.5, this requirement would exclude most crops and landscaping wastes. We recommend adjusting this threshold to a C:N ratio >35	Thank you for your comment. The requirement includes the possibility for the CO_2 Removal Supplier to show evidence for the suitability of biomass with lower C:N ratio. The requirement has been revised to include the type of evidence required, ensuring that the lower C:N ratio does not impact the biomass feedstock's preservation in anoxic conditions. We are open to reconsider changing the treshold value when the methodology is updated, pending peer-reviewed scientific evidence.	Rule 3.6.6. revised to clarify the type of ecidence required for accepting biomass with lower C:N ratio: Eligible biomass shall have a carbon-to-nitrogen (C:N) ratio of at least 50:1. This ensures a low nitrogen content, which reduces the risk of microbial decomposition in anoxic conditions. Biomass with a lower C:N ratio may be considered eligible if additional **peer-reviewed scientific** evidence demonstrates its suitability for long-term carbon storage in anoxic environments, such as relevant pilot studies, pending approval by the Issuing Body.
49	3.6.7	What laboratory tests would be sufficient to demonstrate that "threatments do not pose environmental hazards in submerged conditions"? Could this be tightened to be limited only to peer-reviewed literature?	Thank you for the comment. We carefully revised this requirement (see also the response below, comment no. 50). This rule aims to exclude certain types of biomass feedstocks, such as chemically impregnated woody materials. While modern wood preservatives include environmentally-friendly options, many treatments pose a significant risk to the aquatic ecosystem. However, we acknowledge that for example the use of pesticides is also a chemical treatment. Thus, we have revised the requirement to clarify what evidence is considered sufficient, with an emphasis of the need to utilize applicable local, regional, national or international standards or benchmarks.	Revised rule 3.6.7.: "... unless laboratory tests or comparison with published local, regional, national or international toxicity standards and benchmarks confirm these treatments do not pose environmental hazards at the measured concentrations in submerged conditions."

Comment no	Rule or part	Comments	Puro response	Action
50	3.6.7	Nearly all agricultural material will have been treated with chemicals at some point (e.g. pesticides) but will only contain trace amounts by the time it is ready to be used by storage. Consider changing this rule to "... unless laboratory tests or comparison with published toxicity standards and benchmarks confirm these treatments do not pose environmental hazards at the measured concentrations in submerged conditions"	Please see the response to the above comment no 48 (copied below): Thank you for the comment. We carefully revised this requirement (see also the response below, comment no. 50). This rule aims to exclude certain types of biomass feedstocks, such as chemically impregnated woody materials. While modern wood preservatives include environmentally-friendly options, many treatments pose a significant risk to the aquatic ecosystem. However, we acknowledge that for example the use of pesticides is also a chemical treatment. Thus, we have revised the requirement to clarify what evidence is considered sufficient, with an emphasis of the need to utilize applicable local, regional, national or international standards or benchmarks.	Revised rule 3.6.7.: "... unless laboratory tests or comparison with published local, regional, national or international toxicity standards and benchmarks confirm these treatments do not pose environmental hazards at the measured concentrations in submerged conditions."
51	3.6.8	The individual heavy metals should be listed out rather than suggested via "e.g."	Thank you for your comment. We agree that the requirement should be revised to include the list of heavy metals, and have edited rule 3.6.8. accordingly.	Rule 3.6.8. has been revised to include a list of heavy metals: "Levels of heavy metals that could leach into the ocean and bioaccumulate in marine organisms, including but not limited to mercury (Hg), lead (Pb), cadmium (Cd), arsenic (As), chromium (Cr), copper (Cu), nickel (Ni), and zinc (Zn)."
52	3.6.8	We are concerned about what "limits defined in applicable legislation" could mean. We are not aware of any such limit that applies to OSB applications directly. For example, there are freshwater and saltwater benchmarks for some pesticides set by the US EPA but that is relevant in areas which contain abundant life, such as wetlands or other coastal areas. There are also limits to pesticide application (by farmers) but that is to prevent accumulation of the pesticide in local soils or water. None of these seem relevant to anoxic basins (but might be the best thing until pesticide tests are done on e.g. basin microbes)	Thank you for the comment. Essentially, the permitting authority is responsible for determining which legislation is applied, varying also based on the sovereign state under whose authority the CO2 removal project operates. Therefore, the applicable legislation for a given CO2 removal project may include local, regional, national and international treaties and regulations, ultimately set by the permitting authority. If the permitting authority identifies the need for new legislation specific for this approach, we assume they follow the normal procedures.	No change.
53	3.6.8	Does this mean no pesticide analyses are required if using US agricultural material?	Thank you for the comment. We have revised the language, pesticides shall be measured in all regions.	Rule 3.6.8. b and c have been revised: "in regions with limited control over pesticide use" and @in regions with limited environmental regulation" have been deleted.
54	3.6.9.	There should be a field for inorganic fertilizers and or dry deposition of dusts. There should be a demonstrated lack of nutrient efflux from biomass - including N, P, Fe...otherwise there no point to requirements like a high C:N	Thank you for the comment. We have revised section 3.6., and rule 3.6.9. has been added, with changes to rule 3.6.10 previously 3.6.9). We believe that any innocuous or harmful impurities are covered by these requirements, especially by requirements for analyses set in rule 3.6.8. However, we are wiling to discuss this in more detail if necessary, to better understand whether these requirements can be further clarified.	Section 3.6. has been revised, with changes to rules 3.6.9. and 3.9.10 (previously 3.6.9.). 3.6.9. The CO2 Removal Supplier shall remove harmful impurities from the eligible biomass posing a risk to humans or the environment to the extent required by the local, regional, national or international environmental regulations or other applicable legislation. 3.6.10.The CO2 Removal Supplier shall ensure that the eligible biomass is free from harmful impurities prior to deployment. Impurities are here defined as unwanted organic or inorganic material present in the biomass feedstock. These impurities shall be categorized and accounted for as follows: a. Innocuous Impurities in eligible biomass: Impurities considered harmless to aquatic life, such as small amounts of natural mineral aggregates (e.g., sand or clay), may remain in the feedstock provided that the mass fraction of the total deployed biomass due to the innocuous impurities is reliably quantified and deducted from the reported Output volume (see rule 6.1.5). b. Harmful impurities in eligible biomass: Prior to deployment, the CO2 Removal Supplier shall remove from the biomass any foreign objects (such as visible pieces of plastic, glass, metal, and other debris). Additionally, rule 3.6.8. has been revised to require analyses in all regions.
55	3.6.9	All biomass on earth today contains some amount of microplastic. A realistic minimum should be defined that is considered "none" for qualification purposes.	Thank you for the comment. Threshold concentrations of impurities within the biomass, including both microplastics and larger objects, are essentially controlled by the local permitting authority, who sets the threshold values and other safeguards for human healt h and environmental safety. The requirement has been revised accordingly.	Revised rule 3.6.9.b: Prior to deployment, the CO2 Removal Supplier shall remove from the biomass any foreign objects (such as visible pieces of plastic, glass, metal, and other debris). The CO2 Removal Supplier shall furthermore remove any other impurities posing a risk to humans or the environment, to the extent required by the local, regional, national or international environmental regulations or other applicable legislation.
56	3.7.1.	This is really vague. As long as biomass material is contained and shown to be non-reactive, it shouldn't matter so much about the particle size. In some cases, small particle sizes might end up being preferable.	Thank you for your comment. We agree that the rule 3.7.1 should be revised to remove the limit on biomass particle size, as the rule already enforces the structural integrity of the deployed biomass.	Rule 3.7.1 has been revised, deleting the last part: "Excessively fragmented or pulverized biomass is considered ineligible, as smaller particles decompose faster and impose a higher risk of physical leakage during the deployment process."
57	3.7.2.	This is confusing combined with the above rule 3.7.1.: do small particles compressed into pellets constitute big particles or small particles? If a bunch of small particles compressed together is now classified as a single big partible, there is a factor of water permeability here that is unrecognized	Thank you for your comment. We agree that the rule 3.7.1 should be revised to remove the limit on biomass particle size, as the rule already enforces the structural integrity of the deployed biomass.	Rule 3.7.1 has been revised, deleting the last part: "Excessively fragmented or pulverized biomass is considered ineligible, as smaller particles decompose faster and impose a higher risk of physical leakage during the deployment process."
58	3.7.3.	Confusing, why is material being measured/counted before "baling" procedures? Just measure after processing during deployment and then you don't need o account for this randoml, land based, unknown loss term	Thank you for the comment. Section 3.7. contains requirements for biomass processing and deployment. However, specific requirements for the timing of the measurements is included in section 6.1., as referred to in the biomass eligibility requirements (section 3.6., specifically rule 3.6.4.). Rule 6.1.3 states "the total mass shall be measured as close in time to the deployment as possible". This ensures, that the biomass does not undergo significant changes in its water content, carbon content or decomposition state which could distort the measurements. Rule 6.1.3. is in place to ensure that the biomass is unaltered between the measurement and deployment. The methodology does not strictly specify when the biomass mus be baled. Since the biogenic baling material may be considered as stored carbon, given that it fulfils all the biomass eligibility and sustainability criteria (sections 3.6. and 3.8.), samples of the baling material are also required.	No change.

Comment no	Rule or part	Comments	Puro response	Action
59	3.7.4.	Over what timescale? Timescale of deployment and sinking? Or timescale of 1000 years durability? In -between? All have different answers	Thank you for the comment. This requirement refers to the deployment and sinking phases, and has been revised accordingly.	Revised rule 3.7.4.: The CO_2 Removal Supplier shall evidence that the applied processing of the biomass prevents its dispersion in aquatic environments during deployment and sinking, e.g. via shear stress tests, compression strength tests, submersion tests or similar.
60	3.7.5.	Does this organic baling material also have to have a C:N ratio of 50:1 and 60% lignocellulose?	Thank you for the comment. The requirement mentioned in your comment need to be met only when the CO_2 Removal Supplier intends to include the baling material weight in the CORC calculation - i.e. to consider the baling material as part of the stored carbon.	No change.
61	3.7.7.	Is there consideration for sinking too fast - impact to lower sediments? Generation of sediment plumes? 5-50 m/s sinking is a wide range of sinking speeds.	Thank you for your comment. The sinking speed range has been adjusted to a minimum sinking speed of 0.5 meter per minute. Additional text has also been included requiring the CO_2 Removal supplier to minimize disturbance to the sediment such that none crosses the chemocline.	Revised rule 7.7.7 to have a minimum sinking speed of 0.5m/minute with additional text to limit impacts to the sediment.
62	3.7.7	We feel setting a maximum sink rate at 50 meters per minute is a bit arbitrary and does not appear to be set based on scientific evidence. Suggest making this a bit more general/site specific or referring back to applicable laws (EPA, through consultation with NOAA, will consider sinking speed and potential to interact with pelagic or benthic organisms when reviewing US permits)	Please see the response to the above comment (no 60).	No change.
63	3.7.8.	Will there be an open access database? Or will all this data be private?	Thank you for the comment. The Audit Reports are available to public, but not in a form of a database. The public data that the projects need to include will be available at the Puro Registry, https://registry.puro.earth/carbon-sequestration/retirements.	No change.
64	3.8.2.	Do sustainability requirements also pertain to baling materials if those are also counted as additional C burial?	Thank you for your comment. When the baling material is accounted towards the term Carbon stored, the same sustainability criteria must be followed for both the intended biomass feedstock, as well as the baling materials. If the baling material used cannot be counted towarsd stored carbon, the CO_2 Removal Supplier must evidence that the material is organic/biogenic in origin and made of materials which do not harm the marine ecosystem. These requirements are covered in rule 3.7.5.	No change.
65	3.9.	3.9. It sounds like anoxic basin is defined traditionally, just from dissolved oxygen. But what about non-dissolved forms like SO_4, NO_2, & NO_3 - which are also present in anoxic basins that degrade carbon and produce nasty compounds like H_2S that can kill life.	Please see the response above for comment no 26 (copied below): Sites with NO_2 and NO_3 concentrations that exceed 0.04 mg/L are not eligible due to the increased risk of nitrous oxide production (see rule 3.9.5). Concentrations on nitrate and nitrite shall be monitored annually, and if concentrations exceed 0.04 mg/L for two consecutive monitoring periods than the site is no longer considered eligible. The risk of production and subsequent transport of sulfides, nitrous oxide, and methane are required to be included in the environemtnal risk assessment (see section 4.5). Furthermore, bottle incubations are required to understand production of sulfide, nitrous oxide, and methane in specific site location prior to deployment (see rule 9.4.3). We thank the reviewer for the comment.	No change.
66	3.9.1.a	Any marine permits will designate sites as either circles, parts of circles or polygons, not points. A point defined site will by defintion cause almost all placement activities to be outside the designated site and thus in breach of permit conditions. Consequently, 3.9.1a should be deleted. Also, why is GNSS the only position fixing system referred to? In addition for accuracy, the general requirement (LC/LP data submissions) is for co-ordinates to be expressed in degrees and decimal minutes.	Thank you for the comment. We have revised the requirement, and removed the mention of a point-specific storage site. The requirement already allows for the use of "GNSS or equivalent geospatial technology", which allows the use of other position fixing systems. We have revised the coordinate requirement as suggested in the comment.	Edited rule 3.9.1.: Removed point-specific storage sites. Changed the decimal degree requirement --> degrees and decimal minutes. The CO_2 Removal Supplier shall maintain precise geographic records of all biomass storage sites used in the project. a. The geographic boundaries of a storage site shallmust be defined and documented as a polygonal perimeter, including latitude and longitude coordinates for all vertices, as well as depth ranges within the area. b. The storage site boundaries shall be recorded using Global Navigation Satellite System (GNSS) or equivalent geospatial technology, with coordinates expressed in degrees and decimal minutes (DDD° MM.MMM') format and verified for accuracy.
67	3.9.2.	3.9.2.a: Requiring seasonal records for 10 consecutive years is quite an extensive dataset...and even then can miss episodic oxygenation events. Use of sedimentary data, as well as historical datasets, should be allowed in making a case for stable anoxia at a proposed site, combined with oceanographic circulation	Thank you for the comment. The use of peer-reviewed scientific literature is allowed to supplement data collected by the CO_2 Removal Supplier, including sedimentary data. However, we are open to discuss further clarifications to this requirement, if necessary.	No change.
68	3.9.2.b	Please clarify if 'water column' here means the chemocline and basin or the oxic water column above the chemocline or all of the above.	Thank you for the comment. This requirement concerns the full water column, and the requirement has been edited accordingly.	Rule 3.9.2.b clarified: applies to full water column.
69	3.9.3.	3.9.3.a: Does this include both erosion into a system and out of a system? I.e. do deep basins, which have erosion into the basin (incoming sediment slumps..ect), but are ultimately depocenters and don't erode material out? The wording is unclear. Probably better to phrase as "erosion out of the target area". Erosion into the target area might actually help in C burial rates and permanence.	Thank you for your observation. We have revised the text to make clear the distinction between erosion out of the target area and erosion into the system.	Rule 3.9.3.a modified to "Evidence of low erosion risk out of the storage site. Regions subject to risks for dynamic seabed processes, such as submarine landslides or strong currents that remove material from the target area, are excluded. Erosion into the target area (e.g., sediment deposition) may be acceptable if it enhances carbon burial rates and permanence without compromising the monitoring."
70	3.9.3.c	See section 6.4 of the LC/LP 'Organic material of natural origin assessment guidelines' for a more extensive list of amenities, biological features, and uses of the sea to be considered in determining the specific location of disposal sites - see https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/2014%20WAGs%20English.zip.	Thank you for sharing these guidelines. We are open to clarify improving the requirements in this methodology based on these guidelines for the future updates of this methodology. While specific guidelines have not been added to the methodology at this time, we will look into including references to any relevant guidelines in the Puro.earth guidance documents for this methodology.	No change.
71	3.9.4.	3.9.4.b: Does this mean annual monitoring events? Monitoring twice within a month? There should be some capacity for allowing for the continued fall of oxygen after an unusual perturbation event	Thank you for your comment. As specified in rule 3.9.4.a, the monitoring events are on an annual basis. If a major perturbation event leads to the oxygenation of the storage site for a duration of >1 year, this site would no longer be considered a stable anoxic basin.	Edited rule 3.9.4.b to "annual monitoring events"
72	3.9.5.	This seems like an unusually specific, and extremely low, value. A value of 0.1 uM is pretty close to general high quality analytical detection limits and measurement uncertainty; obtaining accurate values in this range are overly optomistic in weirdnatural environments (such as permenantly anoxic, hypersaline basins like the Orca Basin). A site with no measurable nitrite could fail these parameters just due to analytical uncertainty. Further, given that other nitrite limits such as the EPA maximum contaminate level is 1mg/L this seems like an unnecessarily harsh prescription in the grand scheme of NO_2 standards in overall worldwide industry.	Thank you for your feedback. Our main concern regarding nitrate/nitrite levels is the risk of N_2O production in a nitrogenous zone. The low limit was set to ensure that nitrate and nitrite were near zero. However, given the analytical precision required to assess nitrate/nitrite concentrations so close to the detection limit, we have increased the threshold to 1 uM (0.04 mg/L).	Increased combined nitrate and nitrite threshold to 1 uM (0.04 mg/L)
73	3.9.8.	Dissolved organic carbon is labelled here as DIC	Thank you for pointing this out, it was a misspelling.	Rule 3.9.8. edited: Corrected DIC to DOC.
74		This section seems to be missing risk of reversal. Ignore if this is covered later in the MRV section, but a risk assessment paired with ongoing monitoring to ensure a reversal does not occur is essential to the long-term success and durability of the project	Thank you for the comment. The risk of reversal is address under section 4.3, and the procedures to monitor this risk is mentioned under section 9.7.	No change.

Comment no	Rule or part	Comments	Puro response	Action
75	4.2.2.	Table 4.1: Who validates the how serious a risk is in any various heirarchy of risks? The supplier? An outside review panel?	Thank you for the question. The project identifies, assesses and reports all material risks and their impacts based on the risk hierarchy framework and the risk matrix. Those are reviewed by the permitting authorities, and the independent third-party auditor, according to their respective procedures.	No change.
76	4.2.3.	I don't understand how risks can be defined by a project, when the project has to have risks defined to be able to start.	Please see response to comment no. 74 (copied below): Thank you for the question. The project identifies, assesses and reports all material risks and their impacts based on the risk hierarchy framework and the risk matrix. Those are reviewed by the permitting authorities, and the independent third-party auditor, according to their respective procedures.	No change.
77	4.3.1.b	I don't see how you can do anything about military risks, which kind of negate the whole process anyway. This seems unnecessary. Is there similar wording with convential CDR about the potential for militaries to target and burn forests? Why is that the responsibility of the company anyway?	Thank you for your comment. The purpose of this rule is to ensure that the storage site is located under a stable political environment, which ensures that the necessary regulatory framework exists and cannot be disputed. While the CO2 Removal Supplier cannot ensure that military conflicts will not occur in the future, the assessment shall be based on the current knowledge and understanding of the political climate of the region. We have revised the wording of the requirement for clarity.	Rule 4.3.1.b revised: Replaced "Military conflicts" with " Political or regulatory instability"
78	4.4.1	Can puro please clarify what "no net harm means"? No Net Loss policies applying to construction in wetland areas require the constructor to replace or enhance the same amount of wetland that has been lost. Does this have similar implications?	Thank you for your comment. We consider that the requirements in the methodology and the Puro Standard General Rules ensure that no significant net harm occurs as a result of CO2 removal activity. However applicable statutory requirements may didctate further consequences.	No change.
79	4.4.3.	Does mention of soil health refer to places where biomass material is grown? How does this pertain to the use of agricultural waste?	Thank you for your comment. We are not sure we understand you comment to rule 4.4.3 correctly. The Methodology addresses soil health and biomass eligibility under section 3.6 Requirements for biomass eligibility and characterization. We do not consider agricultural residues a "waste". Nevertheless, we do address agricultural residues under rule 3.6.2.b and Puro Biomass Sourcing Criteria provides further details on the sustainbility criteria required for its eligible use.	No change.
80	4.4.3	There are some circumstances where ocean activiies do not require an EIA in the US. I'm not sure if any mCDR activities will fall under this category, but in case they do, we suggest adding "unless local or national legislation determine no EIA is required", or something to that effect.	Thank you for your comment. All projects seeking certification under the Puro Standard must conduct an Environmental Impact Assessment. In most cases, this is required also by the permitting authority, and in these cases, the same EIA may be submitted by the project for certification purposes, and for the Auditor to verify. In cases where the permitting authority does not require an EIA, the CO2 Removal Supplier must follow the criteria set in the Puro Standard General Rules (GR clause 6.4.3. and 6.4.3.1) and in section 4.4. of the methodology. We have clarified this requirement to explicitly require the CO2 Removal Supplier to provide documentation addressing all material environmental and social impacts.	Rule 4.4.3. revised: Added subrule b. In cases where EIA is not required by the applicable local or national legislative requirements, the CO2 Removal Supplier shall provide documentation that robustly addresses all material environmental and social impacts, following criteria determined in the Puro Standard General Rules and this methodology.
81	4.4.3.	Note that the LC/LP guidelines mentioned above constitute an environmental assessment process for the deposit of biomass in the ocean.	Thank you for your comment. All projects seeking certification under the Puro Standard must conduct an Environmental Impact Assessment. In most cases, this is required also by the permitting authority, and in these cases, the same EIA may be submitted by the project for certification purposes, and for the Auditor to verify. In cases where the permitting authority does not require an EIA, the CO2 Removal Supplier must follow the criteria set in the Puro Standard General Rules (GR clause 6.4.3. and 6.4.3.1) and in section 4.4. of the methodology. We have clarified this requirement to explicitly require the CO2 Removal Supplier to provide documentation addressing all material environmental and social impacts. We believe that this requirement also fulfils the criteria of the London Convention or the London Protocol (LC/LP).	Rule 4.4.3. revised: Added subrule b. In cases where EIA is not required by the applicable local or national legislative requirements, the CO2 Removal Supplier shall provide documentation that robustly addresses all material environmental and social impacts, following criteria determined in the Puro Standard General Rules and this methodology.
82	p. 46	Table 4.2: consideration for loss of water in hydrated biomass? Or does that fall under nutrients?	Thank you for the comment. Unfortunately, we are not sure if we correctly understood your comment. Overall, the pertubation to the water cycle is negligible considering the water content of most biomass feedstocks. Furthermore, transporting large quantities of wet biomass is not logistically practical. However, we are open to discuss this in further detail if necessary.	No change.
83	p. 47	For marine system risks, there should probably be distinction between ocean waters that biomass material has to transit through and isolated anoxic basins.	Thank you for your comment. With the proper sinking speed (minimum speed of 0.5 meters per minute) and packaging of the biomass, we expect the risks to the marine environment during biomass transit to be very low.	No change.
84	4.5.2.	While there is certainly potential to change microbial community structures, it is unclear to me how general surveys of microbial organisms are indicators of risk. If one group of organisms changes and another increases in prominance, but the net effect to local or region biogeochemistry remains the same...does this constitute a risk? Does there have to be a net negative effect for there to be a risk? Or is any change enough?	Thank you for your comment. This is considered a risk because the environmental impacts of changing microbial communities is unknown. Therefore, it should be monitored. Mitigation protocols need only be used if any detected changes in the microbial community "pose a significant threat to the local ecosystem" (4.5.2.c).	No change.
85	4.5.3.	b and d overlap - changes in redox state or switches between redox regimes are the same. In the same vein as dissolved Fe, if specificity is needed, upregulation of sulfate reduction and accumulation of H2S is a risk, since H2S is toxic even to microorganisms that utilize it, when in high concentrations.	Yes, 4.5.3.b states the need to monitor the redox state in general, while 4.5.3.d. explicitly notes the significance of changes to iron cycling. The accumulation of H2S is addressed in rule 4.5.4 and 4.5.5.	No change.
86	p. 49	The same oxidation can happen to any reduced species, see: Fe2+ effluxing from ferruginous systems, not just sulfide	Thank you for the comment. The particular paragraph in the methodology is intended as an example, not an exhaustive list. The text has been clarified to reflect this.	Added "for example" for clarification.
87	p. 50	Methanogenesis can also be the major metabolism when organisms that are usually competitive for substrates, i.e. hydrogen, sulfate reducers, are inhibited (potentially high salinity). There are multiple types of AOM, not just sulfate based.	Thank you for your comment. We have edited this section to refer to AOM more broadly.	Removed sulfate-specific language when referecing to AOM.
88	4.5.8.	Again, to me, this seems like a low value that even totally nitrate/nitrate free system may randomly fail to clear.	Please see response to comment no 71 (copied below): Thank you for your feedback. Our main concern regarding nitrate/nitrite levels is the risk of N2O production in a nitrogenous zone. The low limit was set to ensure that nitrate and nitrite were near zero. However, given the analytical precision required to assess nitrate/nitrite concentrations so close to the detection limit, we have increased the threshold to 1 uM (0.04 mg/L).	Increased combined nitrate and nitrite threshold to 1 uM (0.04 mg/L)
89	4.5.	See Karlen et al. (2000) Crop residues: The rest of the story. Environmental Science & Technology, 43(21), 8011–8015. https://pubs.acs.org/doi/pdf/10.1021/es9011004 for a discussion about the implications of removing crop residues from the land.	Thank you for sharing this publication. Many of the concerns raised in this article have been addressed throughout the methodology. Specific concerns regarding nutrient robbing and terrestrial ecosystem impacts are addressed in section 4.5 as well as in the biomass sourcing eligiblity (section 3.6) and indirect emissions (section 8).	No change.

Comment no	Rule or part	Comments	Puro response	Action
90	4.5.2.a	The text does not make sense! What is the "environmental prior"?	Thank you for the comment. Environmental priors refer to the environmental conditions before biomass deployment, and it is defined in rule 9.3.6.b. We have also included this term in the glossary.	Added Environmental priors to glossary.
91	4.3.5.c	Note that the deep waters of the Black Sea are already undersaturated with regard to calcite and aragonite - https://www.airclim.org/acidnews/ocean-acidification-%E2%80%9Cblack-elephant%E2%80%9D-black-sea and https://www.airclim.org/sites/default/files/document/ocean_acidification_report_for_the_black_sea.pdf. Consequently, monitoring for undersaturation may be unnecessary.	Thank you for the comment. This monitoring threshold is described in more detail in rule 9.6.6.	No change.
92	4.5.	I understood that the expansion of persistent marine sub-oxic environments due to human activity was primarily in mid-depth waters.	Thank you for the comment. To clarify this point, we have changed the text "sub-oxic and anoxic basins" to "sub-oxic and anoxic zones" in the introductory paragraphy for oxygen depletion.	Changed "sub-oxic and anoxic basins" to "sub-oxic and anoxic zones"
93	5.2, 5.3, 6.3.	Oxygen not in dissolved form that is present will make any derivation of total carbon removed not robust as more degradation will take place with SO_4, etc present at the seabed. A smaller fraction of carbon preserved and/or a greater emphsis on negative environmental effects must be incorporated.	Please see response to comment no. 26 (copied below): Sites with NO_2 and NO_3 concentrations that exceed 0.04 mg/L are not eligible due to the increased risk of nitrous oxide production (see rule 3.9.5). Concentrations on nitrate and nitrite shall be monitored annually, and if concentrations exceed 0.04 mg/L for two consecutive monitoring periods than the site is no longer considered eligible. The risk of production and subsequent transport of sulfides, nitrous oxide, and methane are required to be included in the environemental risk assessment (see section 4.5). Furthermore, bottle incubations are required to understand production of sulfide, nitrous oxide, and methane in specific site location prior to deployment (see rule 9.4.3). We thank the reviewer for the comment.	No change.
94	6.1.2.	Material shall be shredded? Previously it was stated that material shouldn't maximize surface area? There should be consistency here. What size does shreded even refer to?	Thank you for the comment. We have revised the rule, as indeed, shredding is the wrong term to use here, as is biomass processing and baling. Instead, the purpose of this rule is to make sure the biomass is homogenized and mixed prior to the analysis, and the wording is therefore revised.	Rule 6.1.2. revised: In the case of heterogeneous biomass, the analyzed biomass shall be **homogenized** and evenly mixed prior to **analysis**. Further requirements for the proper treatment of the biomass are determined in section 3.7.
95	6.1.4.	This seems lenient. How can there not be a concurrent measure of Corg or the wet/dry ratio if the biomass in question has to be shown to have a specific C:N ratio and also contain the correct ratio of lignocellulosic material?	Thank you for your comment. After careful review, we made several changes to the formatting of requirements in sections 3.6. and 6.1 to clarify, that the measurements for C:N, Corg and lignin and cellulose content must be measured as close as possible to the biomass deployment, which was not clearly stated. Essentially, this is to ensure that the biomass will not undergo significant changes in between the measured values and the biomass deployment, which affect the eligibility of the biomass or its carbon content. We hope these changes clarify the measurement protocols and the justification for the timing of the analyses.	Changes to several rules in section 3.6. and 6.1., as detailed below: Requirements for conducting the chemical analyses moved from rule 6.1.4. to be included in rule 3.6.4. Rule 3.6.3. and rule 3.6.4. amended to include further details on the timing of the measurements. Literature values for C:n ratio, lignin gand cellulose content and Corg only allowed for initial screening of potentially eligible biomass.
96	6.1.4.	As for p.27 above, given the potential volume of material, I don't see how a single sample could ever be representative. At the very least, a composite sample derived from multiple different samples is needed.	Thank you for the comment. The sampling procedure is included in section 10.5., which sets the requirements for obtaining representative samples following ISO 18135:2017 based on the desired precision.	No change.
97	6.3.4.	Oxidation rates within the basin? Or outside the basin due to diffusion across the chemocline? In the overlaying oxic water column? This should be clarified.	Thank you for the comment. The requirement has been edited for clarity.	Rule 6.3.4. and 6.3.5. have been revised: The CO_2 Removal Supplier shall quantify the basin specific methane oxidation rates, kCH_4, below the chemocline through headspace equilibration measurements such as those outlined in (Reeburgh, 2007), isotopic analysis (Kawagucci et al., 2021), other similar analysis, or published literature.
98	6.3.6.	For how many years?	Thank you for the comment. The language of the requirement has been clarified to specify the timeframe.	Revised rule 6.3.3: The CO_2 Removal Supplier shall annually retrieve a subset of the deployed biomass following requirements set in rule 9.6.7 and measure the carbon content according to rule 6.1.4 **for the duration of the CO_2 Removal Activity prior to storage site closure and post-closure monitoring**. In cases where the measured value for carbon loss differs from the calculated value (see rule 6.3.2), the more conservative value shall be used.
99	6.3.1.	Measurements of small purturbations in large diffusive areas are...often indeterminant? What are the lower thresholds of acceptability?	Thank you for the comment. Carbon loss is estimated based on the assessment of DIC, CH_4, and N_2O production rates during lab incubations, subsequent in-field biomass retrieval analysis, and a mixing model. Such measurements and models will be subject to analytical and model uncertainty.	No change.
100	6.3.	Remark on calculated and measured carbon loss: If comparing loss rates from incubation bottles to solid loss of biomass retrieved from a seafloor...it should be noted that obtaining accurate masses from plant material sitting for years in salt water is non-trivial. Ignoring the fact that biomass has an internal water content variability that can account for multiple % of total weight, and typically gets averaged out of the equation, the addition of salt (and it's hassle of removal without also losing biomass) means that solid mass phase measurements are going to have significantly more uncertainty than geochemical parameters.	Thank you for the comment. We are aware that the removal of salt from the deployed biomass may prove to complicate the measurements. However, this will lead to a more conservative value, i.e. higher biomass loss and there is not a risk for over-crediting. In any case, the most conservative value must be used, whether sourced from the model results or the direct measurements from the biomass.	No change.
101	6.2.2	Not all agricultural residues are left on the land where it was grown, for example residues resulting from the processing of agricultural material (sugarcane). Would suggest adding additional scenario that allows biomass left on land by processing facility (or something to that effect)	Thank you for the comment. The baseline scenarios are not only limited to these two; biomass can be disposed of also at the processing facility, like in the case of sugarcane. The requirement states: The CO_2 Removal Supplier shall evidence that in the absence of the Marine Anoxic Carbon Storage activity, the utilized biomass would not have been treated or stored in a manner which would have guaranteed a secure long-term carbon storage. **This evidence includes, but is not limited to the following scenarios:** a. The biomass would have been left unharvested or disposed of on forest land. b. The biomass would have been left unharvested or disposed of on agricultural fields.	No change.
102	6.3.1.	The text says "The CO_2 Removal Supplier shall monitor and quantify total loss over the 1000 year storage period"!!! That seems to be a widely unrealistic requirement! A requirement to estimate the losses over that period would be more practical.	Thank you for the comment. We have revised the language of the requirement to improve clarity.	Rule 6.3.1. revised: The CO_2 Removal Supplier shall monitor and quantify the total carbon loss.s over the 1000 year storage period. For the purposes of this methodology, loss is defined as CO_2, CH_4, or N_2O that is released from the ocean storage site that then likely crosses the chemocline over the 1000 year storage period.

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103	6.3.3.	Again the requirement "The CO2 Removal Supplier shall quantify the total amount of CO2e released over the 1000-year storage period" is widely unrealistic! A requirement to estimate the total amount of CO2e released over that period would be more practical.	Thank you for the comment. We have revised the language of the requirement to improve clarity.	Rule 6.3.3. revised: The CO2 Removal Supplier shall quantify the total amount of CO2e released over the 1000-year storage period by monitoring decomposition products and rates through incubation experiments (see section 9.4) and by modeling circulation timescales at the site of deployment (see section 9.5).
104	6.3.6	We have some concerns about the feasibility of recovering deployed biomass in conditions where conventional deep sea technology is not feasible (e.g. ROVs in hypersaline waters). We suggest considering alernative phrasing which allows for acceptable alternatives.	Thank you for the comment. We consider biomass retrieval to be essential for validating the estimated carbon losses. Therefore, a sample of biomass must be retrieved annually. We acknowledge that at certain storage sites, obtaining these samples may be difficult. We are open to discuss revising this requirement based on developments and operational feedback, to understand if flexibility can be increased.	No change.
105	7.1.9.	Is this section relevant for biomass storage in anoxic basins?	Thank you for your comment. Rule 7.1.9 provides guidance on what to include in the development of the project life cycle inventory (LCI). This could be necessary when estimating the embodied emissions of the infrastructure to support the activity. As you point out, it may not be necessary. Yet, we consider it relevant for the calculation of Project Emissions.	No change.
106	Section 9	Compounds related to the degradation of carbon at the seabed when reactions with oxygen NOT in dissolved from take place must be incorporated (added really) into monitoring plans (e.g., H2S).	Please see the response to comment no. 26 (copied below): Sites with NO2 and NO3 concentrations that exceed 0.04 mg/L are not eligible due to the increased risk of nitrous oxide production (see rule 3.9.5). Concentrations on nitrate and nitrite shall be monitored annually, and if concentrations exceed 0.04 mg/L for two consecutive monitoring periods than the site is no longer considered eligible. The risk of production and subsequent transport of sulfides, nitrous oxide, and methane are required to be included in the environemtnal risk assessment (see section 4.5). Furthermore, bottle incubations are required to understand production of sulfide, nitrous oxide, and methane in specific site location prior to deployment (see rule 9.4.3). We thank the reviewer for the comment.	No change.
107	9.2.2.	While I get the difficulty of establishing standards when instrumentation and methods will be wildly variable, this seems a bit...unrigorous. It would be more useful to allow various technologies and instrumentation, but provide guidelines on how much uncertainty is allows for a suite of measurements for the measurement to be recognized as useful towards monitoring.	Thank you for the comment. The Methodology includes section 10.7 Quality Control (QC) System and Procedures. In particular, rule 10.7.5 covers minimum calibration of the measuring equipment. Moreover, section 10.5 Sampling Procedures ensures representativeness in the measurement, and 10.6 estimates measurement uncertainty.	No change.
108	9.2.5/6	monitoring plans should also specifically define the locations of sampling relative to biomass, sediment, and other features, and how that will be achieved. This includes both distances and orientation of that distance relative to flow, etc.	Thank you for the comment. The monitoring plan must include all relevant information and data related to the CO2 removal project, including, but not limited to the location of the storage site and the data collected. Further details for the sampling are included in section 9.3. and section 9.6.	No change.
109	9.3.3.a	There is a floating period here. It is odd to rely on 'best practices' without giving a minimum floor for valid measurements, regardless of procedure.	Thank you for the comment. The purpose of the measurement is to quantify the amount of carbon that is being deployed. We don't see a need to determine a minimum floor value here. On the other hand, rule 9.3.3.b focuses on meeting environmental safeguards and requires determining a priori the values of chemical components. Rule 3.6.8 requires evidence of concentrations of potentially toxic elements (PTE) in the biomass prior to its deployment in line with relevant regulations and rule 3.6.9 is free of impurity.	No change.
110	9.3.7.	Table 2: Above, the protocol states that different sites will have different measurement needs, but here lists a sequence of requirements. All of these measurements, whileindividually potentially useful, will probably not be feasible or be within the same range of measurement confidence at all potential anoxic basin sites, especially if there are weird water chemistries involved - i.e. hypersaline anoxic basins. It seems more useful to define a a needed set of environmental traits for a stable system, about which a suite of various, achievable measurements can be designed to address, rather than trying to measure all possible parameters in situations where they don't mean anything. In a similar vein, I appreciate being as complete as possible...but the extent of this list seems high compared to existing OAE tests for example, that just monitor pH, DIC, and TSS. More can be better, but I'm not sure "more measurements" should be the barrier to entry here. For instance, measurements of sulfate in hypersaline environments can have uncertainties of .5 mM ...which is far to much to have any real utility to monitor sulfate reduction extent in an open system unless the perturbation is enormous.	Thank you for the comment. We have added a stipulation in rule 9.3.7 that allows the CO2 Removal Supplier to justify the omission of measuring geochemical parameters that are not relevant for the specific storage site. In such a case, the CO2 Removal Supplier shall provide proper evidence based on scientific literature.	Edited rule 9.3.7 to allow the CO2 Removal Supplier to omit the characterization of certain geochemical parameters as long as they are able to justify this omission.
111	9.3.7.	Table 2: Cell counts - I'm not sure what the reasoning is here for environmental cell counts. I assume this is to catch a potential bloom of microorganisms...? This would be extremely temporally limited. Also, water measurements would miss any organisms making biofilms on the biomass installation. Further, changes in cell count would be hard to link directly to a biomass installation...Perhaps a different measurement of cellular activity would be more appropriate, or limiting this variable to the solid biomass itself?	Thank you for the comment. We have replaced cell count analysis with live cell staining analysis. Please see also response to No. 140.	Replaced cell count analysis to live cell staining analysis.
112	9.3.7.	Table 2: Microbial functional diversity - Is this intended to be active functional diversity? Metabolic potential? Available groups of general organisms? Those are all different techniques with very different levels of required infrastructure and skill.	Thank you for the comment. We acknowledge that monitoring for functional diversity may not always be feasible. The requirement has been clarified to reflect this, and monitoring of microbial funtional diversity has been included as a recommendation.	Changed "microbial functional diversity" to "microbial diversity"
113	9.3.7.	What are "environmental priors"? I suggest using more commonly understood lamguage.	Thank you for the comment. Environmental priors refer to the environmental conditions before biomass deployment, and it is defined in rule 9.3.6.b. The common term to use here would likely be "baseline", which in the CDR industry holds another meaning and using it here could cause confusion. However, to clarify the meaning of "environmental priors", it has been included and defined in the glossary.	Edited the Glossary, added: Environmental priors - The environmental conditions of the storage site prior to biomass deployment, to be established by the CO2 Removal Supplier prior to deployment through the proper characterization of biological and geochemical properties of the water column and sediment.
114	9.3.8.	What determines if "best practice" protocols are "possible" in a given system? The measurements listed above in Table 2 are quite diverse. "Best practices" are challenging in oceanographic conditions for high preforming academic laboratories, with significant experience, who specialize in only one or two of the above required measurements. The above list would almost require an ensemble of individual experts working at peak field preformance, with an extensive array of available analytical instrumentation...this seems hard to attain. Even if most of the samples are sent to external laboratories for analysis (to reduce instrumentation burden), sample handling for various geochemical and biological parameters is paramount and also requires expertise, especially at sea. Further, if samples are sent away for analysis, there are samples types listed that are time sensitive.	Thank you for the comment. We have revised to requirement for more clarity, and instead of industry best practices, peer-reviewed scientific practices must be used. We acknowledge that for a given parameter there may be multiple protocols, and in cases where there is no consensus of the best protocol to use / no pre-determined scientific best practice, the CO2 Removal Supplier must justify the selection of a given protocol, which needs to be approved by the Issuing Body. When scientific best practices for certain parameters are established, they can be taken into consideration in when the methodology is updated.	Revised rule 9.3.8.: Parameters listed in table 9.2 that do not have established protocols in the above-listed documents shall use **applicable peer-reviewed scientific** best practices and enclose details of the specific method used in the Monitoring Plan **pending approval by the Issuing Body**.
115	9.3.8.	The Regional Seas Conventions (OSPAR, Mediterranean, Baltic) have monitoring guidelines that cover a wide range of parameters, some of which are relevant here.	Thank you for sharing these guidelines. The link to the OSPAR Convention is included in section 3.1. While specific guidelines have not been added to the methodology at this time, we will include references to any relevant guidelines in the Puro.earth guidance documents for this methodology.	No change.

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116	9.3.10.	This starts becoming infeasible with depths greater than 2000 m unless just utilizing CTD data...simply characterizing existing and known water masses should be enough, focusing on the areas closest to the chemocline. Similarly, only measuring geochemical parameters below the chemocline means there won't be a baseline for above the chemocline, which is the area where risk is involved. Geochemical parameters should include proximal water masses.	Thank you for your feedback. Rule 9.3.10 has been revised and subsequenctly moved to section 10.5., and now allows the CO_2 Removal Supplier to decide on the vertical sampling resolution to properly characterize the vertical variability of the full water column. The geochemical measurements listed in table 9.2 have also been extended to be for the full water column.	Revised rule 9.3.10 (now moved to section 10.5.) to allow flexibility in the vertical sampling resolution of geochemical properties listed in table 9.2. Extended the measurements of geochemical parameters listed in table 9.2 to be for the full water column. Subsequently, removed rule 9.3.11. All requirements for water column sampling requirements are moved to section 10.5., rules 10.5.6-10.5.9. Additionally, appropriate ISO standards have been referred to to ensure the sampling protocols follow standard approaches.
117	9.3.10 and 9.3.11	The requirements for sampling at 100 m intervals is unduly prescriptive. This could be a recommendation but with allowance to vary it if circumstances suggest otherwise.	Please see the response above to comment no. 115.	Revised rule 9.3.10 (now moved to section 10.5.) to allow flexibility in the vertical sampling resolution of geochemical properties listed in table 9.2. Extended the measurements of geochemical parameters listed in table 9.2 to be for the full water column. Subsequently, removed rule 9.3.11. All requirements for water column sampling requirements are moved to section 10.5., rules 10.5.6-10.5.9. Additionally, appropriate ISO standards have been referred to to ensure the sampling protocols follow standard approaches.
118	9.3.11.	This should depend on the distance from chemocline to seafloor. Understanding potential geochemical gradients in the benthic boundary layer <50 m from seafloor should be a priority.	Please see the response above to comment no. 115.	Revised rule 9.3.10 (now moved to section 10.5.) to allow flexibility in the vertical sampling resolution of geochemical properties listed in table 9.2. Extended the measurements of geochemical parameters listed in table 9.2 to be for the full water column. Subsequently, removed rule 9.3.11. All requirements for water column sampling requirements are moved to section 10.5., rules 10.5.6-10.5.9. Additionally, appropriate ISO standards have been referred to to ensure the sampling protocols follow standard approaches.
119	Table 9.2	Does there need to be any biotic sampling of the water in addition to the sediment? This would confirm the hypothesis about the functionally anoxic area being free of bacteria or other eukaryotes that might contribute to the degradation of the biomass	Thank you for the comment. As indicated in Table 9.2, microbial sampling of the water is required within the bounds of the storage site as well as the sediment.	No change.
120	9.3.12.	The "the approximate center of the storage site boundary" is nonsensical. I think you mean to say "Water column measurements shall be taken at 5 locations along a transect of the storage site running through the approximate center of the storage site from boundary to boundary".	Thank you, we have edited rule for clarity. Furthermore, the requirements for water column and sediment sampling have been moved to section 10.5. (Sampling procedures) for the ease of reading. References to appropriate ISO standards have also been added, to ensure the sampling protocols follow standard approaches.	Revised water column sampling requirements and moved to section 10.5. (rules 10.5.6.-10.5.9).
121	9.3.13.	Sampling of sediments for contaminants etc is often done using 'stratified random sampling' - e.g., see https://onlinelibrary.wiley.com/doi/abs/10.1002/9780470061572.eqr319. Also, there are guidance documents for sediment such as https://www.cefas.co.uk/publications/aquatic/aemr55.pdf.	Thank you for the comment. We have decided to allow both systematic and stratified approaches to be used for sediment sampling and edited the requirement accordingly, and added references to appropriate ISO standards for sampling.	Rule 9.3.13 revised and moved to section 10.5. (now rule 10.5.10): Sediment samples shall be collected from at least 5 locations within the storage site boundary, considering the approximate center of the storage site boundary (see rule 9.3.10) as further specified in subrules a-d. a. The sampling shall be conducted in a manner representative of the storage site, based on one or several of the following principles, as further detailed in ISO 5667-19:2004: - Random sampling. - Grid sampling. - Gradient sampling b. The CO_2 Removal Supplier shall select the appropriate sampling principle based on the objective of the sampling (rule 10.5.8), which may vary between the project stages (table 9.1). c. Regardless of the sampling technique used, the CO_2 Removal Supplier shall collect replicate measurements from at least 5% of the samples collected, or always at least from one randomly selected sampling location, to assess measurement error. d. Each sediment core shall be at least 30 cm long, and preferably recovered via a multicore sediment sampling device to ensure appropriate replicates. Solid phase extraction of POC and microbes shall be conducted from the solid sediment while all other measurements listed in table 9.2 shall be conducted from the extracted pore water.
122	9.3.	Similar to the above comment (no 102), we are concerned about the feasibility of safely collecting sediment samples near piles of biomass on the sea floor using conventional methodologies (e.g. multicore). However we feel that "as close to the site as possible" is acceptable until improved technologies or improved alternative approaches are found.	Thank you for your comment. We are open to revising the specificity of this rule once new technologies become available.	No change.
123	9.4.1.	Caveat...bottle experiments are specific experiments to test processes and capability, as well as determine potential boundary conditions. They do not truly reflect environmental conditions, especially from the deep ocean.	Thank you for your comment.Yes, this is a known limitation of using bottle incubations to estimate in-field outcomes. While bottle incubations should be set up to reproduce in-field conditions as much as possible, no amount of specifications will allow for identical conditions. However, bottle incubations will provide useful information for the outcome of deployed biomass in anoxic waters withouth requiring long-term in-field studies, which will be more labor and financially intensive.	No change.
124	9.4.1.	There is no consideration of whether these incubations should be kept in the dark (yes) to avoid phototrophy or photochemistry. Also no requirements for water handling...is anoxic water allowed to become oxic on transport and holding periods? This will change water chemistry significantly. How are dissolved gasses being acounted for? What are the initial conditions of the experiment and it's various water and sediment sources that are needed to compare time series data against?	Thank you for your comment. We have added a requirement for the incubations to be kept in conditions without light in rule 9.4.2.c. Proper handling of anoxic seawater and sediments for incubation experiments will be outlined in further guidance documents. We are open to suggestions for proper handling protocols.	Revised rule 9.4.2.c: During the incubation period, care shall be taken to maintain stable incubation conditions such as anoxia, temperature, and **the absence of light.**
125	9.4.2.e	All of the site seawater cannot be filtered or else there will not be water column microbes accounted for...typically a mix of 90% filtered to 10% live water is used. There should be steps taken to ensure the living 'whole' seawater remains alive...i.e., living water from anoxic basins cannot be oxidized, or the anaerobic organisms will die before the incubation begins.	Thank you for your comment. We have edited rule 9.4.2.e to specify that the incubation solution should be a mix of 90% filtered anoxic seawater and 10% whole anoxic seawater. Proper handling of anoxic seawater for incubation experiments will be outlined in further guidance documents. We are open to suggestions for proper handling protocols.	Revised rule to meet scientific guidance.

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126	9.4.2.h	It is pretty hard to fully sterilize anything containing sediment...there should probably be guidelines for this, i.e. autoclaving is not always sufficient...organisms from anoxic basins can be small, so typical 0.2 um 'filter sterilization' is insufficient for anoxic seawater at long timescales.	Tahnk you for the comment. Puro.earth will provide the CO_2 Removal Suppliers with guidance documents including further details on required analyses. We are also open to discuss relevant scientific protocols for meeting this requirements.	No change.
127	9.4.2.i	This is a note, not a protocol phase. Unless it is a requirement, doesn't fit here.	Thank you for the comment. We understand that while this may not be a strict protocol phase, we see it as an important note. However, we will consider adding it as part of the guidance documents (see also response to comment no. 125) in the future.	No change.
128	9.4.2.	There is no consideration of testing to see whether the 'live incubations' are alive. If all the microbes have died on transport from their deep sea homes, then these incubations are essentially telling nothing about potential ecological reponses. Some measure of cellular activity and viability is needed. Not cell counts, which can be confounded by plant biomass and autoflouresence.	Thank you for the comment. We have revised rule 9.4.8 and replaced cell count analysis to live cell staining to measure microbial activity.	No change.
129	9.4.2	There is a need to define how close to deployment conditions the incubations are expected to be - is a similar biomass type sufficient? How close in temperature or pH? Some flexibility in biomass type is very reasonable but there will be a limit where new data becomes needed. Additionally, clarify whether incubations of other organic materials (jute rope, burlap) can be extrapolated from primary biomass data.	Thank you for your comment. Puro.earth will provide the CO_2 Removal Suppliers with guidance documents including further details on required analyses. We are also open to discuss relevant scientific protocols for meeting this requirements.	No change.
130	9.4.2h	Sediment addition is not mentioned in the discussion of controls. How is that sediment handled? Recommend including sediment along with the live-seawater / no biomass control and sterilizing it as well in the second control.	Thank you for your comment. We have edited rule 9.4.2.h to clarify the addition of sediment for the control bottles.	Revised rule to meet scientific guidance.
131	9.4.4.a	This 250 mL volume is fairly arbitrary, especially given that no specific measurement technique is being used. Some picarro or gas bench measurements would use ~5 mL. It would be more efficient and generalizable to provide a standardized amount of uncertainty that a sampling, handling, and measuring procedure can produce to be acceptable for this purpose. The size of a DIC sample, for certain types of measurements, can be a source of uncertainty, but so can all the generalizable handling steps, especially since this is a gas-liquid equilibrium phase. Only constraining one of many sample handling uncertainty variables is not useful.	Thank you for your comment. We have revised rule 9.4.4.a to specify the measurement precision for DIC rather than prescribing the sampling volume.	Replaced sampling volume specification with a measurement precision of 1.5 umol/kg (1SD) and added footnote with reference to the Guide to Best Practices for Ocean CO_2 Measurements.
132	9.4.4.	With DIC, especially in closed system small bottle experiments, and even more so where you have sediment and sulfate reducers or halophiles, solid phase carbonates (dissolution and precipitation) need to be considered in the final DIC values.	Thank you for your comment. The assessment of particulate inorganic carbon (PIC) has been added to rule 9.4.4.c for a full assessment of the carbon budget.	Edited rule 9.4.4.c to add inclusion of PIC assessment.
133	9.4.4a	A volume of 250 mL is not needed for DIC analysis and is recommended against. Best practices can use 30–125 mL	Please see the response above to comment no 130 (copied below): Thank you for your comment. We have revised rule 9.4.4.a to specify the measurement precision for DIC rather than prescribing the sampling volume.	Replaced sampling volume specification with a measurement precision of 1.5 umol/kg (1SD) and added footnote with reference to the Guide to Best Practices for Ocean CO_2 Measurements.
134	9.4.4d	the issue of "dry weight" should be defined - biomass has internal water that is never fully removed. That's fine as long as all measurements are consistent. Recommend asking providers to define their procedures for preparing "dry" biomass and the consistency of that process. (This will also control the uncertainties on dry mass quantification and thus full mass balance.)	Thank you or your comment. Your concerns about the determination of the dry mass are covered by rule 6.1.4.	No change.
135	9.4.5.a	Do **not** recirculate a reduced gas removed from a headspace vial back into the system. Do not inject a gas into the headspace system to reequilibrate pressure unless it is extremely pure and well constrained. With modern sampling and measurement techniques, miniscule volumes of sample are needed. It is probably more efficient to simply ignore reequilibrating pressure, especially since equilibrium with the liquid phase should accomodate. Any uncertainty in gas concentration will be below instrumentation error anyway.	Thank you for this clarification. We have edited rule 9.4.5 accordingly.	Revised rule to meet scientific guidance.
136	9.4.5.	Gas measurements are temperature and pressure dependent. Care should be taken to track measurement and storage temp. I would refrain from moving incubation bottles out of a temperature stable room for measurements. Unless there is somehow a gas measurement device within the temp controlled room, a method for transferring gas samples without external contamination is needed. Typically, at least for methane, I would reccomend a gas tight sample vial filled with heavily sparged hypersaline brine, then do a sample-transfer container headspace-liquid vol:vol displacement technique with several associated air and displacement blanks.	Thank you for your comment. The detail regarding temperature conditions has been added to rule 9.4.5.	Revised rule to meet scientific guidance.
137	9.4.5a	Practicioners may decide that it is not necessary to refill headspace due to the risks of contamination, which is preferred as long as headspace pressure starts high and stays above atmosphere.	Please see the response above to comment no 134 (copied below): Thank you for this clarification. We have edited rule 9.4.5 accordingly.	Revised rule to meet scientific guidance.
138	9.4.6.a	Similar to carbon, the volume here is arbitrary. Defining a limiting amount of sulfide would be more reasonable and informative for making an experiment that actually works.	Thank you for the comment. The wording has been revised. We are open to discuss this in more detail, and further revise the requirement if necessary.	Edited rule 9.4.6.a: Total sulfide measurements shall be taken from a sample of sufficient volume of incubated seawater to allow for accurate analysis from each sacrificial bottle using industry best practices.
139	9.4.6.c	Metal sulfides here are arbitrary and depend wildly on a variety of upstream effects that are not standardized (i.e. was the incubation water allowed to oxidize). Unless there is a good reason for including this, I would leave it off.	Thank you for your comment. After considering your comment, we have decided to remove this requirement.	Removed rule 9.4.6.c regarding the measurement of metaal sulfides.
140	9.4.6.	A preferable way to avoid sulfide scrubbing or low sulfide values is just to do radiolabled S reduction rates, which are fairly achievable with limited equipment.	Thank you for your comment. We have decided not to include this requirement because the addition of this analysis would result in further technical burden that we do not believe are necessary at this time. We are open to discuss this in the future if the need arises.	No change.
141	9.4.8.	Cell Counts: in a closed incubation, these will not be extremely informative as things are expected to grow. Accurate counts will also be quite difficult to achieve against the background of terrestrial biomass and small POC that have confounding autoflouresence. Live cell staining...i.e. redox sensor green, or something like BONCAT, may be appropriate to determine if the incubation retains viable cells.	Thank you for your comment and providing specific alternatives. We have removed the cell count requirement and added a requirement for live cell staining to assess microbial activity.	Replaced cell count analysis to live cell staining analysis.
142	9.4.8.	16S sequencing does not inform functional diversity. It just tells you which microbial groups are present. This is probably a perfectly fine limit to an incubations needs. Metagenomic methods can inform functional diversity but are computationally and resource intensive...and it is unclear to me how these work against a background of biomass dna. Transcripts would inform microbial activity, but this would be even more difficult to obtain reasonable results from.	Thank you for the comment. We acknowledge that monitoring for functional diversity may not always be feasible. The requirement has been clarified to reflect this, and monitoring of microbial funtional diversity has been included as a recommendation.	Edited rule 9.4.8. Changed requirement for assessing funcational diversity into a recommendation and moved this recommendation into a remark box.
143	9.4.8.	CO_2 removal supplier should determine which metabolic function and microbial groups are expected from a suite of geochemical and biological analysis of the study site.	Thank you for this edit. We have included it in rule 9.4.8 for clarity.	Added text for clarity.
144	9.5.1	"dissolved gas" is confusing - does this mean CO_2? I would not refer to bicarbonate as a dissolved gas. If you just mean methane and N_2O please be specific.	Rule 9.5.1 has been edited for clarity. "Dissolved gas" has been replaced with "DIC, CH_4, and N_2O".	Edited text for clarity.
145	9.5.2d	I find this rule unclear - what does it mean to recalculate a mixing regime? Is it assumed there is meaningful new data? What if there isn't?	We have edited rule 9.5.2.d for clarity: the mixing regime shall be updated with new data if available.	Edited text for clarity.
146	9.5.2e	Typo - a constant potential density profile would not be a stratified or anoxic site. Disagree that surface radiocarbon in sediment is relevant for this question (why would it be).	This rule was meant to signifiy shallow anoxic basins defined as an anoxic basin with a total anoxic zone depth of <500 m, such as the Orca Basin. For such anoxic basins, the CO_2 Removal Supplier would only need to prove that the anoxic basin is sufficiently isolated based on sediment age analysis rather than constructing a mixing model.	Edited text for clarity.
147	9.5.	Discussion is needed to validate experimental quality. Bottles should be alive at the end. This can be done with staining or potential alternatives.	Thank you for the comment. The requirements for the laboratory-based monotiring have been revised to include live cell staining. We are open to discuss revising these requirements in more detail when the methodology is updated, and look forward to discussing potential alternatives here.	Details of cell live staining have been added to e.g. rule 9.4.8.
148	9.6.2.	How close to the intervention do sediment characterists have to be measured? What sedimentary characteristics are important? I.e. permeability?	Thank you for your comment. Table 9.3 lists the sedimentary characteristics that need to be monitored and rule 9.6.5 refers to the sediment sampling location.	No change.
149	9.6.6.a	See previous comments on measurement levels. 9.6.6.d: this seems a little arbitrary, and also possibly hard to distinguish if there are perturbations to POC...how are viable cells determined vs total or dormant cells? What is the measure of activity?	Thank you for your comment. We have changed the cell count analysis to live cell staining in accordance with the rule change in 9.4.8. For more details, please refer to the response for No. 140.	Replaced cell count analysis to live cell staining analysis.

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150	9.6.6	Cell counts can't be done well with plant materials around and may not be feasible. Chloroplasts and plant bits can only be determied by something closer to art. Reconsider using this as a threshold	See the response above comment no. 148 (copied below): Thank you for your comment. We have changed the cell count analysis to live cell staining in accordance with the rule change in 9.4.8. For more details, please refer to the response for No. 140.	Replaced cell count analysis to live cell staining analysis.
151	9.6.6	For each threshold, it will be important to define *where* that change is determined (for example, bale interiors will have very different conditions than 1 m away)	Thank you for your comment. We have added the specification for evaluating environmental change in rule 9.6.6. Environmental change shall be based on the mean change within the storage site boundary.	Edited rule 9.6.6 to specify the locale for assessing environemtal change against the set thresholds.
152	9.6.7.	This would actually be a good time to do microbial work looking at colonization or biofilms.	Thank you for your comment. Note that the rule 9.6.6.d has been changed to include live cell staining analysis , what would show whether has been colonized by microbes or has biofilms on its surface.	No change.
153	9.6.7	What is the justification for 1 kg returns? We have used replicates of 2–5 g samples, which is plenty for the analytical targets.	Thank you for your comments. We agree with your suggestion and have revised the rule allowing samples of sufficient size to allow for accurate analysis.	Replaced text: "1 kg each (in dry weight)" for "sufficient size to allow for accurate analysis"
154	9.6.9	What is the justification for 15 years? I have not seen this value arise from the data currently available. Later dates add carbon intensity for diminishing returns. And regardless, fifteen years of annual sampling will not be possible for any startup to promise at this stage. For brines, each sample return will require a separate acoustic system for which batteries cannot yet achieve 15 year lifespan - that would make this unachievable in brine. Recommend much reduced sampling frequency after 2 years (e.g., at 5, 10, and 15 yrs after deployment), and an acknowlegement that later programs cannot be guaranteed.	Thank you for the comment. We have revised the requirement, and agree that the sampling frequency may be reduced. Importantly, this requirements links to section 9.7. "Monitoring CO_2 release and reversal", and if the permanence of the carbon storage is compromised, the supplier must follow the requirements set in the Puro Standard General Rules, as stated in rule 9.7.2.	Revised rule 9.6.7. (please note the change in numbering, now rule 9.6.8.): The CO_2 Removal Supplier shall retain access to the storage site for monitoring purposes throughout the post-closure period, according to the long-term monitoring requirements described in rule 9.6.2. Monitoring post-deployment shall occur at least on years 1, 2, 5, 10 and 15 after the deployment of the final batch of biomass. Further changes related to this requirement made in section 9.7., rule 9.7.3. The CO_2 Removal Supplier shall continue monitoring the permanence of the carbon removal activity during and after site closure (post-deployment and storage closure stages) following requirements set in rule 9.6.8. In cases where the post-closure monitoring shows that the permanence of the carbon storage has been compromised, the CO_2 Removal Supplier shall follow the procedure regarding permanence and risk of reversal described in the Puro Standard General Rules, section 6.7.
155	9.7.2	Unclear how biomass could be released to the atmosphere? Revise to recognize that GHG exchange is constant everywhere and the concern is significant enhancement to this flux, not "any GHG".	Thank you for your observation. We have restructured section 9.7. for clarity.	Section 9.7. restructured.
156	9.7.4	GHG release "events" don't make much sense in this context - is this a holdover from a different pathway?	Thank you for your observation. We have restructured section 9.7. for clarity.	Section 9.7. restructured.
157	10.1.1.	Establishing acceptable uncertainty in measurements, rather than saying "be as good as the best trained oceanographers", would be more useful as guidance when developing project based methods. Especially if geochemical parameters are being compared to solid phase weight loss as a mass balance...the uncertainty of the geochemistry will likely be a lot less than getting a piece of biomass soaked in saltwater to give an accurate/good mass. The uncertainty in solid phases will probably be in the percent range, while geochemistry will likely be around ppm. So, if everything will end up being compared against the solid phase uncertainty regardless, the oceanographic measurements will not be as informative and hunting for slightly smaller uncertainties in the ppm space won't be a good use of resources.	Thank you for your comment. We have reviewed the rules on the measurement of uncertainty to clarify our aim of estimating the "percentage uncertainty" for all measurement types. This allows for their combination and to arrive at a value that expresses the measurement uncertainty of the components of the CORC equation.	Section 10.6 (Estimation of measurement uncertainty) has been edited.
158	10.5	Suggested to add a remark on the future advances in e.g. numerical oceanographic modeling and the impact this may have on impriving the sampling plan.	We thank for the feedback. Indeed, as this approach is yet novel and limited peer-reviewed data exists, there may be significant scientific advances which may improve our understanding of the sampling requirements in the next year or two. Therefore, we have added a remark at the end of section 10.5. to highlight the importance of a well planned and conducted sampling protocol, as well as acknowledging that there is room for improvement as new data is available. Puro.earth is willing to reassess the sampling criteria when possible and necessary.	A remark box was added to section 10.5.