OBSERVATIONS IN RELATION TO CATEGORY ASSESSMENT
AFFORESTATION, REFORESTATION AND REVEGETATION
MANGROVE RESTORATION
APRIL 2026

1. Purpose of these observations

The Governing Board (the Board) of the Integrity Council for the Voluntary Carbon Market (ICVCM), when considering the assessment of methodologies related to Afforestation, Reforestation and Revegetation (ARR) identified that it would be beneficial to make available their observations for the purpose of supporting the future development of methodologies in this Category.

These observations are non-binding and do not impact or form any part of the Assessment Framework, Assessment Procedure, or any Decision (as defined under the Assessment Framework) and are published by the Integrity Council for the purpose of information only.

The Integrity Council may, from time to time, publish other observations for other Categories where it considers this may be useful for CCP-Eligible Programs and other stakeholders and may update and revise its observations from time to time based on further assessment processes or information. Observations are not an exhaustive set of views of the Governing Board, and not all aspects addressed in assessment processes are included. No reliance may be placed on observations, as they are for the purpose of information only, and observations published are without prejudice to other ongoing assessments.

The Governing Board would like to express its gratitude to the experts and other stakeholders engaged in the assessment process, who provided input to the ICVCM regarding this Category. It welcomes novel approaches to increase integrity and recognises that further research and empirical testing of such approaches in methodologies may identify new risks and will be attentive to these as part of general ICVCM ongoing assurance and oversight.

2. Observations relating to ARR methodologies

The Governing Board's observations regarding the assessment of ARR methodologies against the ICVCM Assessment Framework and its Core Carbon Principles generally relate to robust quantification and additionality.

The methodology considered by the Board within this Category and to which these observations relate is Mangrove Restoration protocol, version 1.0, applied under Isometric. The remaining methodologies in this Category remain under assessment by the ICVCM.

2.1. Category Details

Mangrove restoration refers to activities that lead to the re-establishment and recovery of mangrove ecosystems in areas where they have been degraded or lost, thereby restoring the ecological integrity and its carbon storage capacity.

Mangrove Restoration lies within Afforestation, Reforestation, and Revegetation (ARR) activities, which encompass a variety of other practices, including agroforestry, commercial plantations, forest restoration, and farmer-assisted natural regeneration. This is a carbon sequestration category involving biological storage, which requires careful management to mitigate the risk of reversal in the short to medium term.

2.2. Additionality and Robust Quantification

The Mangrove Restoration protocol relies on a dynamic performance-benchmark approach using remote sensing to quantify how baseline mangrove carbon stocks would have evolved without the project intervention. In this approach, the counterfactual baseline scenario is cross checked by regularly observing changes in mangrove carbon stocks in areas outside of the project area that are statistically similar to the project area. By retesting baselines against real-world observations of 'matched controls', the protocol aims to account for evolving market conditions, policy shifts, environmental variability, and other external drivers.

ICVCM note the novel nature of this approach and that it has been designed to increase robustness. Similarly to previous decisions on ARR category, ICVCM also acknowledge that empirical testing has not yet been conducted and that remotely sensed data could become saturated, especially when full canopy cover is achieved, but that future advances in remote sensing technology are likely to address any such risk. In addition, ICVCM also observes that, as country-level jurisdictional baselines continue to develop, there is a risk of inconsistency or conflict between project-level and jurisdictional baseline data. Appropriate measures to manage or mitigate these risks will likely be required in the future.

ICVCM further notes that the protocol clearly specifies the process for developing the dynamic performance-benchmark baseline, including objective justification of criteria and expert review. This is sufficient to meet the Assessment Framework requirements. For future methodology versions, the Board recommends that this type of procedural detail be reflected at the programme-documentation level, centralising baseline governance requirements and enabling their application across methodologies within the programme.

ICVCM further notes that the protocol incorporates digital MRV tools, including GIS datasets, LiDAR-equipped drones, peer-reviewed machine-learning models, and detailed field measurements. Together, these elements strengthen the robustness and reliability of carbon accounting while improving automation, accuracy, and transparency.

Mangrove forests are known to facilitate the production and long-duration storage of carbon in the underlying soil. As such, soil organic carbon is a carbon reservoir eligible for crediting under the protocol. Soil organic carbon stocks must be quantified in each restoration zone at project establishment and at the end of each Reporting Period in which soil organic carbon is credited. Quantification is performed through a robust method of direct soil sampling that requires the use

of soil marker horizons (e.g., a known volume of white feldspar powder evenly distributed on the soil surface within plots). Over time, sediment accumulates above this marker horizon, allowing project proponents to measure the depth of newly deposited soil during subsequent sampling events using soil coring.

ICVCM notes that only additional organic carbon accumulated above the marker horizon is eligible for crediting, and that any soil below the marker is excluded from quantification. This approach provides safeguards to ensure that only soil organic carbon accumulated during the project period is accounted for, thereby limiting the risk of unrealistic measurements.

Allometric equations allow use of simple measurements (for example the diameter of a tree trunk) to express more complex properties, like the volume of a tree and so are a common component of most ARR methodologies. Allometry can vary by species of tree, age and even site location. Not all trees have been sufficiently studied to allow perfect allometric relationships to be equally known across regions of the world, so approximations are frequently used. The methodology requires allometric equations to have been previously published in credible literature before they can be used. In addition, per the requirements of the methodology, the selection of the equation is by the following order of preference: i) Local peer-reviewed equations, ii) Chave, et al. (2014)[1] for project areas in the Tropics, iii) National Forest inventories, or iv) IPCC generalized equations. ICVCM noted during assessment that the chosen equations will undergo independent assessment by a validation and verification body, as well as being subject to Isometric VVB oversight processes, demonstrating sufficient review to confirm appropriateness for the context.

ICVCM note that the methodology permits the use of a conservative global default value for the carbon fraction of dry biomass, but only when more specific factors are unavailable. These preferred factors include: i) regional or species-specific values supported by scientific literature, or ii) genus-specific or national average values, also supported by scientific literature. If the preferred factors are not available, the methodology allows use of a default factor, which is a mean across mangrove species. The Governing Board notes that this parameter is an average and that use of more specific data is mandated where it is available and this subject to oversight by both VVBs and the carbon crediting program.

[1] Chave, J., Réjou-Méchain, M., Búrquez, A., Chidumayo, E., Colgan, M. S., Delitti, W. B., ... & Vieilledent, G. (2014). Improved allometric models to estimate the aboveground biomass of tropical trees. Global change biology, 20(10), 3177-3190. https://doi.org/10.1111/gcb.12629