THE NECTAR EXCHANGE

Additionality of Voluntary Carbon Credits for Wetland, Stream, and Species Mitigation Activities in the United States.

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Nectarex.org

EXECUTIVE SUMMARY

With greater awareness of environmental sustainability across all business sectors, there is a need to contrast the science and policy designed to support different components of natural capital. Natural capital includes the geology, soil, air, water, and all living things, and forms the basis of all economic growth. Payment for credits that represent an investment in the sustainability of different forms of natural capital have become a convenient means to move economic activity closer to sustainability. However, use of environmental credits has not been without debate.

Here we contrast the science and policy of key environmental credit markets in the United States. Environmental credit markets may be based on long standing environmental regulations (e.g., the Clean Water Act [CWA] or the Endangered Species Act [ESA]) or be based on voluntary agreements. There are critical differences between voluntary and regulatory environmental credits in terms of data flows, methods used, and assurances provided.

Our goal is to help market participants find economies of scale by integrating voluntary carbon markets with regulated credits markets under the CWA and the ESA. By employing multiple types of environmental credits to help facilitate the protection of ecological resources, without violating program goals, larger areas can be protected, and financial risks can be reduced. Environmental credit programs share the goals of providing additional, equivalent, and durable ecological outcomes. We hope this report will also help credit buyers investigate the ability of credit suppliers to meet the additional, equivalent, and durable standards advertised. Further, the financial feasibility of all credit markets is limited by availability of reliable data. Integrating credit markets would increase the cost-effectiveness of data collection and program monitoring.

We find that scientific and policy opportunities exist for integration of voluntary carbon credits with regulated credits for water and biodiversity in the US while meeting objectives for additional, equivalent, and durable outcomes. We learned that many regulators working on CWA and ESA are very open to adding carbon credits to water and biodiversity credit projects. Also, while methods of defining additionality differ in many ways, monitoring data and management of statistical error are important for verifying whether additionality occurs. Monitoring data are critical to help demonstrate reduction or elimination of stressors, the effects of beneficial management, etc. One critical differentiator from regulatory programs is that voluntary carbon

Dimensions of Environmental Credits:

Additional – credit represents an additional amount of ecosystem services that otherwise would not occur without credit project

Ecologically Equivalent – credit project provides the same type and amount of ecosystem services as were lost due to changes in the environment elsewhere. Future ecosystem services may be economically discounted to ensure equivalency.

Durable – credit project will be managed long enough to provide ecosystem services sufficient to offset the loss of ecosystem services as required by the program

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markets require a detailed understanding of the regional economics of natural resources (e.g., timber or agriculture). Tracking these regional, or common, practices is an important part of defining additionality. This includes understanding regional regulations. For example, carbon projects must demonstrate additional benefits beyond these regulations.

We also find that regulatory-based markets handle overlapping credits very differently than voluntary carbon markets. If a wetland credit area were to attract a protected species, no loss in wetland credits results. In such a case, credits for wetland and species values could be sold together to offset combined impacts to wetlands and species, or a credit for wetland or species could be sold separately but the associated credit not used for wetland or species would be retired (i.e., not available for future sale). The requirement for regulatory additionality under voluntary carbon markets (Verra 2012; ACR 2020) creates a different situation. The implication seems to be that if a species protected by the ESA were to subsequently occupy the carbon project area, the baseline carbon levels will be adjusted to include the carbon present in the habitat required by the species. Typically, then baseline carbon levels will be greater and there will be a reduction in the accrual of carbon credits. Future vegetative changes beyond this new baseline can then be counted as carbon credits but the likely loss of carbon credits remains. The current carbon programs seem to provide incentives to avoid locations that might attract threatened and endangered species or to use native vegetation. Our integrative analysis of these credit programs highlights the need for carbon programs to avoid creating disincentives for biodiversity. We offer one possible solution – initiate an Enhancement of Survival Permit under Section 10 of the ESA at the start of a carbon project. This would provide assurances that USFWS will not require increased commitment to provide habitat as habitat improves during the carbon project.

There are also significant differences in the price / acre for CWA, ESA, and voluntary carbon credits, with the latter currently far less financially beneficial to those providing credits. However, there is increasing global and domestic demand for carbon credits, surpassing the demand for regulatory CWA or ESA market credits. Markets for protected species are currently limited to portions of 19 states (RIBITS accessed 6/12/2024). Therefore, many species would benefit from voluntary carbon projects that improve native vegetation and recover/reintroduce natural ecosystem processes. Shifting public policy (i.e. recent US Supreme Court decision in Sackett V. EPA) has also increased the number of streams and wetlands at risk of loss. Voluntary carbon markets could be a critical driver to protect these sensitive areas.

Some have argued that improving outcomes in voluntary carbon markets will increase the price of credits, and such evidence is accruing. While the biophysical differences of water, biodiversity, and carbon are large, getting practitioners to collaborate across these markets, starting with shared data collection and management skills, will improve market prices and sustainability outcomes.

Integrating voluntary carbon credits with existing wetland, stream, and species credit projects will likely entail modification of the current operational instruments. There are several options that may be considered:

- Utilizing so-called stranded acres, that is those lands associated with mitigation projects that currently generate no 404 CWA or ESA credits;
- Or, if voluntary carbon credits additionality tests could be revisited, then

- Modification of existing operational instruments (including potentially site protection instruments) to enable mitigation lands (such as preservation lands or buffer lands) that generate small amounts of credits to be repurposed as carbon offsets.
- Modifying existing instruments to add a voluntary carbon attribute to existing multiple authority credits.

It may be possible to integrate voluntary carbon credits with proposed wetland, stream, and species compensatory mitigation projects, however, it would entail revisiting the issue of additionality for voluntary carbon projects with Verra and ACR.

All options would require establishing a baseline for carbon sequestration, implementing land management practices that would foster carbon sequestration, and implementing performance standards and monitoring regimes acceptable under voluntary carbon crediting standards.

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INTRODUCTION

Environmental credit markets are becoming increasingly mainstreamed thanks to businesses communicating how their activities relate to Environmental, Social, and Governance (ESG) risk factors, and thanks to increased investment in infrastructure to adapt to climate change. While much of this demand has been driven by global programs seeking cooperation for a healthy planet, the United States (US) has maintained active markets for environmental credits for decades, driven primarily by the Clean Water Act (CWA) and the Endangered Species Act (ESA).

The environmental credit purchased is a commodity (i.e., a private good) but the underlying ecological benefits are not a commodity. Ecological benefits from natural capital, commonly referred to as ecosystem services, are not commodities because they rarely exist independently of each other, their benefits can be enjoyed by many, and establishing property rights is usually not realistic (i.e., they're public services). However, various policies or regulations have been put in place so that management actions to steward ecosystem services can be sold as credits. While property rights are established for geographic boundaries (e.g., land), the ecosystem services contained therein often remain vulnerable to change due to events outside of property boundaries, and the benefits of the natural capital (e.g., water quality, biodiversity, climate mitigation) can actually be enjoyed by many, not just the credit buyer.

The objective of this report is to support the growth of environmental markets by comparing and contrasting credit attributes while looking for opportunities to integrate markets to improve the cost-effectiveness of investments in credits. This report will compare and contrast the science and policy that underlie voluntary carbon credits and regulatory credits under the CWA and the ESA. It is our hope that by including such different ecosystem services and policy regimes within a single treatment that a greater understanding of how best to invest in the environment in the face of unprecedented global change can be gained.

The ability of a credit project sponsor to demonstrate increases in ecosystem services above some baseline level, or "additionality," is a key concept for all these credit markets. If we are to integrate multiple credit programs to improve cost-effectiveness and reduce uncertainty, we must take care to ensure that the ecosystem services the credits represent are additional.

There are many different definitions of additionality, but it means in essence that no credit is given for benefits that would have occurred on a site without any additional actions, private investment and financial incentives (Gardner and Fox 2013, Robertson et al. 2014). For example, carbon credits would not be awarded for activities that were required to be performed or would have happened without the financial incentive that carbon credits would provide. Carbon credits would not typically be available from lands that were required to be restored as wetlands, streams, or species habitat as part of an existing mitigation bank.

To unwrap this complexity, we will highlight how additionality is defined in each ecosystem credit market separately. Then we will highlight considerations for integrating these markets.

WHY LOOK AT MARKETS IN AN INTEGRATED WAY?

A significant bottleneck in the development of these markets is the effort to collect natural resource data to develop and verify environmental credits. Natural resource professionals working on water quality and biodiversity have field skills and data that could be used to help improve and expand carbon markets. Further the remote sensing technologies increasingly being leveraged by the carbon market can help improve water and biodiversity markets, as these later industries already see the value. Integrated credit projects would allow natural resource professionals to focus their data collection efforts and reduce transaction costs.

Buyers in all environmental credit markets need good information to ensure they are investing in the most robust projects given the underlying complexity of environmental credit markets. It's important to keep in mind the different biophysical properties of these different ecosystem services. For example, it may take a decade, or more, before the abundance of some wildlife species reflect what a landscape can carry after landscape change (Tilman et al 1994; Bruggeman et al. 2009). In contrast, with water, a flood results when water exceeds the landscape's ability to hold it safely. After a heavy rain event it may only take a day or a week for flooding to disappear. With carbon, even in urban areas with variable emission sources, CO2 concentrations mix quickly over space (Briber 2013). Mixing with water and species is more limited (i.e., these ecosystem services are more place-based). Surface water flows through well-defined streams and rivers, and wildlife species are often unable to cross roads, neighborhoods, or even sometimes fields. These differences do create differences in how credits are defined and measured. Relationships among stakeholder groups interested in water, species, and carbon credits have also differed historically. In other words, market demand was created by different drivers across these ecosystem services. The quantification and exchange of these credits describes the different market structures (Fig 1).

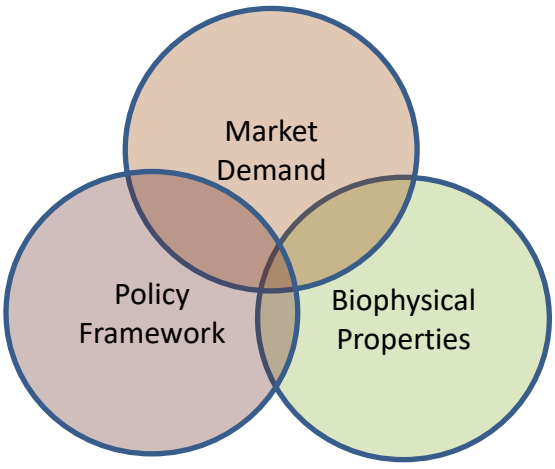

Figure 1. Conceptual model of factors interacting to affect the structure of environmental credit markets.

Our hope is that by looking at these markets in an integrated way, buyers can avoid buying bad credits and find the most cost-effective providers. For example, a buyer should be wary of if a biodiversity credit is based too much on market structure used for water or carbon. Replicating market structures across different ecosystem services could prevent credits from meeting additionality, equivalence, and durability standards. Awareness of these differences can also help with communication and support the growth of all environmental credit markets. Integrating these markets on the ground means multiple ecosystem service credits could lead to larger protected areas, providing more stable ecosystem service flows given environmental changes (Maxwell et al. 2020).

Some have predicted that recent criticisms of voluntary carbon markets will result in a decline in prices and demand (Twidale and Mcfarlane 2023). Recent analysis of market data indicate that credit volumes

sold decreased by 51%, comparing 2021 to 2022, but average credit prices increased by 82% due to buyers' willingness to invest in high quality projects (Ecosystem Marketplace 2023). Below we highlight efforts to correct problems with carbon credits. Currently, there is a large disparity in prices between voluntary carbon credits and regulatory-based credits under the CWA and the ESA, with the latter being far more expensive. Integrating credit opportunities will help manage financial risks, as these projects do represent significant investments, and increase ROI. The best credit projects are not only backed by adequate capital, they are also data-driven with measurable outcomes.

Demand for carbon credits is expected to increase by a factor of 15x by 2030 and by 100x by 2050 (McKinsey&Co 2021). McKinsey&Co further highlight significant mobilization challenges that will prevent the voluntary carbon market from meeting this demand. Thus, integrating carbon, water, and species credits will help meet market demand. This increase in carbon credit demand is expected to be supported by the Security and Exchange Commission's recent requirements for publicly traded companies to disclose carbon emissions and strategies for reducing climate risks that they deem material to their operations (SEC 2024). Whether carbon offsets will be required by law at the federal level remains uncertain. In 2022, the US Supreme Court struck down the USEPA's efforts to regulate carbon emissions under the Clean Air Act, stating that such a law would need to come from Congress (West Virginia v. Environmental Protection Agency, No. 20-1530 (2022)). In order to better direct investments for climate mitigation President Biden committed to supporting voluntary carbon markets to create credible climate action and economic opportunity (The White House 2024). To strengthen investment of private capital and to live up to the potential of carbon markets, President Biden has released Principles for Responsible Participation in voluntary carbon markets. The effort further directs USDA and DOE to evaluate how their programs can better support voluntary carbon markets.

The 2008 Federal Mitigation Rule tasked regulators when considering compensatory mitigation under the CWA to consider the functions likely to be provided by the proposed mitigation projects. These regulations charged regulators with ensuring to the extent practicable that mitigation projects would replace functions and services provided by the resources impacted through permitting (33 CFR 332.3(a)(1)/40 CFR 230.93(a)(1)). Many years of research have indicated that one function of many wetland and stream systems is to store carbon. As Mitsch and Gosselink (2015) summarized wetlands can accumulate organic matter (carbon) either because of increased rates of primary productivity or decreased rates of decomposition and export. Peatlands can hold 5x the amount of carbon as terrestrial forests per hectare (Temmink et al. 2022). Mangroves come in a close second to peatlands, and salt marshes and seagrass meadows can hold roughly 2x the carbon as terrestrial forests (Temmink et al. 2022). Sea level rise due to climate change is expected to reduce the number of coastal wetlands and thus their ability to store carbon. Nahlik and Fennesey (2016) found that freshwater inland wetlands in the US hold 10 times more carbon than tidal wetlands. Much of that carbon storage is more than 30 cm below the surface. Organic matter accumulates in wetland soils due in large part to anaerobic conditions characteristic of wetland soils which is the result of reduced fragmentation of organic materials (leaves, twigs, wood, and roots) (Craft 2001, Collins and Keuhl 2001).

Given the efficiency with which some wetlands can sequester carbon, nature-based carbon solutions could help protect wetlands that would otherwise be threatened by real estate development, if we are able to improve reliability (performance) of carbon credits and prices do increase. Thus, the demand for carbon projects on wetlands could eventually limit the need to offset development impacts under the CWA. Given changes in technology and demand, it is hard to predict when this competition may occur.

Recent amendments to the definition of waters of the US, because of the Supreme Court decision in Sackett V. Environmental Protection Agency, could also reduce the demand for CWA compensatory mitigation, at least in those states without independent state regulatory authority over state waters. Such political changes could encourage compensatory mitigation providers to help improve the rigor of carbon markets to protect their investments in compensatory mitigation by entering the carbon offset market while simultaneously helping to protect atmospheric stability and water quality.

We had the opportunity to present barriers and opportunities associated with the possibility of adding voluntary carbon credits to wetland, stream, and species mitigation banks in the US compliance market at the National Mitigation and Environmental Markets Conference in Jacksonville, FL in 2023. We surveyed the audience about our proposition. We asked:

1) If CWA and ESA credit providers had already added carbon credits to their wetland, stream, or species crediting projects?

2) If they have additional land not providing CWA or ESA credits that could go toward carbon?

3) If, as a regulator under the CWA and ESA, would they be open to adding carbon credits?

The results highlight what we believe is a significant, untapped opportunity in environmental markets.

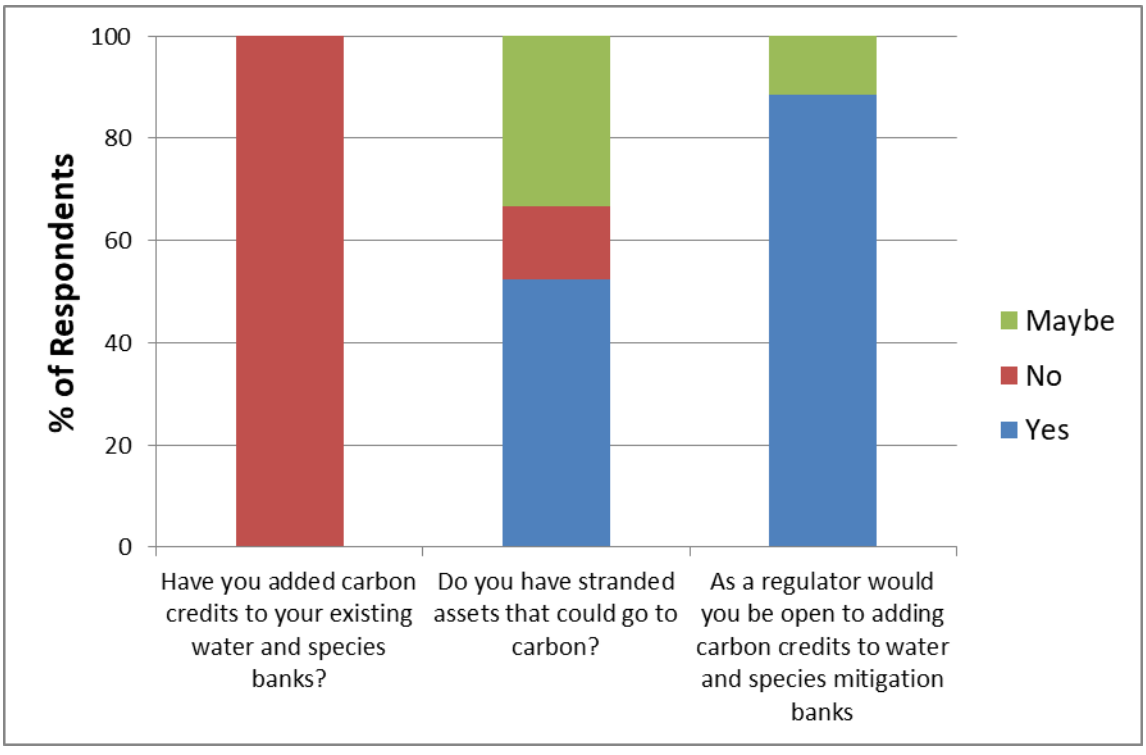

Figure 2. Results of questionnaire provided at the Multi-Benefit Banking session at the National Mitigation and Ecosystem Banking Conference in 2023.

It was a bit surprising that no one has yet added carbon credits to their CWA & ESA projects, as folks within the community have certainty discussed the idea in the past. Also interesting was the majority indicating that they have additional acreage that may be used for carbon. But a significant portion were unsure. This result highlights the need for programmatic guidance to integrate these markets – criteria for identifying possible carbon assets that are additional to water and species benefits needs to be made clear. And, finally, it was very encouraging to see that regulators responsible for upholding requirements of the CWA and the ESA were overwhelmingly supportive of adding carbon credits to the projects they oversee. Granted, we did not sample an unbiased group – as we presented in a session on "Multi-Benefit Banking", but it highlights a pathway for improving the effectiveness of markets for sustainability.

ADDITIONALITY UNDER THE CLEAN WATER ACT

The purpose of 404 CWA compensatory mitigation is to offset environmental losses/losses of aquatic resource functions associated with permitted activities (33 CFR 332.3(a)(1)/40 CFR 230.93(a)(1)). Compensatory mitigation is required only for significant resource losses that are important to the human or aquatic environment and must be directly related to those losses in scope and degree (33 CFR 320.4(r)(2)).

Compensatory mitigation should be, to the extent practicable, in advance of or concurrent with impacts (33 CFR 332.3(m)/40 CFR 230.93(m)). Compensatory mitigation should be located where it is most likely to replace functions lost through permitting activities. That means the project should be in the same general geographical area as the permitted loss such as the same watershed or ecoregion where it is ecologically suited to providing the lost functions and is thus most likely to offset those lost functions (33 CFR 332.3(d)(1)/40 CFR 230.93(d)(1)).

In evaluating both the permitted losses and the compensatory mitigation project, the regulator is charged with considering the suite of functions provided by the resources, such as

- Flow contributions to receiving waters.
- Trapping, transformations, filtering, and transport functions (including primary productivity, sediments and nutrient cycling, and pollutants)
- Retention and attenuation of floodwaters and runoff
- Temperature modulation
- Habitat and food for flora and fauna

In evaluating a mitigation project, the Corps typically considers the suite of aquatic resource functions and services provided by the mitigation project.

Credits represent the accrual or attainment of aquatic resource functions at a compensatory mitigation site or the loss of functions at an impact site (33 CFR 332.2/40 CFR 230.92.2). The metrics used vary considerably across resources. They may be expressed in terms of area (acres, square feet), length (feet), or non-dimensional units unique to the resource (such as wetland condition or function, bottomland hardwoods, sedge meadow, coniferous bog, stream function, etc.).

Typically, the number of credits generated by a project reflect the difference between pre and post compensatory mitigation conditions (33 CFR 332.8(o)(3)/40 CFR 230.98(o)(3)). However, credits may be

generated by preservation of at-risk resources but generally at higher ratios than for restoration or enhancement of resources (33 CFR 332.3(h)/40 CFR 230.93(h) and 33 CFR 332.8(o)(6)/40 CFR 230.98(o)(6)). Credits may also be authorized for buffers, uplands, and riparian areas but only when they are essential to maintaining the ecological quality and functions of aquatic resources (33 CFR (33 CFR 332.3(i)/40 CFR 230.93(i)) and typically at higher ratios than restoration or establishment of wetlands or streams.

ADDITIONALITY UNDER THE ENDANGERED SPECIES ACT

The 2023 ESA Compensatory Mitigation Policy (USFWS 2023; ESA-CMP) sets the goal of achieving no net loss of species condition relative to pre-impact status for compensatory mitigation. The ESA requires reasonable and prudent measures (RPM) to minimize incidental take of the species. Where take is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect a federally listed species, or to attempt to engage in any such conduct" (United States 1983). This may include actions that offset the impact of the incidental take to the maximum extent practicable. Offset measures should be, preferably, in advance of or concurrent with impacts and consider landscape-scale effects along with climate change. For areas designated as critical habitat, the offset must "target the maintenance, restoration, or improvement of the recovery support function of the affected critical habitat" (USFWS 2023, pg 7) using the best available science. While it is preferred to estimate the take and offset in terms of number of individuals, occupied habitat is often used as a surrogate measure.

Durability is a critical component of species credits, specifying that the increased benefit provided by the RPMs should last at least as long as the impacts they were designated to offset. Adequate legal, real estate, and financial protections are required to ensure durability. Uncertainty in offset measures should be noted where they exist, given the random variation that often exists with threatened and endangered species. The offset metrics must be scientifically defensible, and it may be necessary to adjust metrics over time using adaptive management.

Additionality is defined as "benefits beyond baseline conditions" (USFWS 2023, pg. 8) due to the offset measure. If the land is already protected for some conservation goal, demonstrating additionality above existing conservation value specified by the land protection measure can be challenging. If the offset cannot provide simultaneous or, preferably, advanced additionality to offset the impact, the temporal loss of ecological value must be compensated by a larger offset. If offset measures fail to provide required additional benefits, then offset sponsor must provide adequate additional measures or the take authorization may be invalidated.

USFWS also specifies Service Areas, or a geographical boundary within which the exchange of habitat and/or individuals would be approved. Service areas highlight a unique difference for species credits relative to carbon. Maintaining biological processes to support biodiversity is often very limited spatially (Bruggeman et al. 2005). Service areas are defined to capture geographic areas with sufficiently similar genetic populations and/or areas of focused actions aimed at listed species recovery.

Credits can only be exchanged between the mitigation provider and those who are creating the impact – secondary markets are not permitted. The mitigation provider determines the asking price of credits, though ideally, a competitive marketplace exists to affect credit prices.

Ensuring that credits provide the same or greater benefits to species as the benefits lost at the site of impact is critical. Credits may be generated by restoring or enhancing habitat, establishing new habitat or preserving existing habitat that lacks protection. Preservation credits are valuable for many species due to fact that preventing the loss of high-functioning habitat can be more efficient and more certain of success than trying to create high-functioning habitat where it does not currently exist. Long time periods often associated with creating species habitat and the loss of natural disturbance regimes (e.g., fire) required to maintain such habitat can make re-establishment difficult. Species recovery plans often establish the roles of habitat preservation and restoration to guide credit projects. The location of the credit project relative to other habitat areas, including protected areas, is an important consideration. Impacts and benefits should both be quantified using the same credit/debit metric.

Evaluation of bank value will include an understanding of threats to a species, as referenced in the Species Status Assessment and/or Recovery Plan, if available. The most cited threats are habitat loss and habitat fragmentation, or the breaking up of habitat into smaller fragments. The credit project will require a long-term management plan with a funding mechanism to ensure stewardship of species values for as long as needed, and typically in perpetuity. In rare circumstances, USFWS will approve the use of research, captive rearing, or non-habitat-based threat reductions as credits. The ESA-CMP also specifies that information on offset measures will be made publicly available through the central registry RIBITS.

For credits generated under the ESA, the USFWS leads a Mitigation Review Team (MRT) to validate & verify the credits. The MRT efforts focus on determining whether the conservation bank meets the needs of the species in a manner that is consistent with the conservation goals for the species. A strict monitoring program rooted in sound science is used to ensure a bank meets its goal of created conservation value. The mitigation banking instrument, the enabling document, requires detail descriptions of baseline conditions including how the location of the bank contributes to and is affected by connectivity habitat.

VOLUNTARY CARBON CREDITS

To provide a reasonable dimension, we'll only focus on voluntary carbon markets from the American Carbon Standard (ACR) and the Verra Voluntary Carbon Standard (VCS). These organizations represent carbon registries that record GHG reduction and removal projects while also serving as the bodies setting the standards for carbon methodologies. These registries define eligibility requirements for credits including requirements for approval of methodologies, project validation and verification. Third party development of protocols is encouraged and involves a rigorous review process. They leverage a public comment period and blind scientific peer-review process. And the validation and verification bodies must meet strict competency requirements.

There has been significant growth in the voluntary carbon market: sales broke $1 billion in 2021, with forestry and land use credits accounting for 61% of the credits sold (Ecosystem Marketplace 2023). The most aggressive growth was observed for credits under Verra standards (Fig 2). While growth under ACR has been slower, it's important to remember ACR standards also support the regulated California Compliance Offset Program, included here for comparison.

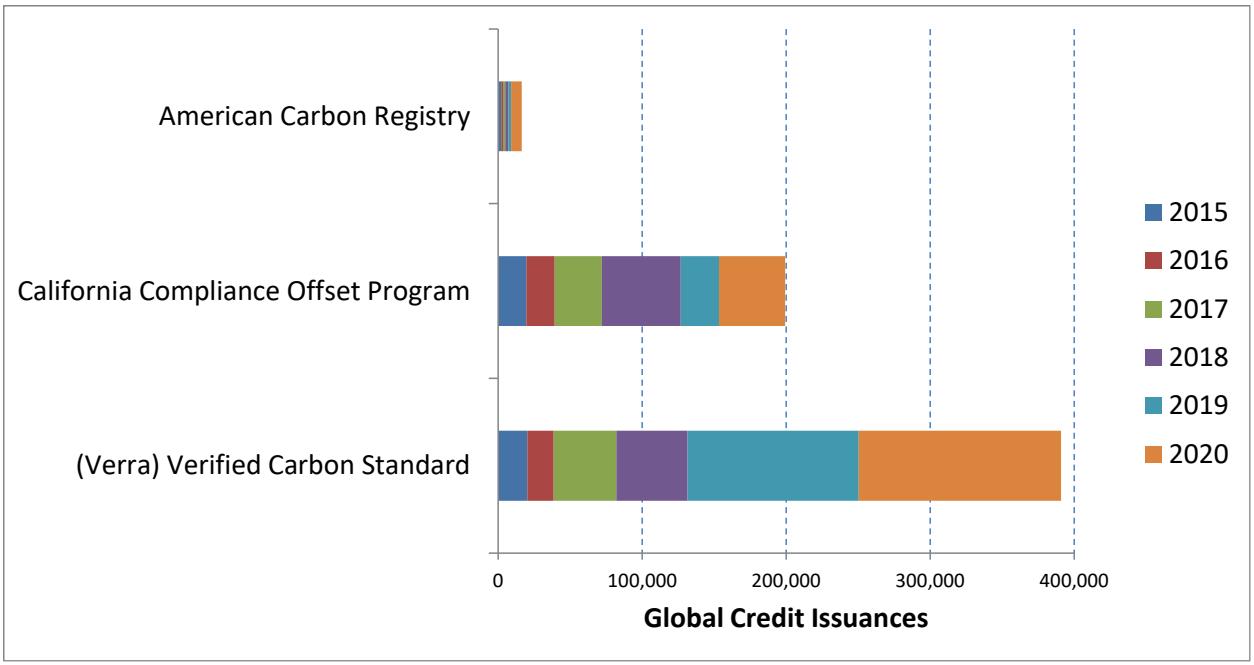

Figure 3. Growth in voluntary carbon markets, ACR and VERRA, compared to the California Air Resources Board compliance. Data from the World Bank Carbon Pricing Dashboard (https://carbonpricingdashboard.worldbank.org/carbon_crediting).

Historically forested carbon credit projects have required about 2,000 acres to be cost-effective. An industry of carbon consultants works with landowners to develop carbon credits. If the proposed project is large enough upfront costs are usually delayed until credits begin to sell. Project development costs start at about $30,000 for land use-based carbon sequestration projects. Many carbon firms are available to set-up carbon projects and often work with these main registries. Some carbon firms set their own standards and then market & sell their own credits. Some have argued that the lack of organization in voluntary carbon markets limits their effectiveness for combating climate change (Shifflett and Holger 2023).

Advancements in data science are improving our ability to verify GHG reductions and removals within these programs. Programs with advancements in data science, including nature technology (e.g., remote sensing, Machine Learning, etc.), under both ACR and Verra will be highlighted here that have allowed carbon removal projects on smaller parcels to be cost-effective. Our focus on small acreage programs is intended to fit our objective of determining when carbon credits can be integrated with water and species regulatory programs in the US. However, these programs focus on forested ecosystems, and we will not consider different biomes for now. In these other biomes, the uncertainty in system functioning means a greater amount of data are needed to estimate carbon value and thus larger projects are required to justify investment. However, data science advancements have been made in agricultural systems allowing for smaller acreage projects. We recommend those interested in agricultural-based carbon credits to investigate Indigo Ag and CIBO Technologies.

ADDITIONALITY: AMERICAN CARBON REGISTRY

ACR was the first voluntary carbon registry in 1996 and is currently managed by Winrock International. In 2012 it became the approved registry for the California Air Resources Board for their cap-and-trade compliance market. The objective of the ACR Standard is to "ensure that project-based offsets represent emissions reductions and removals that are real, measurable, permanent, in excess of regulatory requirements and common practice, additional to business-as-usual, net of leakage, verified by a competent independent third party, and used only once" (ACR 2020, pg. 10).

Projects deemed to be additional upon validation are considered additional for the duration of their crediting period unless policy changes occur. Projects must have control over sinks for removals to count as additional. Title to offsets is established prior to registering project. A three-prong test of additionality is required (ACR 2020):

1. Exceed regulatory/legal requirements
2. Go beyond common practice
3. Overcome at least one of three implementation barriers:
    a. Institutional – are carbon revenues key for overcoming significant organizational, cultural, or social barriers for project implementation?
    b. Financial – projects must face capital constraints that carbon revenues could address. Carbon funding is reasonably expected to incentivize creation of the project. Or carbon funding is key for maintaining the project management as economically viable after it begins.
    c. Technical – are carbon revenues key for offsetting technical risk of the project such as deploying new methods/technology, lack of trained personnel and supportive infrastructure, or lack of knowledge on the required practice.

Data Science Considerations

ACR offers a variety of methodologies for specific types of carbon sources, sinks and reservoirs that affect project calculations. Methods must include estimates of uncertainty. Sampling error associated with emission reduction/removal can not exceed 10%. If unable to meet this target, then reported amount of reduction/removal shall be the mean minus the lower bound of the 90% CI. Alternatively, specific methodologies can define different criteria as accepted by the scientific peer-review process. However, the sampling error must not exceed 20%. Use of biogeochemical models must include estimates of input and structural uncertainty. When estimating emission reduction/removals for projects and baselines the methods shall be based on peer-reviewed science, appropriate to the source of sink, and quantify uncertainty. Project start date is defined as when additional carbon reductions have occurred relative to the baseline.

Agriculture, Forestry, and Other Land Use (AFOLU) projects must use the Tool for Risk Analysis and Buffer Determination and enter into a legally binding Reversal Risk Mitigation Agreement that details how risk will be mitigated and how compensation will be provided in the event of a reversal (ACR 2020). Further, proponents must account for carbon leakage and deduct that leakage from their available credits. Carbon leakage is the increase in carbon emissions that result from economic activities that are displaced by the carbon project. Validation and verification for the carbon project can be conducted by the same contractor and at the same time. Validation is evaluating the project plan against requirements of the methodology and occurs once per crediting period. Verification is the ex-post assessment of the GHG emission removals for the reporting period.

The regulatory surplus test requires the project activity exceed legal requirements but excludes voluntary agreements or optional guidelines or general government policies. However, if a regulatory requirement is put in place during the crediting period and mandates the project activity, the project will no longer be eligible. AFOLU projects with easements must consider legal requirements of that easement if recorded at least 1 yr prior to project start date. Within the approved time window, the baseline scenario would need to include requirements of the easement.

The common practice test requires that the proposed project not use predominant practices used in the business sector and will reduce emissions below levels provided by common practices. If a common practice test is passed at the start of a project, it is deemed suitable for the duration of the project. Changes in common practices can prevent projects from being renewed.

The performance standard approach can be used to determine additionality instead of the three-prong test reported above if regulatory additionality can first be demonstrated. A performance threshold must be demonstrated to highlight that the project will provide reductions/removals significantly better than similar activities recently applied in the region.

- Practice-based – project activity occurs sufficiently infrequently in the region it can be considered additional.

- Installation of the project technology is sufficiently low that installation of the technology for the project is considered additional.
- If sufficient data exist to assign an emission rate to characterize a sector, the expected removals from the project in excess of the benchmark constitute additionality.

For all AFOLU projects that use performance standards to assess additionality they must be re-evaluated at a minimum of every 10-years. A project's GHG removals may not be permanent due to, for example, fire, flood, or insect infestation or landowners choosing to not renew a project. However, AFOLU projects must commit to projects for a minimum of 40 years. Reversal risk is also evaluated with the ACR Tool for Risk Analysis and Buffer Determination, which determines the number of credits to be deposited into the ACR Buffer Pool Account. The risk analysis must be re-evaluated every 5 years. AFOLU projects require a legally binding Reversal Risk Mitigation Agreement that details risk mitigation mechanism and compensation for reversals. Rather than use a buffer pool, an insurance product can be used. Other financial assurances can also be used including bonds and letters of credit. ACR must be confident that these financial assurances could offset possible reversals.

Aggregation of multiple sites into one project (or a Grouped Project) to improve efficiency is possible. All sites will share a common definition of additionality and baseline while using the same ACR methodology and project start date. A Programmatic Development Approach is also possible which defines a common project start date but allows sites to enter the project at different times – assuming a sufficient technical reason exists. A common ACR methodology is needed along with a common calculation of project risk. The sites are considered "cohorts" and should have similar baseline conditions.

Small Acreage Opportunities with ACR

Finite Carbon in cooperation with ACR has developed "Core Carbon" to mobilize carbon from smaller forest owners using an Improved Forest Management approach on as few as 40 acres (ACR 2021). The method follows ACR's programmatic development approach. Reduced project size is facilitated by leveraging techniques in data science. Project and baseline data can be generated by 1) Project-level inventory using an unbiased sample of inventory plots within the project boundary; or 2) Regional Inventory using an unbiased sample of inventory plot data from the USFS Forest Inventory Analysis (FIA) program.

A suite of forest criteria are used to define similar sample plots. Baseline timber stocks are estimated yearly, and a long-term baseline average timber stock is used. A project level inventory defines baseline assuming a harvest level that maximizes NPV of perpetual wood products. The carbon project scenario then describes activities to defer harvesting and enhance growth during the crediting period. Inventory plot data must have been collected within the past 10 years. Any model used must be peer-reviewed, relevant to the management scenario, and parameterized to the specific conditions of the project. Estimates of uncertainty in baselines are not required but strongly encouraged to be included in estimates of credits. Sampling error in estimated carbon stock of the ACR project must not be greater than 10%. If not, additional adjustments will have to be made.

The program requires demonstration of no leakage above 3% and non-native forest stands are permitted in the program under certain restrictions. The project must be enrolled within 5 years of start date. To ensure additionality, a regulatory surplus test is required, but existing forest management plans and tax abatement programs do not pose a regulatory barrier. Further a common practice test is used to ensure that the proposed project is outside of common practice for the region.

Steps to ensure permanence include use of credit buffer pools, insurance or other ACR approved methods. These measures must be adequate to ensure no reversal of carbon sequestered due to unforeseen natural disturbance or choice of landowners to leave the program (ACR2021).

ADDITIONALITY: VERRA VOLUNTARY CARBON MARKET STANDARD

Verra has methods to capture unique features of biomes that are regularly updated (Verra 2023). They maintain a main standard for defining additionality and baseline for AFOLU carbon credits (Verra 2012). We'll focus our review on this stepwise approach (Fig 4).

The first step is the identification of alternative land use scenarios to the proposed project (Fig 4). The objective is to identify realistic and credible land-use scenarios that would have occurred within project boundaries in absence of the Voluntary Carbon Standard (VCS) project. Activities that occurred within the project boundary within 10 years may be determined to be credible and realistic. Otherwise, credibility must be justified by examining spatial planning information, legal requirements and assessment of economic feasibility. Credible baseline scenarios should be in compliance with all

mandatory legal and regulatory requirements. If not, one could demonstrate that the current practice in the region doesn't limit the baseline scenario due to lack of enforcement of laws or regulation.

To be considered additional, the proposed VCS project without the financial benefit of carbon credits could pass a barrier test or it must be demonstrated to be financially less attractive than at least one of the baseline scenarios using Investment Analysis (Fig 4). If the VCS project generates no financial or economic benefits other than carbon credits, then a simple cost analysis should be used. If it is demonstrated that the VCS project provides no financial benefit outside of VCS credits, then one can skip to Common Practice Analysis. In not, the investment comparison analysis or benchmark analysis should be used to contrast financial benefits of the VCS project and baseline land uses.

Investment comparison analysis uses internal rate of return, net present value, payback period, or cost benefit ratio depending on characteristics of the proposed VCS project. Benchmark analysis choses from the financial indicator listed above. This benchmark return is to represent standard returns in the market but not specifically linked to the risk profile or profitability of a specific developer. Government bond rates that reflect private investment and/or specific project type can also be used as determined by an independent financial expert. Developers who consistently deploy VCS projects can use internal benchmarks based on their experiences.

For investment comparison analysis or benchmark analysis, comparison of financial indicators starts by estimating the financial benefits of the VCS project assuming no sale of carbon credits. Under the investment comparison analysis, if one of the baseline land uses offers higher financial returns than the VCS project without carbon credits then the VCS project is not considered financially attractive. Under the benchmark analysis, if the VCS project without carbon credits has lower financial returns than the benchmark then the VCS project is not financially attractive. If the VCS project without the benefit of carbon credits is less financially attractive than the baselines, then the VCS project can be considered additional.

A sensitivity analysis is used to show the robustness of financial attractiveness determination to reasonable variations in critical assumptions. If the proposed VCS project fails the sensitivity analysis and the project cannot be considered additional by means of financial analysis, then Barrier analysis can be applied.

Barrier analysis maybe performed instead of or with investment analysis. The goal is to determine whether the proposed project faces barriers that prevent the VCS project without revenue from carbon credits and do not prevent the implementation of at least one of the baseline land uses. Barriers may include financial, institutional, technological, local traditions, ecological conditions, social/demographic issues, or ownership rights.

Assuming all previous steps are passed, then common practice analysis is used to catalogue similar activities as the proposed activities for the VCS project. Such projects would have a similar scale implemented in the same region, within the last 10 years. If similar projects exist and distinctions (i.e. differences in circumstances or presence of barriers) with the proposed VCS project cannot be made, then the VCS project is not considered additional. Otherwise, the proposed VCS project cannot be considered a baseline project, and it is indeed additional.

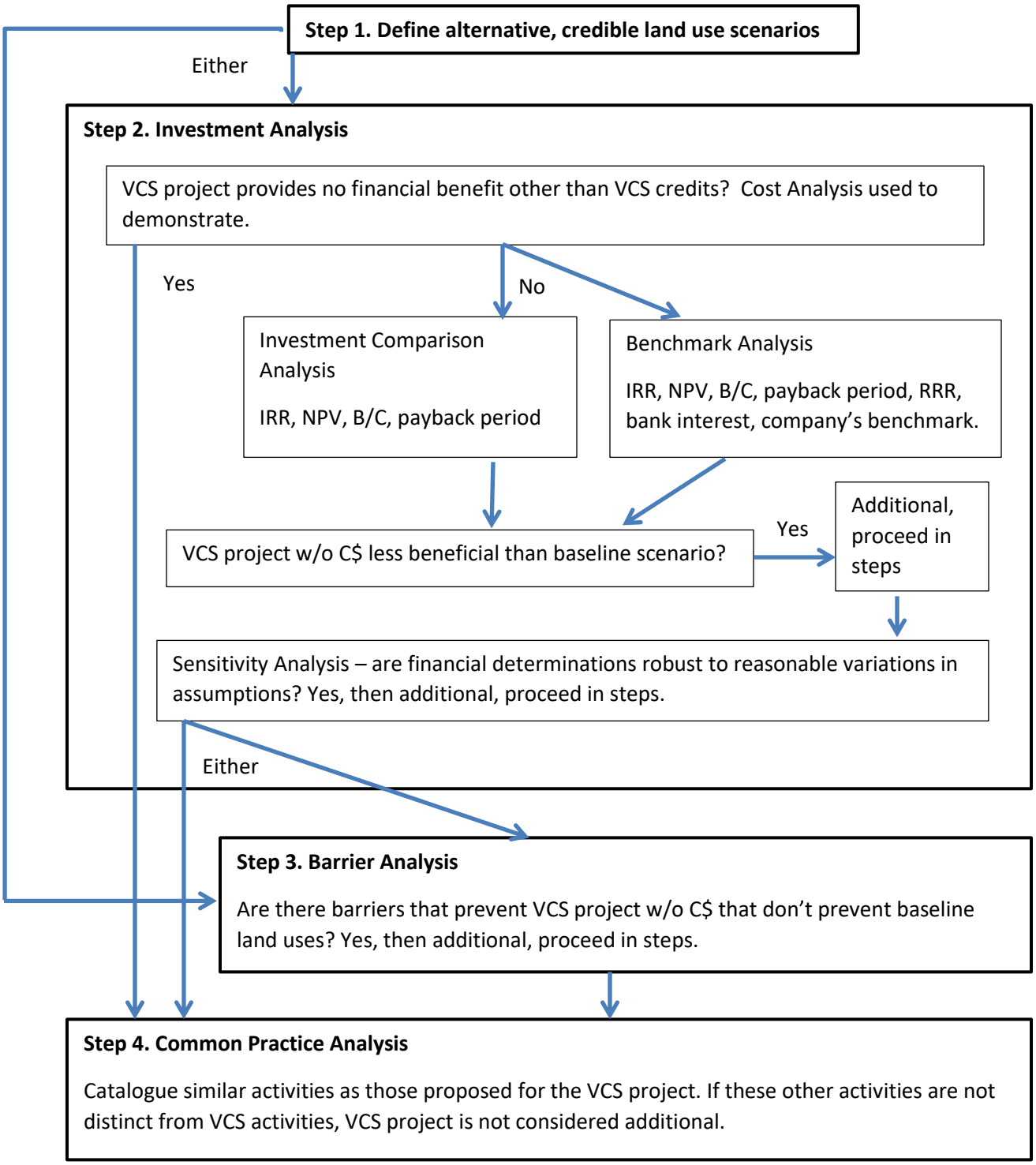

Figure 4. Schematic of VERRA's Voluntary Carbon Standard AFOLU Additionality Tests v3.0 (Verra 2012). Here we capture the complexity and multiple pathways to additionality. IRR, investment rate of return; NPV, net present value; B/C, benefit-cost analysis; RRR, required rate of return; C$, expected revenue from carbon project.

Small acreage opportunities with Verra

The American Forest Foundation collaboration with The Nature Conservancy and Terra Carbon developed the Family Forest Carbon program to mobilize carbon from smaller land holders (Verra 2022). This is accomplished using advanced techniques in data science. The Initial market is being developed in the Upper Midwest to Mid-Atlantic States. The smallest parcel size for enrollment is 30 acres. The program is looking forward to expanding in the Southeast next.

The method is rooted in applying Improved Forest Management practices. Landscape-scale statistical analysis is used to contrast GHG reductions in the VCS project versus control plots. Control plots are selected across the landscape based on a suite of forest attributes that characterize the baseline forest management scenario. Each plot must be re-measured every 10 years. The project site must be actively engaged in timber production. Under this protocol leakage is only assessed as market leakage to determine if harvesting of timber is enhanced across the sampled landscape.

While this is an approved Verra method, they do not follow the additionality method above. However, regulatory surplus must be demonstrated, and performance benchmarks must be applied. Measurement of control plots constitutes a dynamic, spatially explicit benchmark of periodic timber stock change. Performance in the VCS project plot in excess of this benchmark are emission reductions considered additional.

VOLUNTARY CARBON INTEGRITY EFFORTS

The popular press and academic studies have captured problems with voluntary carbon markets. In brief, the complexity of stakeholder relationships and the geographic extent of carbon projects have created projects unable to meet reported credit yields. Rather than rehashing issues, we highlight initiatives aimed at correcting these failures. These include the Integrity Council for the Voluntary Carbon Market (ICVCM), the Voluntary Carbon Markets Integrity Initiative (VCMI), and the Climate Action Data Trust. While regulatory based markets rely heavily on the Army Corps of Engineers, US EPA, and USFWS for standard setting, in voluntary carbon markets these independent bodies are working to set the standards.

ICVCM and VCMI recently began collaborating to construct Core Carbon Principles (ICVCM led) and a Claims Code of Practice (VCMI led) so that carbon credit markets provide real, verifiable impact on climate change using the best available science and practices. The Core Carbon Principles (CCP; ICVCM 2023) are designed to ensure that carbon credit projects generate high quality credits. The Claims Code of Practice ensures companies buying credits apply that investment to account for their carbon footprint effectively. The Claims Code of Practice encourages companies buying voluntary credits to count them as “climate contributions” rather than carbon offsets.

The ICVCM CCP (ICVCM 2023) include demonstration of effective governance emphasizing transparency, accountability, and continuous improvement. This includes use of registries to securely and

unambiguously record and track mitigation activities. Validation and verification of mitigation must use a robust independent third party. GHG reductions and removals must demonstrate additionality and be permanent reductions or removals of GHG, such that any reversals would be fully compensated. CCPs also include avoidance of double counting and require the use of sound scientific methods to estimate GHG reductions and removals. Adherence to social and environmental safeguards are required while pursuing mitigation activities. The CCP also ensures that climate mitigation activities are compatible with achieving net zero emissions by 2050.

A critical need in carbon markets is a common registry of credits across different carbon methodologies. One proposed solution is the Toroto Carbon Metaregistry which links carbon projects through a blockchain within a GIS framework. The World Bank, the Government of Singapore, and IETA are collaborating to create the Climate Action Data Trust to provide a decentralized repository of market activity across all carbon markets. Their goal is to increase transparency and accountability of carbon markets while fostering collaboration and innovation.

CONSIDERATIONS FOR INTEGRATING CREDIT MARKETS

While there are environmental and economic benefits integrating markets, there are many critical considerations to ensure that the credits exchanged represent additional, equivalent, and durable ecosystem services required by each individual program when integrating credit markets.

Mitigation credits may be thought of as bundles of ecosystem functions or services (Gardner and Fox 2013, Robertson et al. 2014). Those bundled functions or attributes may include those that are integral to a specific aquatic resource such as habitat for specific fish, wildlife, or plant species, flow attenuation and baseflow augmentation, carbon transformation and sequestration, etc. Parsing or unbundling those functions and/or services that are integral to the functioning of an ecological resource and then trading them separately could reduce the likelihood of a mitigation project offsetting the loss of functions/services provided at the permitted impact site. Repeated parsing functions and trading them separately could result in cumulative overall losses of resource functions in the bank's service area, watershed, or ecoregion (Gardner and Fox 2013, Martin 2010, Robertson et al 2014).

A credit might be associated with vernal pool restoration and support one or more associated vernal pool species such as the federally endangered vernal pool tadpole shrimp (*Lepidurus packardi*) or the endangered Sebastopol meadow foam (*Limnanthes vinculans).* Such a credit would have multiple attributes, carbon, wetland, and species. It might be thought of as having a stack, a group, or a bundle of attributes falling under different regulatory authorities such as the Army Corps of Engineers (wetlands), U.S Fish and Wildlife Service (vernal pool habitat and species), and California Department of Fish and Wildlife (species). As such it might be thought of as a multiple authority credit.

The terminology for describing these multiple authority credits with multiple attributes can be confusing. There are no universally accepted terms for this condition among regulators, academia, compensation providers, and policy makers (Robertson et al 2014, von Hase 2018). Some call these multiple authority credits stacked credits and insist that they cannot be unstacked with each attribute sold off separately (Layne 2010, Martin 2010, von Hase 2018). Others refer to them as bundled credits and insist that the attributes cannot be unbundled (see Gardner and Fox 2013, Robertson et al 2014, von Hase 2018). One suggestion is to refer to these credits as stacked and bundled (M. Gause Pers. Comm.). Regardless of terminology it is generally agreed that parsing and trading these functions separately could lead to a loss of resource functions in a bank's geographic service area and is inconsistent with regulations such as the 2008 Mitigation Rule (Martin 2010, Gardner and Fox 2013, Robertson et al. 2014).

The regulatory considerations described above do not prevent the use of wetland, stream, and species credits as offsets for permitted impacts by multiple authorities. Multiple authority credits can be used in two ways that are consistent with the regulatory constraints discussed above: 1) as an offset to co-located resources impacted by a specific project; or 2) as an offset to a single resource such as a wetland, vernal pool, or a listed species (Martin 2010, Gardner and Fox 2013). However, in either situation, once the credit is debited, it is retired and is no longer available for use whether all its attributes have been utilized or not. The use of a single credit to offset more than 1 permitted impact is known colloquially as "double dipping" (Gardner and Fox 2013, Robertson et al. 2014).

To avoid double dipping while generating voluntary carbon credits with regulated markets, one might quantify carbon sequestration beyond the required additionality of ESA or CWA when land stewardship investments are initiated.

Many mitigation banks have acreage that generates few if any mitigation credits. A term coined for these areas is stranded acreage (Per. Comm. Jim Bergen, Delta Land Services). Stranded acres are lands that a sponsor often must secure or purchase when developing a mitigation bank. They may be uplands that extend far beyond any required buffers for wetland or stream banks, existing tidal wetlands, or even wetland preservation areas that under current district or state policies generate few if any credits at high ratios (15:1, 20:1, 50:1 or more – for example see Maryland Mitigation Ratios for Non-Tidal Wetlands (2021), New England Mitigation Guidelines (2016), or the Virginia MBI Template (2018)). These lands may remain in cultivation, may be timbered, left alone or fallow, allowed to regenerate/reforest naturally, or be excluded from the actual bank limits. In other cases, they may be conserved through site protection mechanisms but receive little if any active management. In summary, the mitigation operators could choose to use the stranded acres to recoup capital invested in the original land acquisition or develop those acres as a carbon project.

Stranded acres might be more actively managed to generate carbon offsets, for example through active forest or soil management to encourage carbon sequestration. Appropriate tree species might be

planted at approved densities and with suitable management regimes (competition control, precommercial thinning, etc.) to encourage sequestration of carbon in plant biomass and soils. Lands currently under cultivation might follow practices intended to encourage carbon sequestration (use of biochar, no till cultivation, etc.) or even remove those areas from cultivation. Similarly, tidal wetlands might be managed through hydrologic enhancement or beneficial use of dredged material (thin layer disposal(deposition)) which would have the potential to generate carbon credits based on improvement over baseline conditions (Silvestrum et al. 2021).

Boyd et al (2023) argue for more explicit inclusion of the amount of carbon removed per unit time. Time considerations would improve the performance and clarity of carbon markets. The updated Verra standards are moving in that direction, but credits still represent volume (mTCO2e) and not volume per unit time (Verra 2023). The same concern could be levied for species and water credits as well which are dominated by area-focused metrics and not area per unit time. However, the great majority of species and water credits are established in perpetuity.

CLEAN WATER ACT

Given the diversity of ecosystem services provided by streams or wetlands, integrating markets will be considered for generating credits for stranded acres. The stacking and bundling of carbon and water credits will be difficult due to the issues discussed above. However, if market prices for carbon offsets increase substantially or there is a marked reduction in demand for 404 credits due to a more restrictive definition of waters of the US, bundled and stacked credits that include species, waters, and carbon attributes may become feasible.

Many CWA mitigation instruments allow lands to be removed from a bank. The sponsor could seek to do so, remove a conservation easement, or deed restriction and modify a bank instrument to facilitate establishment of a carbon offset with current condition as baseline and management focused on carbon sequestration rather than a suite of other functions or as offsets for losses of wetlands or streams. It may be difficult to secure the necessary regulatory approvals to reduce the area covered by an existing site protection mechanism. Some mechanisms like deed restrictions may prove easier to modify than recorded conservation easements (Wood and Martin 2016).

As a result of the amendments to the federal definition of Waters of the US that resulted from the SCOTUS decision in Sackett V EPA (33 CFR 328/40 CFR 120), there may be substantially less demand for 404 credits in states without independent regulatory authority over waters (such as AL, IA, GA, MO, MS, and TX). See ASWM (2016) and McElfish (2022) for more detailed discussion of which states have independent regulatory authority over waters. As a result of the amendments to the definition, Corps permits (and any associated compensation) may not be required for impacts to ephemeral streams, and wetlands that are not abutting and do not have a continuous surface water connection to other jurisdictional waters.

Regulators in evaluating a proposed bank providing wetland, stream, species, and carbon offsets may have several questions that must be addressed before the new bank or modification of an existing bank is allowed to move forward:

- **Is it Allowable?** – Do Corps regulations allow use of lands associated with mitigation bank credits for other programs? This issue is addressed in the 2008 Mitigation Rule and as discussed in Part II above is allowable provided the same credit is not used to offset impacts associated with 2 different projects (33 CFR 332.3(j)/40 CFR 230.93(j)).

- **Do the current bank instruments and associated documents allow for use of credits outside of section 404 CWA?** Many bank instruments and associated documents including site protection instruments only authorize use of bank credits as offsets under Section 404 CWA (for example Charleston 2014, Mobile District 2023, Wilmington 2020). In those situations, the regulators (Corps and state counterparts), the Interagency Review Team, and Corps and state Counsel's will need to agree to a modification of the instruments to allow for generation and release of carbon offsets.

  On the other hand, some districts like Jacksonville and New Orleans Districts have developed guidance for so-called environmental or multiple authority banks. Others like the districts in the South Pacific Division (Albuquerque, Los Angeles, Sacramento, and San Francisco) have developed templates for all aspects of multiple authority banks (draft prospectus, prospectus, and instrument).

  Guidance from many districts (such as Charleston, Huntington, and Wilmington) define appropriate buffer widths for wetlands and/or streams associated with mitigation banks. Lands outside of those limits, which are often outside the limits of exiting site protection mechanisms (i.e. conservation easements) might be considered for generating carbon offsets.

- **Parsing functions**? – Does the proposal entail unstacking or unbundling the functions provided by an aquatic resource and trading them separately? When the Corps & IRT approve a credit project, they typically consider the suite of functions provided by the aquatic resources to be provided by the project (Martin 2010, Gardner and Fox 2013). Parsing functions performed by many aquatic systems such as carbon sequestration or carbon transformation could be viewed as running counter to the 2008 Mitigation Rule which specifies that the same credit cannot be sold twice (33 CFR 332.3(j)(1)/40 CFR 230.93(j)(1)). Parsing and then trading those functions such as carbon sequestration separately could reduce the likelihood of compensation offsetting the cumulative permitted losses of aquatic resource functions in the project service area, watershed, or ecoregion (Martin 2010, Gardner and Fox 2013). This practice is likely to be opposed by Corps districts and the IRT. As a practice it would also run counter to some state laws and regulations that require mitigation projects not contribute to a loss of wetland functions or acreage.

- **Double dipping? –** Using the same credit for 2 different projects or double dipping is counter to the mitigation rule which says that the same credit cannot be used to offset 2 different projects (33 CFR 332.3(j)(1)/40 CFR 230.93(j)(1)). Double dipping can also lead to a loss of aquatic resource functions in a service area or watershed (Martin 2010, Gardner and Fox 2013, Robertson et al 2014).

- **Credit Ownership?** - A common attitude among many regulators is that because a specific regulatory agency was responsible for overseeing bank development and approval the credits generated by the bank somehow belong to that agency or can only be used to offset impacts authorized by that regulatory agency. This attitude is often tied to perceived scarcity of bank

credits (and thus greater demand) in a certain service area. Obviously, the credits belong to the bank sponsor not the regulator. So long as the sale of credits is consistent with federal (and state) regulations then consideration should be given to allowing those credits to be used for other purposes.

- **Additional workload? –** Will adding a new type of credit to a bank area necessitate additional effort on the part of regulators? Adding carbon credits to existing credit projects will entail at least some additional work on the part of regulatory agencies (Corps, etc.) and the IRT, specifically:
    - Adding a new credit type to an existing bank would likely require public noticing the proposed modification (33 CFR 332.8(g)(1)/40 CFR 230.98(g)(1)).
    - Several documents associated with the bank would need to be reviewed and potentially revised, including the bank instrument, site protection instruments (conservation easement, declaration of restrictions, etc.), monitoring and management plans, and long-term management plans.
    - Many approved bank instruments from across the country authorize use of bank credits only for Section 404 permit compensation (for example see templates for Charleston District (2014), Mobile District (2023), and Wilmington District (2020). Some site protection documents indicate that all functions/services are locked up as part of 404 compensatory mitigation. These provisions would need to be reexamined and potentially revised by regulators.
    - Current monitoring & performance standards would need to be examined to determine whether they are compatible with carbon crediting or if additional procedures and metrics would be necessary.
    - Revisions of instruments, performance requirements, monitoring, etc. would entail additional coordination with the IRT, the sponsor, and parties responsible for issuance and verification of carbon credits.

- **Transparent credit tracking?** Can tracking of credit transactions for carbon credits as well as other resources be conducted transparently (Gardner and Fox 2013)? Will there be a single ledger that tracks all credit activity to reduce the likelihood of miscounting debits of credits?

- **Addition of carbon credits may affect monitoring and performance standards.** Assessment and verification of carbon credits will entail very different and often intensive monitoring. Depending upon land use type and treatment different methods for assessment of baseline conditions and accrual of carbon crediting have been developed (see for example Earth Partners 2012 and Silvestrum et al 2021).

- **Evaluation of baseline conditions for carbon crediting.** Ideally, baseline conditions used to evaluate carbon sequestration would be evaluated before a mitigation bank is approved and operational. This would likely maximize potential carbon yield and help projects track regulatory surplus requirements of voluntary carbon markets. However, for addition of carbon credits to an existing bank this is not possible. Instead, baseline data might be collected at the time the instrument is modified to allow for carbon crediting and would focus only on those areas likely to generate carbon credits. Most likely that would be the stranded acreage discussed above or those areas that were originally intended to generate minimal 404 credits. Credits would then be accrued over time based on additional carbon sequestration over baseline conditions. Recognizing that this may take considerable time to generate an appreciable amount of carbon

offsets, one option might be to allow the long-term manager of the bank property to sell carbon offsets once the bank has gone into the long-term management phase. Funds from the sale of carbon offsets might be used to augment existing funding for long-term management of the bank.

ENDANGERED SPECIES ACT

The ESA-CMP (USFWS 2023) also recognizes the problem associated with selling carbon credits from species credit projects. Species credits projects will include some level of carbon sequestration, but the loss of habitat will also include the loss of carbon sequestration. Thus, to sell a carbon credit to account for a different offset from the same acreage as the species habitat would result in a net loss of carbon sequestration (i.e., double dipping). However, as discussed above, if a stream or wetland impact affects species as well, then the stream or wetland bank can sell credits simultaneously (i.e., for the same impact) for the species and water quality without creating a net decrease in ecological value (i.e., stacked credits without double dipping).

Species bank boundaries represent areas necessary to maintain habitat function for the species which may include buffer areas that reduce edge affects from outside land uses that reduce attractiveness of the area for the species. While these buffer areas may be required, they may lead to limited credits because they contribute less to the overall function of the bank.

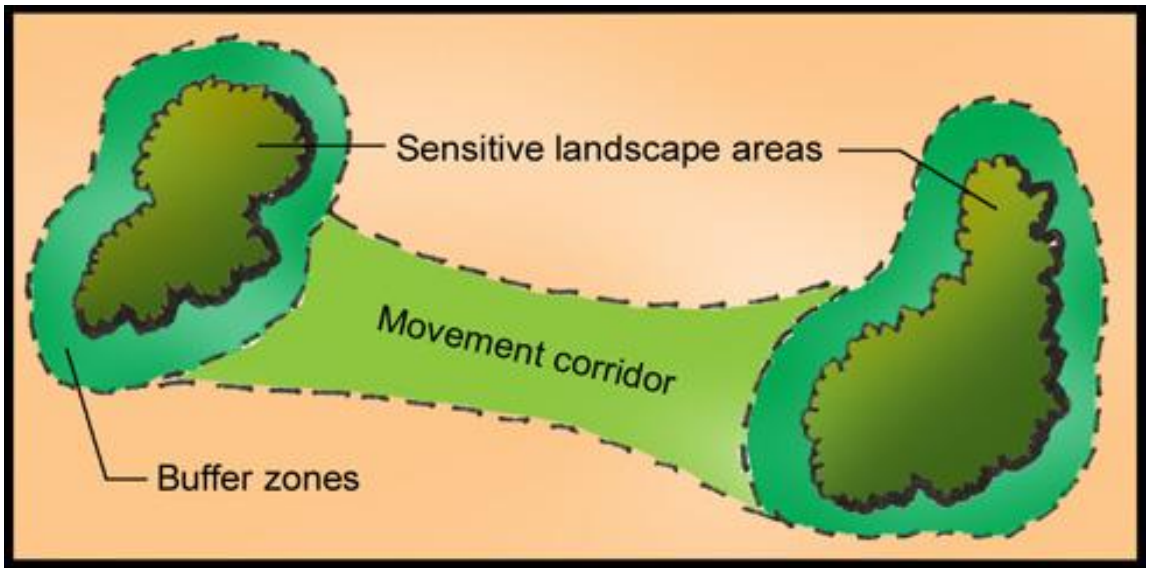

Figure 5. Illustration of buffers and corridors to generate biodiversity value from the US Department of Agriculture Conservation Buffers Guidelines (https://www.fs.usda.gov/nac/buffers/guidelines/2_biodiversity/8.html)

The Council on Environmental Quality recently issued guidance for Federal agencies to account for and coordinate to protect and consider ecological connectivity in decision making (Mallory 2023). Ecological

connectivity in this context refers to landscape attributes that facilitate the movement of species across the landscape (Fig 5). Species credit projects must be able to demonstrate some connectivity between the credit project site and the rest of the population. The problem is the presence of connectivity habitat and the extent to which connectivity contributes to species survival and recovery is usually unknown at the time of trades. No habitat connectivity tests have been formalized, though a common definition of habitat connectivity for all species is conceivable (Bruggeman et al. 2005; 2009) and has been applied in the field (Bruggeman and Jones 2014).

Sites implementing carbon projects could lead to increased use of these sites by candidate and listed species as natural vegetative composition improves. Enacting ESA policy at carbon projects would likely cause the carbon project to then fail or at least question the regulatory surplus test described above for the ACR and Verra programs. In such cases, the carbon project's vegetative structure that led to occupancy by the species would likely create a new baseline for the carbon project. Redefining baseline in this way would invariably result in a loss of carbon credits. Or, if a market for candidate and listed species exists, the carbon project could be cancelled, and a species conservation bank could be established. At current voluntary carbon credit values, a species conservation bank would be more financially rewarding.

An Enhancement of Survival Permit (ESP, ESA Section 10(a)(1)(A)) could be used by the carbon project to create a USFWS approved management plan to authorize any possible affects. An ESP establishes a baseline habitat quality for an area such that any additional conservation value generated by management activities would not lead to greater restrictions under the ESA. Thus, any additional habitat quality that accrues during a carbon project could be considered as a "regulatory surplus". An ESP could be initiated before a candidate or listed species is found on at a carbon project in the US. Also, natural resource management actions to support carbon goals could perhaps decrease, at least temporarily, habitat quality for candidate and listed species. An ESP would help manage this issue as well.

Given that the biodiversity crisis in the US coincides with the need for carbon sequestration services, we feel alternative market structures could be investigated beyond one solution offered here. The presence of the regulatory surplus test under ACR and Verra serves a critical purpose to support additionality across a variety of land management regimes. However, crediting under the CWA is not structured such that restoration and attraction of listed species leads to a decrease in available stream or wetland credits, though it would add another layer of management. Perhaps a carbon credit program could be devised such that inclusion of threatened and endangered species habitat is acceptable but payments would only be made for carbon additionality. This would require devising new carbon credit methodologies not restricted to the regulatory surplus test for the ESA. The critical task is to track how management, that otherwise would not have happened without a carbon market, created more carbon sequestration.

CONCLUSION

There are many fundamental differences in how the CWA, ESA, and voluntary carbon markets are organized. In the absence of government regulators, voluntary carbon markets specify detailed methods and statistical performance standards. Voluntary carbon markets have a strong demand for low error

rates when measuring carbon sequestration. This is possible thanks to the greater biophysical simplicity in carbon-dynamics vs water- and biodiversity-dynamics.

Also, leakage is a critical consideration for voluntary carbon markets, in which participation in carbon markets should not cause increased exploitation of carbon sinks (e.g., forests or peatlands) to make up for lost revenue in commodity markets (e.g., timber) due to the carbon project. In contrast, under CWA and ESA, in theory, all equivalent ecological resources are protected in the same way, so no leakage should occur if enforcement is effective.

In the short-term multiple authority credits that have a carbon sequestration attribute are not likely to be used solely as carbon offsets because current prices are much lower than prices charged for wetland, stream, and species credits.

Yet, integrating voluntary carbon projects with regulated credit markets in the US could help data flows and ensure standards are met. Efforts to improve the data science of carbon sequestration in wetlands and grasslands are ongoing. Improved data science will likely make carbon projects on smaller wetlands and grasslands cost-effective, helping to ameliorate the mobilization challenge of nature-based carbon credits.

Creating additionality tests that that work with regulations for other ecosystem services could also help with mobilization challenges. Perhaps, the most immediate feasible change in the US would be to recognize that the presence of a candidate, threatened, or endangered species does not negate the accumulation of additional carbon. Importantly, the presence of these species under the ESA does not lead to any financial benefit unless public subsidies or offset markets are present. Such financial benefits are rarer than the species. Preventing carbon programs from being discounted by the presence of listed species could have significant impacts on species recovery and thus delisting species. Increased habitat protection is particularly important given the need for species to move their ranges in response to a changing climate (Mallory 2023).

Integrating voluntary carbon credits with existing wetland, stream, and species credit projects will likely entail modification of the current operational instruments. There are several options that may be considered:

- Utilizing so-called stranded acres, that is those lands associated with mitigation projects that currently generate no 404 CWA or ESA credits.
- Or, if voluntary carbon credits additionality tests could be revisited, then
    - Modification of existing operational instruments (including potentially site protection instruments) to enable mitigation lands (such as preservation lands or buffer lands) that generate small amounts of credits to be repurposed as carbon offsets.
    - Modifying existing instruments to add a voluntary carbon attribute to existing multiple authority credits.

It may be possible to integrate voluntary carbon credits with proposed wetland, stream, and species compensatory mitigation projects, however, it would entail revisiting the issue of additionality for voluntary carbon projects with Verra and ACR.

All options would require establishing a baseline for carbon sequestration, implementing land management practices that would foster carbon sequestration, and implementing performance standards and monitoring regimes acceptable under voluntary carbon crediting standards.

As business practices continue to embrace sustainability, collecting, analyzing, and sharing data effectively recognizing the diversity of sustainability goals will be critical. Carbon market participants should be aware there is a broad industry of experts in the restoration, protection and management of ecosystems to help. We hope the present treatment was a useful step in that direction.

TAKEAWAYS FOR CWA/ESA BANK SPONSORS:

- Regulators are open to adding carbon credits to CWA/ESA projects
- Deed restrictions are likely to be easier to modify than conservation easements and thus provide more freedom for adjusting how lands are valued in these markets.
- Existing mitigation instruments will likely have to be modified to accommodate carbon credits.

TAKEAWAYS FOR VOLUNTARY CARBON PARTICIPANTS:

- CWA/ESA regulators would like to find avenues to work with carbon markets.
- Attracting candidate, threatened or endangered species to carbon projects is a good thing in terms of sustainability. Policy tools under the ESA (i.e., Enhancement of Survival Permits) exist to help projects avoid conflicts with the regulatory surplus standard.
- The CWA/ESA practice area offers a group of professionals with significant project management and data collection experience.

TAKEAWAYS FOR CWA/ESA REGULATORS:

- Adding carbon values to CWA/ESA projects will require additional effort to understand the differences in the way credits are defined, validated, and verified.
- Adding carbon values to proposed CWA/ESA projects may result in larger and more ecologically valuable projects.
- Market participants will need greater clarity on what carbon associated with CWA/ESA projects may be found to be additional.
- A willingness to modify CWA/ESA mitigation instruments will often be needed.

REFERENCES

American Carbon Registry (ACR). 2020. Requirements and specifications for the quantification, monitoring, reporting, verification, and registration of project-based GHG emissions reductions and removals. Version 7.0. Winrock International

American Carbon Registry (ACR). 2021. Methodology for the quantification, monitoring, reporting and verification of greenhouse gas emissions reductions and removals from small non-industrial private forestlands. Version 1.0. Winrock International

Association of State Wetland Managers. 2016. Status and Trends Report on State Wetland Programs in the United States. 94pp.

Boyd PW, L Bach, R Holden, C Turney 2023. Redesign carbon-removal offsets to help the planet. Nature 620: 947-949

Briber BM, LR Hutyrs, AL Dunn, SM Raciti, JW Munger. 2013. Variations in atmospheric CO2 mixing ratios across a Boston, MA urban to rural gradient. Land 2: 304-327.

Bruggeman, D. J., and M. L. Jones. 2014. Development of adaptive management tools to guide habitat allocations for at-risk species. Final Report to the Strategic Environmental Research & Development Program.

Bruggeman, D. J., M. L. Jones, F. Lupi, and K. T. Scribner, 2005. Landscape Equivalency Analysis: Methodology for calculating spatially-explicit biodiversity credits. Environmental Management 36: 518-534.

Bruggeman, D. J., M. L. Jones, K. Scribner, and F. Lupi. 2009. Relating tradable credits for biodiversity to sustainability criteria in a dynamic landscape. Landscape Ecology 24: 775-790.

Charleston District, Army Corps of Engineers. 2014.Mitigation Banking Instrument Template. https://ribits.ops.usace.army.mil/ords/f?p=107:27:17560111938128::NO::P27_BUTTON_KEY:10

Collins, M. E. and R. J. Kuehl. Organic matter accumulation and organic soils. Pp. 137-162 in J. L. Richardson and M. J. Vepraskis. Wetland Soils: Genesis, Hydrology, and Landscapes. Lewis Publishers.

Craft, C. B. 2001. Biology of wetland soils. PP. 107-135 in J. L. Richardson and M. J. Vepraskis. Wetland Soils: Genesis, Hydrology, and Landscapes. Lewis Publishers.

Earth Partners. 2012. VCS Module VMD0019: Methods to Project Future Conditions. Verion 1.0 Sectoral Scope 14. 33pp.

Ecosystem Marketplace 2021. Voluntary carbon markets rocket in 2021, on track to break $1 billion for the first time. Ecosystem Marketplace Insight Team. September 15, 2021

Ecosystem Marketplace 2021. Voluntary carbon markets top $1 billion in 2021 with newly reported trades. Special Ecosystem Marketplace COP26 Bulletin.

https://www.ecosystemmarketplace.com/articles/voluntary-carbon-markets-top-1-billion-in-2021-with-newly-reported-trades-special-ecosystem-marketplace-cop26-bulletin/

Ecosystem Marketplace. 2023. Paying for Quality: State of the Voluntary Carbon Markets 2023. Washington DC. Forest Trends Association.

Gardner, R. C. and J. Fox. 2013. The Legal Status of Environmental Credit Stacking. *Ecology Law Quarterly* 40(4) 101-145.

Integrity Council for the Voluntary Carbon Market 2023. Core carbon principles, assessment framework and assessment procedure. July 2023.

Jacksonville District, Army Corps of Engineers. 2022. Guidance for Establishment and Use of Multipurpose Mitigation Banks and In-Lieu Fee Programs in the Jacksonville District. https://ribits.ops.usace.army.mil/ords/f?p=107:27:2070909205543::NO::P27_BUTTON_KEY:10

Layne, V. 2011. Layering multiple credit types in mitigation banks. National Wetland Newsletter. 33(1): 8-9.

Mallory, B. 2023. Guidance for Federal Departments and Agencies on Ecological Connectivity and Wildlife Corridors. Memorandum for Heads of Federal Departments and Agencies. Council on Environmental Quality. Executive Office of the President. March 21, 2023.

Martin, S. 2010. An alternative to unbundling ecosystem services. National Wetland Newsletter. 32(6): 27.

Maxwell SL, V Cazalis, N Dudley, M Hoffmann, et al. 2020. Area-based conservation in the twenty-first century. Nature 586: 217-227.

McKinsey & Company 2021. A blueprint for scaling voluntary carbon markets to meet the climate challenge. January 2021

Mitsch, W. J. and J. L. Gosselink. 2015. Wetlands, 5th Edition. Van Nostrand Reinhold, New York.

Mobile District, Army Corps of Engineers. 2023. Mobile District Mitigation Bank Instrument Template. https://ribits.ops.usace.army.mil/ords/f?p=107:27::::::

Nahlik, A. M. and M. S. Fennessy. 2016. Carbon storage in US wetlands. Nature Communications: DOI: 10.1038/ncomms13835. Pp 1-9.

New England District, Army Corps of Engineers. 2016. New England District Compensatory Mitigation Guidance. https://ribits.ops.usace.army.mil/ords/f?p=107:27:17560111938128::NO::P27_BUTTON_KEY:0

New Orleans District, Army Corps of Engineers. Water Infrastructure Improvements For The Nation (WIIN) ACT, SECTION 5014, Environmental Bank Guidelines. https://www.mvn.usace.army.mil › Portals › 56 › docs › regulatory › publicnotices › 2020-WIINact-EBG.P

Norfolk District, Army Corps of Engineers and Virginia Department of Environmental Quality. 2018. MBI Template and Exhibits. https://ribits.ops.usace.army.milRobertson, M, T. BenDor, R. Laeve, A.

Riggsbee, J. B. Ruhl, and M. Doyle. 2014. Stacking Ecosystem Services. Front. Ecol. Environ: 12(3): 186-193

Securities and Exchange Commission. 2024. The enhancement and standardization of climate-related disclosures for investors. 17 CFR 210, 229, 230, 232, & 249

Shifflett S, D Holger. 2023. Carbon-credit raters aim to assess a notoriously opaque market. Wall Street Journal. Feb 7, 2023

Silvestrum Climate Associates and Restore America's Estuaries. 2021. VMD0052. Demonstration of Additionality of Tidal Wetland Restoration and Conservation Project Activities. 15pp.

South Pacific Division, Army Corps of Engineers, US EPA, US Fish & Wildlife Service, NOAA Fisheries, California Department of Fish and Wildlife, California Regional Water Quality Boards. 2021. California Mitigation Bank Instrument Template. https://ribits.ops.usace.army.mil/ords

Temmink RJM, LPM Lamers, C Angelini, TJ Bouma, C Fritz, J van de Koppel, R Lexmond, M Rietkerk, BR Silliman, H Joosten, T van der Heide. 2022. Recovering wetland biogeomorphic feedbacks to restore the world's biotic carbon hotspots. Science 376 594-611.

Tilman D, RM May, CL Lehman, MA Nowak. 1994. Habitat destruction and the exctinction dbt. Nature 371: 65-66.

Twindale S and S Mcfarlane 2023. Carbon credit market confidence ebbs as big names retreat. Rueters. Sept 1, 2023

Wood, C. and S. Martin. 2016. Compensatory Mitigation Site Protection Handbook for the Corps Regulatory Program. U.S. Army Corps of Engineers, Institute for Water Resources. 21pp.

United States. 1983. The Endangered Species Act as amended by Public Law 97-304 (the Endangered Species Act amendments of 1982). Washington: U.S. G.P.O.

US Fish and Wildlife Service. 2023. Endangered Species Act Compensatory Mitigation Policy. Appendix 1, 501 FW 3.

Verra 2012. Tool for the demonstration and assessment of additionality in VCS agriculture, forestry, and other land use (AFOLU) project activities. VT0001. Version 3.0. 1 February 2012

Verra 2022. Methodology for improved forest management using dynamic matched baselines from national forest inventories. VM0045. Version 1.0. 26 October 2022.

Verra 2023. Verified Carbon Standard. V4.5 29 August 2023

von Hase, Amrei and Cassin, Jan. 2018. Theory and Practice of 'Stacking' and 'Bundling' Ecosystem Goods and Services: a Resource Paper. Business and Biodiversity Offsets Programme (BBOP). Forest Trends, 2018, Washington, D.C.

The White House. 2024, May 28. Fact Sheet: Biden-Harris Administration Announces New Principles for High-Integrity Voluntary Carbon Markets. . https://www.whitehouse.gov/briefing-room/statements-releases/2024/05/28/fact-sheet-biden-harris-administration-announces-new-principles-for-high-integrity-voluntary-carbon-markets/

Wilmington District, Army Corps of Engineers.2020. Umbrella Mitigation Bank Instrument Template. https://ribits.ops.usace.army.mil/ords/f?p=107:27::::::