CLIMATE ACTION RESERVE

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Urban Forest Management

Project Protocol

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Acknowledgements

Staff (alphabetical)

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Lead Author

John Nickerson

Supporting Authors

Cindy Chiang
Jonathan Remucal
Sarah Wescott

Previous Versions

Lead Author

John Nickerson

Supporting Authors

Derik Broekhoff
Robert Z. Lee
Heather Raven
Emily Warms
Sarah Wescott

Workgroup

This workgroup convened for the development of the Urban Tree Planting Project Protocol Version 2.0 and Urban Forest Management Project Protocol Version 1.0. Workgroups are not reconvened for programmatic updates to protocols (e.g., Version 1.1); for additional information, see section 4.3 of the Reserve Program Manual.

Andy Trotter	West Coast Arborists
Brett Milligan	University of California, Davis
Cindy Blain	Sacramento Tree Foundation
Denise Farrell	Environmental Capital, LLC
Doug Wickizer	CAL FIRE
Francisco Escobedo	University of Florida
Jeremy Williams	ArborVitae Environmental Services
John DeGoede	University of California, Davis
John Melvin	CAL FIRE
Katie Hoeberling	University of California, Davis
Mark McPherson	Hillis Clark et al
Michelle Passero	The Nature Conservancy
Misha Sarkovich	Sacramento Municipal Utility District
Nancy Hughes	California Urban Forests Council
Robert Hrubes	Scientific Certification Systems
Russell Hansen	City of San Jose
Tom Hayes	Environmental Conservation Alliance
Walter Passmore	City of Palo Alto

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Abbreviations and Acronyms

C	Carbon
CAL FIRE	California Department of Forestry and Fire Protection
CH_4	Methane
CO_2	Carbon dioxide
CRT	Climate Reserve Tonne
DBH	Diameter at Breast Height
FIA	Forest Inventory and Analysis Program of the U.S. Forest Service
GHG	Greenhouse gas
GIS	Geographical Information System
ISO	International Organization for Standardization
KML	Keyhole Markup Language (see glossary)
N_2O	Nitrous oxide
PDD	Project Design Document
PIA	Project Implementation Agreement
Reserve	Climate Action Reserve
RPF	Registered Professional Forester (California only)
SSR	Source, sink, or reservoir
UFM	Urban forest management
UFMPP	Urban Forest Management Project Protocol
USFS	United States Forest Service
VOC	Volatile Organic Compound

1 Introduction

The Urban Forest Management Project Protocol (UFMPP) provides requirements and guidance for quantifying the net climate benefits of activities that sequester carbon in woody biomass within an urban environment. The protocol provides project eligibility rules, methods to calculate a project's net effects on greenhouse gas (GHG) emissions and removals of carbon dioxide (CO_2) from the atmosphere ("removals"), procedures for assessing the risk that carbon sequestered by a project may be reversed (i.e., released back to the atmosphere), and approaches for long term project monitoring and reporting.

The goal of this protocol is to ensure that the net GHG reductions and removals caused by a project are accounted for in a complete, consistent, transparent, accurate, and conservative manner[1] and may therefore be reported to the Climate Action Reserve (Reserve) as the basis for issuing carbon offset credits (called Climate Reserve Tonnes, or CRTs). Additionally, it is the goal of the Reserve to ensure the protocol is as efficient and practical as possible for Project Operators.

As the premier carbon offset registry for the North American carbon market, the Reserve encourages action to reduce GHG emissions by ensuring the environmental integrity and financial benefit of emission reduction projects. The Reserve establishes high quality standards for carbon offset projects, oversees independent third-party verification bodies, issues carbon credits generated from such projects, and tracks the transaction of credits over time in a transparent, publicly-accessible system. The Reserve is a private 501(c)(3) nonprofit organization based in Los Angeles, California.[2]

Only projects that are eligible under and comply with this UFMPP may be registered with the Reserve. Section 8 of this protocol provides requirements and guidance for verifying the performance of project activities and their associated GHG reductions and removals reported to the Reserve.

1.1 About Urban Forests, Carbon Dioxide and Climate Change

Urban forests have the capacity to both emit and absorb CO_2, a leading greenhouse gas that contributes to climate change. Trees, through the process of photosynthesis, naturally absorb CO_2 from the atmosphere and store the gas as carbon in their biomass, i.e., trunk (bole), leaves, branches, and roots. Carbon may also be stored in the soils that support the urban forest, as well as the understory plants and litter on the urban forest floor. After trees are removed, their wood residue may be converted into mulch, with CO_2 gradually released to the atmosphere through decomposition. Carbon may continue to be sequestered for a substantial amount of time in wood products and in landfills. Carbon from urban forests may also be used to provide fuel for biomass energy. Urban trees can reduce summertime air temperatures and building energy use for air conditioning, thus reducing GHG emissions from electricity generation (Akbari 2002). In winter, trees can increase or decrease GHG emissions associated with energy consumed for space heating, depending on local climate, site features, and building characteristics (Heisler 1986).

[1] See the WRI/WBCSD GHG Protocol for Project Accounting (Part I, Chapter 4) for a description of GHG reduction project accounting principles.
[2] For more information, please visit www.climateactionreserve.org.

When trees are disturbed, through events like fire, disease, pests, or harvest, some of their stored carbon may oxidize or decay over time, releasing CO_2 into the atmosphere. The quantity and rate of CO_2 that is emitted may vary, depending on the particular circumstances of the disturbance. Depending on how urban forests are managed or impacted by natural events, they can be a net source of emissions, resulting in a decrease to the reservoir, or a net sink of emissions, resulting in an increase of CO_2 to the reservoir. In other words, urban forests may have a net negative or net positive impact on the climate.

2 Urban Forest Management Definition and Requirements

For the purposes of this protocol, an Urban Forest Management (UFM) Project is a planned set of activities designed to increase removals of CO_2 from the atmosphere, or reduce or prevent emissions of CO_2 to the atmosphere, through increasing and/or conserving urban forest Carbon Stocks.

A glossary of terms used in this protocol is provided in Section 9. Throughout the protocol, important defined terms are capitalized (e.g., "Urban Forest Owner").

2.1 Project Definition

A UFM Project focuses on activities that maintain or increase carbon inventories relative to baseline levels, as defined in this protocol, of carbon within the project boundary. Eligible management activities may include, but are not limited to:

- Increasing the urban forest productivity by removing diseased and suppressed trees
- Reducing emissions by avoiding tree removals
- Planting additional trees on available and appropriate sites
- Monitoring, protecting, and treating trees to avoid premature mortality from stressors such as drought, pests, storm damage, and abiotic agents
- Reducing the vulnerability of trees to impacts of climate change by increasing resilience

2.2 Urban Forest Owners

Credits for a UFM Project must be quantified from carbon that is owned by participating entities. An Urban Forest Owner is a corporation, a legally constituted entity (such as a utility or special district), city, county, state agency, educational campus, individual(s), or a combination thereof that has legal control of any amount of urban forest carbon[3] within the Project Area.

Having legal control of urban forest carbon means that the Urban Forest Owner has the legal authority to effect changes to urban forest carbon quantities (right to plant or remove trees, for example). Legal control of urban forest carbon may be conveyed, for purposes of satisfying this protocol, through fee ownership, perpetual contractual agreements, deeded encumbrances, or other legal provisions. This protocol recognizes the fee owner as the default owner of urban forest carbon where no explicit legal encumbrance exists. Individuals or entities holding mineral, gas, oil, or similar *de minimis*[4] interests without fee ownership are precluded from the definition of Urban Forest Owner.

Only counties, municipalities, educational institutions, and utilities/special districts, or Urban Forest Owners that own a minimum of 50 acres, referred to as Large Urban Forest Owners, may develop a project independently. Urban Forest Owners are able to combine, or aggregate, forest carbon with other Urban Forest Owners to develop a UFM Project at increased scale. Urban Forest Owners must agree to a single Project Operator (see below) who is designated to manage the requirements of the project. A single Project Operator may aggregate projects across multiple areas that they own, if applicable. Aggregated projects may only include the carbon controlled by permission as described in Section 2.3.

[3] See definition of Carbon Stock in the glossary.
[4] *de minimis* control includes access right of ways and residential power line right of ways.

2.3 Project Operators

A Project Operator must be one of the Urban Forest Owners or a legal entity created to represent the Urban Forest Owners. The Project Operator is responsible for undertaking a project and registering it with the Reserve, and is ultimately responsible for all project listing, monitoring, reporting, and verification. The Project Operator is responsible for any Reversals associated with the project and is the entity that executes the Project Implementation Agreement (see below) with the Reserve.

In all cases where multiple Urban Forest Owners participate in a UFM Project, the Project Operator must secure an agreement from all other Urban Forest Owners that assigns authority to the Project Operator to include the carbon they own in the project. Such an agreement must provide any of the Urban Forest Owners the opportunity to opt out of the project.

2.4 Project Implementation Agreement

A Project Implementation Agreement (PIA) is a required agreement between the Reserve and a Project Operator setting forth the Project Operator's obligation (and the obligation of its successors and assigns) to comply with the terms of the protocol. Project Implementation Agreement forms can be found on the Climate Action Reserve's website.

3 Eligibility Rules

In addition to the definitions and requirements described in Section 2, UFM Projects must meet several other criteria and conditions to be eligible for registration with the Reserve, and must adhere to the following requirements related to their duration and crediting periods.

Section 3.1	Project Location	→	*Urban Areas (including Urban Clusters) and Places (including Incorporated Places and Census-Designated Places) within the U.S.*
Section 3.2	Limits to Site Preparation	→	*Disturbance on more than 2% of the Project Area annually not permitted*
Section 3.3	Project Start Date	→	*No more than six months prior to project submission*
Section 3.4	Additionality	→	*Meet legal requirements*
		→	*Meet performance standard*
Section 3.5	Project Crediting Period	→	*25 years*
Section 3.6	Minimum Time Commitment	→	*100 years*
Section 3.7	Regulatory Compliance	→	*Compliance with all applicable laws*
Section 3.8	Social and Environmental Co-Benefits	→	*Projects are encouraged to report on relevant co-benefits*

3.1 Project Location

Only those activities that occur within the Urban Areas[5] and Places[6] boundaries defined by the most recent publication of the United States Census Bureau,[7] are eligible to develop a project under this protocol. Projects must be entirely within defined Urban Area and/or Place boundaries as of Project Commencement.

3.1.1 Project Area

The Project Area is the geographic extent of the project. The Project Area may be made up of consolidated or disaggregated polygons (i.e., parcels, or portions of parcels) within an Urban Area and/or Place polygon established by the U.S Census Bureau. A map layer combining Urban Areas and Places is available on the Urban Forest Project Protocol webpage to assist with identifying eligible Project Areas. When determining the extent of the Project Area at the Project Start Date (see Section 3.3), the most recent Urban Areas and Places GIS layers must be used. These map layers are available from the U.S. Census Bureau website.[8]

[5] Urban Areas are composed of Urbanized Areas (areas with populations ≥50,000 people) and Urban Clusters (populations ≥2,500 and <50,000).

[6] Places are composed of Incorporated Places and Census-Designated Places, and defined by the U.S. Census Bureau. Generally, an Incorporated Place is an area that is legally incorporated under the laws of its respective state, whereas a Census-Designated Place is a community that lacks a separate government but otherwise resembles incorporated places, with a residential core, relatively high population density, and a degree of local identity.

[7] https://www.census.gov/geo/maps-data/

[8] https://www.census.gov/geo/maps-data/data/tiger-line.html

No part of the Project Area can be included if commercial harvesting of timber has occurred in the Project Area in the past 10 years where the canopy cover was reduced by more than 50% within a contiguous acre, excepting where the harvest occurred for safety or forest health purposes. Additionally, the issuance and transaction of credits will be suspended if commercial harvesting of timber products occurs any time during the project. Where the harvesting of commercial timber products is anticipated, the Project Operator should consider the use of a protocol that addresses the carbon stored in harvested wood products, such as the Reserve's Forest Project Protocol or the California Air Resources Board's Compliance Offset Protocol for U.S. Forest Projects. Exceptions to the prohibition are recognized where commercial timber products might be generated from harvests conducted primarily for safety, salvage of material when trees are in decline, and developing improved resilience to wildfire and pests.

A KML file must be submitted with the project to clearly identify the project boundaries. At a minimum, UFM Projects must be at least 25 acres. A project can be made up of one or many participating Urban Forest Owners. Project acreage shall be based on area calculations derived from GIS analysis, such as ArcGIS or Google Earth. GIS data are generally considered to be improvements over strict adherence to county parcel acreages since GIS data are based on aligning property boundaries to geographic characteristics and/or property corners as described in property deeds or official survey notes.

The project must list the county assessor's parcels (APs), the portion of each AP included in the project (as a percentage), the sum of acres derived from the county tax records for all included APs, and the sum of acres derived from the GIS analysis. The sum of acres should be compared between the AP and GIS sources, with the lesser of the two used for the Project Area. If there is a significant discrepancy between AP and GIS acres, the Project Operator may work with the county assessor to resolve any disputed AP acres. The GIS acreage may be used when greater than the AP acreage if the Project Operator provides evidence (e.g., boundary survey) substantiating the accuracy of the GIS acreage.

3.2 Limits to Site Preparation

UFM Projects that plow, till, or rip soils, resulting in the removal of the roots of herbaceous understory in preparation for planting trees where more than 2% of the Project Area is disturbed on an annual basis are not eligible, since soil-related emissions above baseline levels are not quantified in this protocol. Where such plowing, tilling, or ripping of soils occurs as described within an existing project in any one year, the transacting of credits will be suspended until the subsequent years and soil disturbance rates brings the average below the 2% threshold, after which time the 2% threshold in any given year is renewed.

3.3 Project Start Date

The start date for a project is the date at which the Project Operator initiates an activity that will lead to increased GHG reductions or removals with long-term security relative to the project baseline. The start date is initiated by activities that increase carbon inventories and/or decreases emissions relative to the baseline. Evidence of discrete and verifiable activities that justify a start date includes:

- Submitting the project to the Reserve. The Project Start Date is the date of submittal
- Dated planning documents that indicate the date in which the activities were initiated
- Recordation of a conservation easement

To be eligible, the project must be submitted to the Reserve no more than six months after the Project Start Date.[9] Projects may always be submitted for listing by the Reserve prior to their start date.

3.4 Additionality

The Reserve will only register projects that yield surplus GHG emission reductions and removals that are additional to what would have occurred in the absence of a carbon offset market (i.e., under "Business As Usual"). For a general discussion of the Reserve's approach to determining additionality, see the Reserve's Program Manual.[10]

Projects must satisfy the following tests to be considered additional.

3.4.1 Legal Requirement Test

UFM Projects must achieve GHG reductions or removals above and beyond any GHG reductions or removals that would result from compliance with any federal, state, or local law, statute, rule, regulation, or ordinance. Projects must also achieve GHG reductions and removals above and beyond any GHG reductions or removals that would result from compliance with any court order or other legally binding mandates.

Deeded encumbrances, tree planting and management ordinances, provisions of management plans required by law, and contractual agreements, collectively referred to as Legal Agreements, may effectively control urban forest carbon and convey ownership rights to the carbon inventories controlled, affecting which party may claim ownership to any eligible GHG reductions or removals. Similarly, these same controls may have an effect on urban forest carbon inventories beyond the control of any of the Urban Forest Owners and, as such, must be considered to be legal constraints on the project.

The baseline trend for UFM Projects is based on comparison of historic data as described in the Quantification Guidance and includes the effects of legal requirements. This ensures that any GHG reductions or removals achieved by the project are above and beyond any GHG reductions or removals that would result from engaging in Business-As-Usual activities, thereby satisfying the legal requirement test.

3.4.2 Performance Standard Test

UFM Projects must achieve GHG reductions or removals above and beyond any GHG reductions or removals that would result from engaging in Business-As-Usual activities. UFM Projects automatically satisfy the performance standard by maintaining carbon stocks above the baseline.

3.4.3 Enhancement Payments

Enhancement payments provide financial assistance to landowners in order to implement discrete practices that address natural resource concerns and deliver environmental benefits. Examples of relevant enhancement payments include:

- California Climate Investments (CCI), formerly called Greenhouse Gas Reduction Funds (GGRF)
- USFS grants and agreements

[9] Projects are considered submitted when the project developer has completed and uploaded the appropriate project submittal forms to the Reserve software.
[10] Available at http://www.climateactionreserve.org/how/program/program-manual/.

Urban Forest Owner(s) may pursue enhancement payments that support urban forest management carbon project activities. Because every available enhancement payment is not comprehensively addressed by the protocol at this time, the Urban Forest Owner(s) must still disclose any such payments to the verifier and the Reserve on an ongoing basis. The Reserve maintains the right to determine if payment stacking has occurred and whether it would impact project eligibility.

3.5 Project Crediting Period

The crediting period for a UFM Project is 25 years. Projects may be renewed for additional crediting periods with the prospect of incorporating updated technology into the project analysis. The initial baseline can be maintained for the life of the project. There is no limit to the number of times the crediting period may be renewed. Any previously issued credits must be monitored as described below.

3.6 Minimum Time Commitment

Projects must monitor, report, and undergo verification activities for 100 years following the last credit issued to the project.

3.7 Regulatory Compliance

Each time the UFM Project is verified, the Project Operator must attest that the project is in material compliance with all applicable laws relevant to the Project Activity. For this protocol, instances of non-compliance are likely to be considered "material" if they directly pertain to the management of project carbon stocks. Project Operators are required to disclose in writing to the verifier all instances of material non-compliance of the project with any law. If a verifier finds that a project is in a state of material non-compliance, then CRTs will not be issued for GHG reductions that occurred during the period of non-compliance. Non-compliance solely due to administrative or reporting issues, or due to "acts of nature," will not affect CRT crediting.

3.8 Social and Environmental Co-Benefits

All UFM Projects will provide climate benefits to the extent in which they generate credits. The ability to achieve additional environmental and social co-benefits depends on consideration of additional factors, some of which are described in this section. Only those projects where public and/or tribal entities participate in direct urban tree management activities (e.g., planting, tree distribution, etc.) are required to include the provisions for social and environmental co-benefits. However, these provisions may serve as suggestions to NGOs and other privately funded projects that may wish to enhance social and environmental co-benefits. Where required, the provisions must be described in the Project Design Document (PDD) and implemented throughout the Project Life. The Reserve has developed a PDD template that outlines elements that need to be addressed.[11]

3.8.1 Social Co-Benefits

Projects can create long-term climate benefits as well as providing other social and environmental benefits. Investment in projects has the potential to improve the quality of life for urban communities in a number of ways. Among other benefits, urban forest projects can improve air quality and reduce storm water runoff, provide shade, and increase property values by creating a more aesthetically pleasing environment. Projects also have the potential to create

[11] Available at http://www.climateactionreserve.org/how/protocols/urban-forest/.

negative social externalities, such as an uneven distribution of project benefits due to an uneven distribution of projects sites throughout a community (e.g., skewed toward more affluent communities). Therefore, social co-benefits should be taken into consideration during project design, in order to prevent these negative social externalities.

Table 3.1. Social Co-Benefits of Urban Forest Management Projects

Social Provisions	Elements to Include in the Project Design Document (PDD)
Equitable distribution of forest resources	Describe how the project will make progress toward achieving relatively equal distribution of tree canopy cover by neighborhood whenever possible.
Public participation	Establish guidelines to ensure adequate notification, opportunities for public participation, and documentation with regards to public activities with urban forest management.

3.8.2 Environmental Co-Benefits

The protocol has a goal of permanently removing greenhouse gases from the atmosphere by sustaining carbon benefits generated from urban forests for at least 100 years. Healthy urban forests can also provide environmental benefits as well as create negative externalities. Projects have the potential to improve air quality and reduce storm water runoff and energy usage. However, they can also contribute to reduced biodiversity, introduce invasive species, and damage infrastructure. Inefficient water usage during maintenance can also put pressure on local and regional water supplies. Projects should employ an evaluation of environmental co-benefits, as well as elements to prevent creating negative environmental externalities.

Table 3.2. Environmental Co-Benefits of Urban Forest Management Projects

Environmental Provisions	Elements to Include in the Project Design Document (PDD)
Biodiversity	Describe how UFM Project activities will maintain and enhance biodiversity, including: 1. Benefits of tree species selection and composition to biodiversity within the Project Area. 2. Use of specific tree species, sizes and/or distributions to support unique habitat elements.
Native species	Describe how UFM Project activities will promote the use of native species, including: 1. Strengths and limitations of using native trees in the project. 2. Preferential treatment of native species.
Non-native species	Describe how UFM Project activities will limit and target the use of any non-native species, including: 1. Strengths and limitations of using non-native trees in the project. 2. Resistance to insects and disease.
Climate change resilience	Describe how UFM Project activities will enhance the resilience of the urban forest to climate change, including: 1. Ability of urban forest to adapt to climate change. 2. Resistance to natural disturbances.

Environmental Provisions	Elements to Include in the Project Design Document (PDD)
Air quality	Describe how UFM Project activities will enhance air quality benefits, including: 1. Tree selection and distribution to reduce air pollutants. 2. Tree selection and distribution to reduce emissions of Biogenic Volatile Organic Compounds (BVOCs). 3. Design tree maintenance activities to reduce fossil fuel emissions.
Physical characteristics	Describe how UFM Project activities will enhance physical characteristics of the urban environment, including: 1. Tree shading. 2. Wind protection. 3. Minimize disturbance to city infrastructure (e.g., sidewalks, power lines, etc.).
Water management	Describe how UFM Project activities will improve water management, including: 1. Increase infiltration and recharge of groundwater. 2. Reduce stormwater runoff. 3. Conserve water from urban forest management.

4 GHG Assessment Boundaries

The quantification of all included sources, sinks, and reservoirs (SSR) (Table 4.1 below) are described in the Urban Forest Management Quantification Guidance on the Reserve's website.

Table 4.1. Description of all Sources, Sinks, and Reservoirs

SSR	Source Description	Type	Gas	Included (I) or Excluded (E)	Justification/Explanation
UF-1	Standing live carbon (carbon in all portions of living trees)	Reservoir / Pool	CO_2	Included	Increases in standing live carbon stocks are likely to be a large Primary Effect of UFM Projects.
UF-2	Shrubs and herbaceous understory carbon	Reservoir / Pool	CO_2	Excluded	For crediting purposes shrubs and herbaceous understory are excluded since changes in this reservoir are unlikely to have a significant effect on total quantified GHG reductions or removals. Furthermore, it is generally not practical to undertake measurements of shrubs and herbaceous understory accurate enough for crediting purposes.
UF-3	Standing dead carbon (carbon in all portions of dead, standing trees)	Reservoir / Pool	CO_2	Included	Standing dead wood is expected to be a small portion of UFM Projects, but may be substantial in rare cases.
UF-4	Lying dead wood carbon	Reservoir / Pool	CO_2	Excluded	For crediting purposes lying dead wood carbon is excluded since changes in this reservoir are unlikely to have a significant effect on total quantified GHG reductions or removals. Changes associated with carbon projects are likely to increase lying dead wood. Furthermore, it is generally not practical to undertake measurements of lying dead wood accurate enough for crediting purposes.
UF-5	Litter and duff carbon (carbon in dead plant material)	Reservoir / Pool	CO_2	Excluded	Litter and duff carbon are excluded since changes in this reservoir are unlikely to have a significant effect on total quantified GHG reductions or removals. Furthermore, it is generally not practical to undertake measurements of litter and duff accurate enough for crediting purposes.
UF-6	Soil carbon	Reservoir / Pool	CO_2	Excluded	Soil carbon is not anticipated to change significantly as a result of UFM Projects.

SSR	Source Description	Type	Gas	Included (I) or Excluded (E)	Justification/Explanation
UF-7	Carbon in in-use forest products	Reservoir / Pool	CO_2	Excluded	Urban forests do not produce significant levels of wood products that persist for long enough periods of time to meet permanence requirements and projects will not substantially change wood product production.
UF-8	Forest product carbon in landfills	Reservoir / Pool	CO_2	Excluded	Urban forests do not produce significant levels of wood products and projects will not substantially change wood product production.
UF-9	Nutrient application	Source	N_2O	Excluded	The use of nitrogen-based fertilizers is not expected to be a significant source of emissions.
UF-10	Biological emissions from site preparation activities	Source	CO_2	Excluded	Biological emissions from site preparation are not quantified since projects that involve intensive site preparation activities are not eligible.
UF-11	Mobile combustion emissions from site preparation activities	Source	CO_2	Excluded	Mobile combustion CO_2 emissions from site preparation are not quantified since projects that involve intensive site preparation activities are not eligible.
			CH_4	Excluded	Changes in CH_4 emissions from mobile combustion associated with site preparation activities are not considered significant.
			N_2O	Excluded	Changes in N_2O emissions from mobile combustion associated with site preparation activities are not considered significant.
UF-12	Mobile combustion emissions from ongoing project operation and maintenance	Source	CO_2	Excluded	Mobile combustion CO_2 emissions from ongoing project operation and maintenance are unlikely to be significantly different from baseline levels and are therefore not included in the GHG Assessment Boundary.
			CH_4	Excluded	CH_4 emissions from mobile combustion associated with ongoing project operation and maintenance activities are not considered significant.
			N_2O	Excluded	N_2O emissions from mobile combustion associated with ongoing project operation and maintenance activities are not considered significant.

SSR	Source Description	Type	Gas	Included (I) or Excluded (E)	Justification/Explanation
UF-13	Stationary combustion emissions from ongoing project operation and maintenance	Source	CO_2	Excluded	Stationary combustion CO_2 emissions from ongoing project operation and maintenance could include GHG emissions associated with electricity consumption or heating/cooling at Urban Forest Owner facilities or at facilities owned or controlled by contractors. These emissions are unlikely to be significantly different from baseline levels and are therefore not included in the GHG Assessment Boundary.
			CH_4	Excluded	CH_4 emissions from stationary combustion associated with ongoing project operation and maintenance activities are not considered significant.
			N_2O	Excluded	N_2O emissions from stationary combustion associated with ongoing project operation and maintenance activities are not considered significant.
UF-14	Biological emissions/ removals from changes in urban tree planting and management outside the Project Area	Source	CO_2	Excluded	Emissions due to leakage are unlikely to be significantly different from baseline levels and are considered to be de minimis. Therefore, this SSR is not included in the GHG Assessment Boundary.

5 Quantifying Net GHG Reductions and Removals

This section provides general requirements and guidance for quantifying a UFM Project's net GHG reductions and removals. Detailed methodological approaches to quantifying GHG reductions and removals are provided in the supplemental Quantification Guidance. The Reserve will issue Climate Reserve Tonnes (CRTs) to a project upon confirmation by an accredited and Reserve-approved verification body that the project's GHG reductions and removals have been quantified following the applicable requirements of this section (see Section 8 for verification requirements).

UFM Projects quantify carbon storage based on a relationship between canopy cover and carbon storage. The amount of carbon per acre of canopy cover is referred to as a ratio estimator. Projects may use default ratio estimators published by the Reserve, which have been organized by Assessment Area. Alternatively, projects may choose to sample their forest and generate project-specific ratio estimators. In either case, measuring or estimating project canopy cover is a crucial component of project quantification. This can be done via remote sensing, satellite imagery, and tools like iTree Canopy.[12] An overview of the steps for quantifying urban forest carbon is given below. For more information, refer to the Quantification Guidance document.

1. **Estimating baseline onsite carbon stocks**. The baseline is an estimate of what would have occurred in the absence of a UFM Project. To establish baseline onsite carbon stocks, the Project Operator must apply the appropriate methodology developed according to the guidelines established in the Quantification Guidance. Baseline estimates are developed for a 100-year period. Generally, baselines do not change during the life of the project, absent findings of errors in initial calculation or reconciliation associated with methodological updates.

2. **Determining actual onsite carbon stocks**. Each year, the Project Operator must determine the UFM Project's actual onsite carbon stocks. This must be done by updating the project's canopy estimate for the current year and applying the appropriate ratio estimator, following the guidance in this section and in the Urban Forest Management Quantification Guidance.

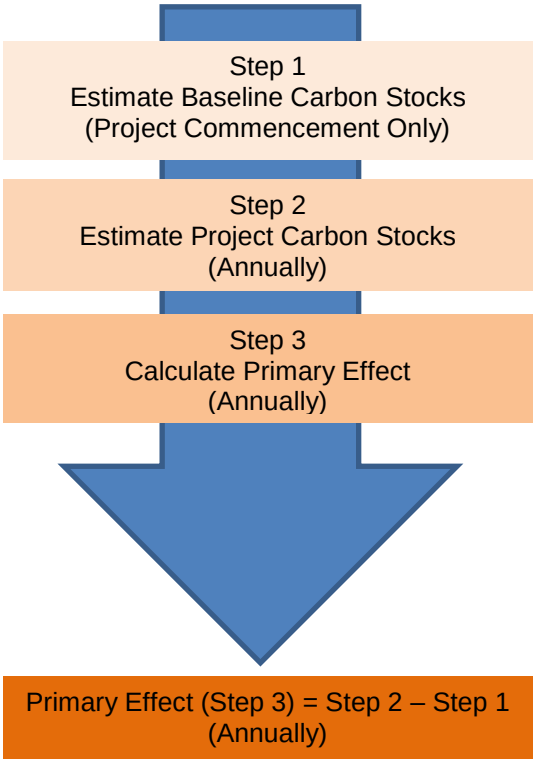
3. **Calculating the project's Primary Effect**. Each year, the Project Operator must quantify the actual change in GHG emissions or removals associated with the project's intended ("primary") effect. For any given year, the Primary Effect is calculated by:
    a. Estimating the change in canopy cover between the current year and prior year.
    b. Extrapolating the change in canopy cover to a change in carbon stocks, using the ratio estimators.
    c. Estimating the difference in baseline carbon stocks between the current year and the prior year.
    d. Subtracting (c) from (b) to establish the change in carbon sequestration between the baseline and project scenarios.

4. **Calculating total net GHG reductions and removals.** For each year, total net GHG reductions and removals are calculated by summing a UFM Project's Primary Effects. If

[12] https://canopy.itreetools.org/

the result is positive, then the project has generated GHG reductions and/or removals in the current year. If the result is negative, this may indicate a Reversal has occurred (see Section 6).[13]

The required formula for quantifying annual net GHG reductions and removals is presented in Equation 5.1. Net GHG reductions and removals must be quantified and reported in units of carbon dioxide-equivalent (CO_2e) metric tons.



Equation 5.1. Annual Net GHG Reductions and Removals

$$\boldsymbol{QR_y = (\Delta AC_{onsite} - \Delta BC_{onsite})}$$

Where, Units

QR_y = Quantified GHG reductions and removals for year y tCO_2e

ΔAC_{onsite} = $(AC_{onsite, y}) - (AC_{onsite, y-1})$ tCO_2e

Where,

$AC_{onsite, y}$ = Actual carbon (CO_2e) as quantified for year y tCO_2e

$AC_{onsite, y-1}$ = Actual carbon (CO_2e) as inventoried for year y-1 tCO_2e

ΔBC_{onsite} = $(BC_{onsite, y}) - (BC_{onsite, y-1})$ tCO_2e

Where,

$BC_{onsite, y}$ = Baseline onsite carbon (CO_2e) as estimated for year y tCO_2e

$BC_{onsite, y-1}$ = Baseline onsite carbon (CO_2e) as estimated for year y-1 tCO_2e

[13] A Reversal occurs only if: (1) total net GHG reductions and removals for the year are negative; and (2) CRTs have previously been issued to the project.

5.1 Urban Forest Management Baseline

To develop a project baseline for a UFM Project, a trend line is developed by calculating a historic estimate of carbon stocks and a recent estimate of carbon stocks. The trend line must pass through at least two historical inventory estimates that are at least 10 years apart and with the earliest point no earlier than 1990. For instance, if a project commences in 2018, the historical estimates may be done using aerial imagery from 2005 and 2015, since the two points pre-date the Project Start Date, are at least 10 years apart from one another, and do not pre-date 1990. Both estimates are developed by first estimating tree canopy area for each date from remotely sensed data and applying the ratio estimators. If historical imagery is not available, more recent images may be used, subject to Reserve approval. The resulting trend is extended 25 years into the future beginning from the Project Start Date, provided legal constraints have not changed substantially (other than changes associated with this protocol) during the 25-year period. The stocking amount is then held steady for the balance of the 100-year projection (75 years following the 25-year trend). A description of how legal constraints affect baseline considerations and technical issues associated with the baseline are described in the Quantification Guidance.

If there are unanticipated changes to legal constraints within the initial 25-year crediting period that will affect carbon stocks in the Project Area, projects are required to disclose the changes. Projects may be eligible to continue for the remaining 25-year crediting period but may not be eligible to renew the crediting period unless the project modifies its baseline to reflect the changes in legal constraints. A review of legal constraints will be performed during each verification, and determination of significance is ultimately subject to the discretion of the Reserve.

6 Ensuring the Permanence of Credited GHG Reductions and Removals

Changes in urban forest management have the potential to enhance the rate of CO_2 absorption, providing removals, and reducing or eliminating emissions associated with the loss of trees (reductions). Reductions may be possible with some UFM Projects. The Reserve requires that credited GHG reductions and removals be effectively "permanent." For UFM Projects, this requirement is met by ensuring that the carbon associated with credited GHG reductions and removals remains stored for at least 100 years.

The Reserve ensures the permanence of GHG reductions and removals through three mechanisms:

1. The requirement for all Project Operators to monitor onsite carbon stocks, submit regular monitoring reports, and submit to regular third-party verification of those reports along with periodic full verifications for the duration of the Project Life.
2. The requirement for all Project Operators to sign a Project Implementation Agreement with the Reserve which obligates Project Operators to retire CRTs to compensate for Reversals of GHG reductions and removals.
3. The maintenance of a Buffer Pool to provide insurance against Reversals of GHG reductions and removals due to unavoidable natural disturbances.

GHG reductions and removals can be "reversed" if the stored carbon associated with them is released (back) to the atmosphere. Many biological and non-biological agents, both natural and human-induced, can cause Reversals. Some of these agents cannot completely be controlled (and are therefore "unavoidable"), such as natural agents like fire, insects, pathogens, drought, and wind. Other agents can be controlled, such as human activities like land conversion. Under this protocol, Reversals due to controllable agents are considered "avoidable". If the quantified GHG reductions and removals in a given year are negative, and CRTs were issued to the UFM Project in any previous year, the Reserve will consider this to be a Reversal regardless of the cause of the decrease.

The Buffer Pool is a holding account for project CRTs, which is administered by the Reserve. All UFM Projects must contribute a percentage of CRTs to a Buffer Pool any time they are issued CRTs for verified GHG reductions and removals. A project that has an Unavoidable Reversal will use Buffer Pool CRTs proportionally from all projects that have contributed to the pool to compensate for the Reversal. Project Operators do not receive payment for their contributions to the Buffer Pool.

If a project experiences an Unavoidable Reversal of GHG reductions and removals (as defined in Section 6.2.2), the Reserve will retire a number of CRTs from the Buffer Pool equal to the total amount of carbon that was reversed (measured in metric tons of CO_2). The Buffer Pool therefore acts as a general insurance mechanism against Unavoidable Reversals for all projects registered with the Reserve.

6.1 Contributions to the Buffer Pool

Projects may be affected by financial risks, management risks, social risks, risks from pollution, and risks from natural disturbances (disease/insects, wildfire, flooding, drought etc.). To compensate for these risks, each project must contribute 6% of their issued CRTs to the Buffer

Pool. The Reserve may determine to re-distribute CRTs to Project Operators in the future, or modify the amount of contributions to the Buffer Pool, if actual Unavoidable Reversals deviate significantly from the current evaluation of risks.

6.2 Compensating for Reversals

The Reserve requires that all Reversals be compensated through the retirement of CRTs. If a Reversal associated with a UFM Project was unavoidable (as defined below), then the Reserve will compensate for the Reversal on the Project Operator's behalf by retiring CRTs from the Buffer Pool. If a Reversal was avoidable (as defined below) then the Project Operator must compensate for the Reversal by surrendering CRTs from its Reserve account, or surrender CRTs from another land use project registered with the Reserve in the event that the Project Operator does not have sufficient CRTs to cover the Reversal.

6.2.1 Avoidable Reversals

An Avoidable Reversal is any Reversal that is due to the Project Operator's negligence, gross negligence, or willful intent, including harvesting, development, and harm to the Project Area due to the Project Operator's negligence, gross-negligence or willful intent. Requirements for Avoidable Reversals are as follows:

1. If an Avoidable Reversal has been identified during annual monitoring, the Project Operator must give written notice to the Reserve within thirty days of identifying the Reversal. Additionally, if the Reserve determines that an Avoidable Reversal has occurred, it shall deliver written notice to the Project Operator.
2. Within thirty days of receiving the Avoidable Reversal notice from the Reserve, the Project Operator must provide a written description and explanation of the Reversal to the Reserve.
3. Within four months of receiving the Avoidable Reversal notice, the Project Operator must retire a quantity of CRTs from its Reserve account equal to the size of the Reversal in CO_2-equivalent metric tons (i.e., QR_y, as specified in Equation 5.1). In addition:
    a. The retired CRTs must be those that were issued to the project, or that were issued to other UFM Projects registered with the Reserve. If no other UFM CRTs are available, the Reserve will approve another appropriate source of credits, with a preference for land use projects.
    b. The retired CRTs must be designated in the Reserve's software system as compensating for the Avoidable Reversal.
4. Within one Reporting Period of receiving the Avoidable Reversal notice, the Project Operator must provide the Reserve with a verified estimate of current onsite carbon stocks and the estimated quantity of the Avoidable Reversal.

6.2.2 Unavoidable Reversals

An Unavoidable Reversal is any Reversal not due to the Project Operator's negligence, gross negligence or willful intent, including, but not limited to, the examples provided in Section 6 above. Requirements for Unavoidable Reversals are as follows:

1. If the Project Operator determines there has been an Unavoidable Reversal, it must notify the Reserve in writing of the Unavoidable Reversal within six months of its occurrence.
2. The Project Operator must explain the nature of the Unavoidable Reversal and provide a verified estimate of onsite carbon stocks within two Reporting Periods so that the Reversal can be quantified (in units of CO_2-equivalent metric tons).

If the Reserve determines that there has been an Unavoidable Reversal, it will retire a quantity of CRTs from the Buffer Pool equal to the size of the Reversal in CO_2-equivalent metric tons.

6.3 Disposition of Projects after a Reversal

If a Reversal lowers the UFM Project's carbon stocks below its approved baseline carbon stocks, the project will be terminated as the original baseline approved for the project would no longer be valid. If a project is terminated due to an Unavoidable Reversal, a new project may be initiated and submitted to the Reserve for registration on the same Project Area. New projects may not be initiated on the same Project Area if the project is terminated due to an Avoidable Reversal.

7 Project Monitoring, Reporting, and Verification

This section provides requirements and guidance on project monitoring, reporting rules, and procedures.

7.1 Project Documentation

Project Operators must provide the following documentation to the Reserve in order to register a UFM Project.

Table 7.1. Project Documentation Submittal Requirements

Document	When Submitted/Required
Project Submittal Form	Once, at project initiation when the Project Operator wishes to submit project concept to Reserve. Must be submitted within 6 months of the Project Start Date.
Project Design Document	Once, prior to initial verification.
Signed Attestation of Title Form	Prior to issuance of credits. Required at initial verification, full verification, and every optional desktop verification.
Signed Attestation of Regulatory Compliance Form	Prior to issuance of credits. Required at initial verification, full verification, and every optional desktop verification.
Signed Attestation of Voluntary Implementation Form	Once, prior to the issuance of credits as part of the initial verification.
Verification Report	Upon completion of verification and prior to issuance of credits. Required at initial verification, full verification, and every optional desktop verification.
Verification Statement	Upon completion of verification and prior to issuance of credits. Required at initial verification, full verification, and every optional desktop verification.
Project Implementation Agreement (PIA) and PIA Amendments	Upon completion of verification and prior to issuance of credits. Required at initial verification, full verification, and every optional desktop verification.

Project submittal forms can be found at http://www.climateactionreserve.org/how/program/documents/.

Projects using default ratio estimators need not enlist a Professional Forester, Certified Arborist, or Certified Forester for developing project reports. For projects that develop their own ratio estimators per the Quantification Guidance, all reports that reference carbon stocks must be submitted with the oversight of a Certified Arborist, a Certified Forester, or Professional Forester so that professional standards and project quality are maintained. Any Certified Arborist, a Certified Urban Forester, Professional Forester or Certified Forester preparing a project in an unfamiliar jurisdiction must consult with a Certified Arborist, a Certified Urban Forester, Professional Forester or Certified Forester practicing forestry in that jurisdiction to understand all laws and regulations that govern urban forest practices within the jurisdiction. This requirement does not preclude the project's use of technicians or other unlicensed/uncertified persons working under the supervision of the Professional Forester, Certified Arborist, or Certified Forester.

All projects shall submit a shapefile as a KML that matches the maps submitted to depict the Project Area. The project's reported acres shall be based on the shapefile submitted to the Reserve.

7.1.1 Urban Forest Project Design Document

The Project Design Document (PDD) is a required document for reporting information about a project. The document is submitted at the initial verification. PDDs are intended to serve as the main project document that thoroughly describes how the project meets eligibility requirements, discusses summaries associated with developing data according to quantification requirements, outlines how the project complies with terms for additionality and describes how project Reversal risks are calculated. All methodologies used by Project Operators and descriptions in the PDD must be clear in a way that facilitates review by verifiers, Reserve staff, and the public. PDDs must be of professional quality and free of incorrect citations, missing pages, incorrect project references, etc. A PDD template has been prepared by the Reserve and is available on the Reserve's website.[14] The template is arranged to assist in ensuring that all requirements of the UFMPP are addressed. Use of the Reserve's template is optional, but strongly recommended for ease of verification.

7.2 Monitoring Report

Monitoring is the process of regularly collecting and reporting data related to a project's performance. Annual monitoring of UFM Projects is required to ensure up-to-date estimates of project carbon stocks and provide assurance that GHG reductions or removals achieved by a project have not been reversed. Project Operators must conduct monitoring activities and submit monitoring reports according to the schedule and requirements presented in Section 7.2. Monitoring is required for a period of 100 years following the final issuance of CRTs to a project for quantified GHG reductions or removals.

Monitoring activities consist primarily of updating a project's canopy cover estimates, forest carbon stock estimates, calculating emission reductions for the Reporting Period, and submitting the information in annual monitoring reports to the Reserve at frequencies defined in Section 7.3. CRTs are only issued in years that the project data are verified, as described in Section 7.4.

A monitoring report must be prepared for each Reporting Period. Monitoring reports must be provided to verification bodies whenever a project undergoes verification. The monitoring report must be completed and submitted to the Reserve within 12 months of the end of the Reporting Period. When required verifications must be conducted as explained below, both the verification report and the monitoring report must be completed and submitted to the Reserve within 12 months of the end of the Reporting Period. Monitoring reports must include an update of the project's calculations. The project's calculations must include the following:

1. An updated Project Inventory reflecting estimate of the current year's carbon stocks quantified for the project's Primary Effect. Acceptable methodologies for updating the project's inventory are provided in the Quantification Guidance. The update is determined by:
    a. Including any new forest field inventory data obtained during the Reporting Period (if applicable).
    b. Applying ratio estimators to updated canopy cover estimates.

[14] http://www.climateactionreserve.org/how/protocols/urban-forest/.

   c. Updating estimates for removals and/or disturbances that have occurred during the Reporting Period.
2. The baseline carbon stock estimates for the current Reporting Period, as determined following the requirements in Section 5 and approved at the time of the project's registration.
3. A preliminary calculation of total net GHG reductions and removals (or Reversals) for the Reporting Period, following the requirements in Section 5.
4. A preliminary calculation of the project's Buffer Pool contribution.
5. If a Reversal has occurred during the previous Reporting Period, the report must provide a written description and explanation of the Reversal, whether the Reserve classified the Reversal as Avoidable or Unavoidable, and the status of compensation for the Reversal.

7.3 Reporting and Verification Cycles

This section describes the required reporting and verification cycles. A UFM Project is considered automatically terminated as the result of an Avoidable Reversal (see Section 6.3) if the Project Operator chooses not to report data and undergo verification at required intervals.

7.3.1 Reporting Period Duration and Cycles

Projects must report their initial carbon stock data associated with the Project Start Date. Project Operators must report their project stocks annually with the exception of the Reporting Period immediately following the Project Start Date, which can be any length of time up to one year following the Project Start Date. This enables Project Operators to establish an annual reporting cycle that is convenient for the entity.

Reporting Periods must be contiguous, i.e., there must be no gaps in reporting during the crediting period of a project once the first Reporting Period has commenced.

7.3.2 Verification Cycles

A project must be initially verified within 12 months of the end of its initial Reporting Period which begins based on the Project Start Date. The initial verification must confirm the project's eligibility and confirm that the project's initial carbon stocks and baseline have been established in conformance with the UFMPP. Subsequent verifications may include multiple Reporting Periods, (in which case, the time period covered by the multiple Reporting Periods is referred to as the "Verification Period"). The end date of any Verification Period must correspond to the end date of a Reporting Period.

Verification has both required frequencies and optional frequencies. Required verification is established on a temporal framework to ensure that ongoing monitoring of urban forest carbon stocks are accurate and up-to-date. Optional verification is at the Project Operator's discretion and may be conducted in the years in which verification is not required and the Project Operator wishes to receive credits. Required verifications are referred to as full verifications. Optional verifications are referred to as desk review verifications. Details of verification scheduling requirements are provided within this section.

Verification must be completed within 12 months of the end of the Reporting Period(s) being verified. For required verifications, failure to complete verification within the 12-month time period will result in account activities being suspended until the verification is complete. The project will terminate if the required verification is not completed within 36 months of the end of the Reporting Period(s) being verified. There is no consequence for failure to complete verification activities within 12 months for optional verifications.

7.3.3 Full Verification Requirements

A full verification is a verification in which Project Inventory data are verified through a process that audits data in the office. Site visits are not required if the Reserve's default ratio estimators are used for inventory calculations, but the other components of a full verification must still take place. Projects developing their own ratio estimators must include a site visit as part of the full verification. The Reserve requires that an approved third-party verification body verify all reported data and information for a project and conduct a site visit for projects developing their own ratio estimators. Verification Periods shall comprise no more than five Reporting Periods, excepting the first Reporting Period, which must undergo a full verification.

7.3.4 Optional Desk Review Verification

In between required full verifications, the Project Operator may choose to have an approved third-party verification body conduct a desk review of annual monitoring reports as an optional verification. CRTs may be issued for GHG reductions/removals verified through such desk reviews. The desk review verifications are based on the reported data being within acceptable parameters. If the project has implemented significant changes to the quantification methodology since the last verification, the verification team must perform a full verification. Significant changes to the quantification methodology include, but are not limited to, changes to the ratio estimator value, changes to the Project Area, or a change to the technology used to assess canopy cover. The Reserve will determine whether a change to the quantification methodology rises to this level.

Submission of annual monitoring reports to the Reserve is required even if the Project Operator chooses to forego desk review verification.

7.4 Issuance and Vintage of CRTs

The Reserve will issue Climate Reserve Tonnes (CRTs) for quantified GHG reductions and removals that have been verified through either full verifications or desk reviews. Full verification may determine that earlier desk reviews overestimated full carbon stocks. Any resulting downward adjustment to carbon stock estimates will be treated as a Reversal (see Section 6). In this case, the Project Operator must retire CRTs in accordance with the requirements for compensating for a Reversal (Section 6.2). Vintages are assigned to CRTs based on the proportion of days in a calendar year within a Reporting Period.

7.5 Record Keeping

For purposes of independent verification and historical documentation, Project Operators are required to keep all documents and forms related to the project for a minimum of 100 years after the final issuance of CRTs from the Reserve. This information may be requested by the verification body or the Reserve at any time.

7.6 Transparency

The Reserve requires data transparency for all projects, including data that displays current carbon stocks, Reversals, and verified GHG reductions and removals. For this reason, all non-confidential project data reported to the Reserve will be publicly available on the Reserve's website.

8 Verification Guidance

This section provides guidance to Reserve-approved verification bodies for verifying GHG emission reductions associated with urban forest projects.

This section supplements the Reserve's Verification Program Manual,[15] which provides verification bodies with the general requirements for a standardized approach for independent and rigorous verification of GHG emission reductions and removals. The Verification Program Manual outlines the verification process, requirements for conducting verification, conflict of interest and confidentiality provisions, core verification activities, content of the verification report, and dispute resolution processes. In addition, the Verification Program Manual explains the basic verification principles of ISO 14064-3:2006 which must be adhered to by the verification body.

Verification bodies must read and be familiar with the following International Organization for Standardization (ISO) and Reserve documents and reporting tools:

- Urban Forest Management Project Protocol
- Urban Forest Management Quantification Guidance
- Reserve Program Manual
- Reserve Verification Program Manual
- Reserve software
- ISO 14064-3:2006 Principles and Requirements for Verifying GHG Inventories and Projects

Only Reserve-approved urban forest project verification bodies are eligible to verify UFM Project reports. To become a recognized urban forest project verifier, verification bodies must become accredited under ISO 14065. Information on the accreditation process can be found on the Reserve website at http://www.climateactionreserve.org/how/verification/how-to-become-a-verifier/.

8.1 Standard of Verification

The Reserve's standard of verification for UFM Projects is the Urban Forest Management Project Protocol (this document), Quantification Guidance, the Reserve Program Manual, and the Reserve Verification Program Manual. To verify a Project Operator's initial Project Design Document and annual monitoring reports, verification bodies apply the verification guidance in the Reserve's Verification Program Manual and this section of the UFMPP to the requirements and guidance described in Sections 2 through 7 of the UFMPP.

This section of the protocol provides requirements and guidance for the verification of UFM Projects. This section describes the core verification activities and criteria that must be undertaken and addressed by a verification body in order to provide a reasonable level of assurance that the GHG removals or reductions quantified and reported by Project Operators are materially correct.

Verification bodies will use the criteria in this section to determine if there exists a reasonable assurance that the data submitted on behalf of the Project Operator to the Reserve addresses

[15] Found on the Reserve website at http://www.climateactionreserve.org/how/program/program-manual/.

each requirement in the UFMPP, Sections 2 through 7. Project reporting is deemed accurate and correct if the Project Operator is in compliance with Sections 2 through 7.

Further information about the Reserve's principles of verification, levels of assurance, and materiality thresholds can be found in the Reserve's Verification Program Manual at http://www.climateactionreserve.org/how/program/program-manual/.

8.2 Project Verification Activities

Required verification activities for UFM Projects vary depending on whether the verification body is conducting an initial verification for registration on the Reserve, full verification, or an optional annual verification involving a desk review. The following sections contain guidance for all of these verification activities.

8.2.1 Initial Verification

Verifiers must ensure that the project has met the UFMPP criteria and requirements for eligibility, Project Area definition, additionality, quantification, and calculation of baseline. The verification body must assess and ensure the completeness and accuracy of all required reporting elements submitted in the Project Design Document.

8.2.2 Full Verification

Full verification involves review of the project's eligibility, quantification, relevant attestations, soil carbon emissions associated with management activities, adherence to environmental and social safeguards (if applicable), and buffer pool contribution. Site visits are not required for full verifications of projects that are using default ratio estimator values, as described in the Quantification Guidance.

8.2.3 Optional Desk Review Verification

Full verification is required every five Reporting Periods, at a minimum. Optional desk verifications can occur for interim Reporting Periods according to preferences of the Project Operator. Credits can be verified and registered as the result of an optional desk verification. The main focus of optional desk verifications is to assure that annual monitoring reports are complete, and that project quantification was performed correctly, as described in the Quantification Guidance. If the project has implemented significant changes to the quantification methodology since the last verification, the verification team must perform a full verification. See Section 7.3.4.

Table 8.1 displays the protocol sections that are verified at the initial verification, the full verification, and/or the optional annual verification.

Table 8.1. Verification Items and Related Schedules

Verification Items	Section of UFMPP	Initial	Full	Optional	Apply Professional Judgment[16]?
1. Project Definition	2.1 Urban Forest Management	X			No
2. Urban Forest Owner	2.2 Urban Forest Owners	X	X		No
3. Project Operator	2.3 Project Operators	X	X		No
4. Project Implementation Agreement	2.4 Project Implementation Agreement	X	X	X	No
5. Project Location	3.1 Project Location	X			No
6. Project Area	3.1.1 Project Area	X			No
7. Limits to Site Preparation	3.2 Limits to Site Preparation	X	X		Yes
8. Project Commencement	3.3 Project Commencement	X			Yes
9. Additionality	3.4.1 Legal Requirement Test 3.4.2 Performance Test	X	X		Yes
	3.4.3 Enhancement Payments	X			
10.Project Crediting Period	3.5 Project Crediting Period	X	X		No
11.Minimum Time Commitment	3.6 Minimum Time Commitment	X	X		No
12. Social and Environmental Co-Benefits	3.7 Social and Environmental Co-Benefits	X	X		Yes, for public or tribal entities only
13. Social Co-Benefits	3.8.1 Social Co-Benefits	X	X		Yes, for public or tribal entities only
14. Environmental Co-Benefits	3.8.2 Environmental Co-Benefits	X	X		Yes, for public or tribal entities only
15. GHG Assessment Boundaries	4 GHG Assessment Boundaries	X	X		No
The verification topics below are linked to quantification requirements. The verification of project inventories is described in detail below this table. Verifiers shall assure that requirements associated with the references in this table have been satisfied and implement the specific guidance requirements for verifying inventories below.					
16. Quantifying Net GHG Reductions and Removals	5 Quantifying Net GHG Reductions and Removals Urban Forest Management Quantification Guidance	X	X	X	No
17. Urban Forest Protocol Baselines	5.1 Urban Forest Management Baseline Urban Forest Management Quantification Guidance	X			No
18. Permanence and Buffer Pool Contributions	6.1 Contributions to the Buffer Pool	X	X	X	No
19. Permanence and Compensating for Reversals	6.2 Compensating for Reversals 6.2.1 Avoidable Reversals 6.2.2 Unavoidable Reversals	X	X	X	No

Table 8.1 comprises the full list of verification items required to be part of verification activities. To assist with performing verifications, the Reserve provides Verification Elements tables below (Tables 8.2, 8.3, 8.4) that include additional details on verification standards and periodicity.

[16] Verifiers must use professional judgment to verify protocol criteria which are not quantitative or can be measured completely with objective analysis.

Table 8.2. Verification Guidance

Verification Element	Description	Verification Frequency
I	All items in Table 8.1 have been reviewed and deemed satisfactory by the verifier, both in terms of clear presentation and aligned with the protocol requirements.	Initial full verification only. For projects using project-specific ratio estimators, full site verification is required during the initial verification.
II	Review project Assessment Area(s) or stratum. Verifier shall inspect the project map and determine if the entire Project Area is assigned using the correct Assessment Area(s), or are employing the appropriate methodology per the Quantification Guidance for stratification (if stratifying) for projects developing project-specific ratio estimators. Determination of the appropriateness of the Assessment Area used or stratification will occur during review of evidence provided by the Project Operator (such as aerial imagery) or through a site visit, if applicable.	Initial full verification. For projects using project-specific ratio estimators, full site verification is required during the initial verification, and each time the project opts to update its field-based inventory and ratio estimator(s).
III	Confirm Project Area boundaries are within eligible Project Areas, including evaluation of the accuracy and conservativeness of the project acreage. Determination will occur during review of evidence provided by the Project Operator (such as aerial imagery) or through a site visit, if applicable. A comparison between the acreage of the Project Area identified by AP and GIS sources has been made and the lesser of the two has been used for the final Project Area. However, if the Project Operator opts to use GIS acres, an evaluation of the accuracy of GIS acres must be performed based on a review of supporting documentation (e.g., boundary survey) and ground-truthing activities and will require a site visit.	Initial full verification. For projects using project-specific ratio estimators, full site verification is required during the initial verification, and each time the project opts to update its field-based inventory and ratio estimator(s).
IV	Confirm all aspects of the Quantification Guidance have been implemented correctly.	Each verification.
V	Confirm that the calculation or identification of ratio estimators, expansion to Assessment Area(s) or stratum (for projects developing their own ratio estimators), and expansion to overall Project Area, for historical estimates and current estimates, were implemented correctly.	Each verification.
VI	Confirm that confidence statistics for canopy cover were correctly calculated and meet minimum requirements per the Quantification Guidance.	Each verification.

8.3 Verifying Urban Forest Management Carbon Estimates

The method of verification of carbon estimates varies depending on whether the verification is part of the initial verification, full verification, or an optional desk review verification. The verification elements and their periodicity are explained in this section.

Table 8.3. Verification Guidance for Quantification

Verification Element	Description	Verification Frequency
I (Legal Constraints in the Baseline)	Assess applicable legal constraints that may affect carbon stocks in the Project Area. Confirm that such legal constraints are appropriately modeled into the baseline, per the Quantification Guidance.	Initial full verification.
II (Legal Constraints Review)	Confirm whether there are new, unanticipated legal constraints that may affect carbon stocks in the Project Area.	Each verification.
III (Historical Tree Canopy Area)	Confirming that the methodology for quantifying the historical tree canopy area specified in the Quantification Guidance was implemented correctly as stated in the quantification guidance, as part of the initial full verification. The verifier must independently calculate the canopy area for each applicable Assessment Area (or stratum) using a randomized selection of points used by the Project Operator. The points must be overlaid on the remote sensing image the Project Operator used to generate their estimate/measurement of canopy area. The verifier shall determine if each point 'hits' or 'misses' a tree crown. The verifier shall sample enough points (or plots for projects developing their own ratio estimators) to arrive at a determination of canopy area with +/- 5% at 1 Standard Error for each Assessment Area. The percentage canopy area determined by the verifier must be within 10% of the estimate provided by the Project Operator. The verifier may repeat their effort if the Project Operator is not in conformance with the verifier. Failure to find conformance after three efforts results in failure of the ability to verify the reported canopy area. The Project Operator must resample/re-measure the canopy area and prior to renewing verification activities. The i-Tree Canopy tool may be used to perform the analysis. The Reserve recommends the verifier replicate the approach used by the Project Operator, but verifiers should use professional judgement to determine whether the approach is sound.	Initial full verification.
IV (Current Tree Canopy Area)	Confirming that the methodology for quantifying current tree canopy area specified in the Quantification Guidance was implemented correctly as stated in the quantification guidance. The verifier must independently calculate the canopy area for each Assessment Area if the project spans multiple Assessment Areas, or the Project Area using a randomized or systematic	Each verification.

Verification Element	Description	Verification Frequency
	application of points used by the Project Operator. The points must be overlaid on the remote sensing image the Project Operator used to generate their estimate/measurement of canopy area. The verifier shall determine if each point 'hits' or 'misses' a tree crown. The verifier shall sample enough plots to arrive at a determination of canopy area with +/- 10% at 90% confidence interval. The percentage canopy area determined by the verifier must be within 10% of the estimate provided by the Project Operator. The verifier may repeat their effort if the Project Operator is not in conformance with the verifier. Failure to find conformance after three efforts results in failure of the ability to verify the reported canopy area. The Project Operator must resample/re-measure the canopy area and prior to renewing verification activities. The i-Tree Canopy tool may be used to perform the analysis.	
V (Carbon Estimates for Ratio Estimators)	Confirming that the methodology and requirements for quantifying carbon estimates specified in the Quantification Guidance were implemented correctly.	Each verification.
VI (Ratio Estimators and Summary Calculations)	Confirming that ratio estimators are correctly calculated (or selected, if default ratio estimators are used) and expansions to the Project Area are performed correctly.	Initial full verification.
VII (Updated Project Data)	Confirming that updated emission reduction estimates are accurate, and the project is continuing to use the same ratio estimator as previous verifications.	Each verification following the initial full verification.

8.3.1 Field-Based Inventory Verification Activities

This section applies only to projects that choose to calculate and use their own ratio estimators. For these projects, verification bodies are required to conduct a site visit and verify carbon stock inventory calculations of all sampled and/or measured carbon pools within the Project Area. Inventories of carbon stocks may be used to determine the project baseline and to quantify GHG reductions and removals against the project baseline over time. In these cases, the verification activities must include re-measurement of a randomly selected subset of project data used to calculate the inventory estimate for the project. The data sampled by verifiers are the tree canopy measurements and the ground-based plot measurements. The verification approach for all metrics derived from measured and/or sampled data is based on a randomly selected comparison of verifier data to Project Operator data in a process referred to as sequential sampling.

Verification using the sequential sampling methodology requires the verification body to sequentially sample successive plots. Sequential approaches have stopping rules rather than

fixed sample sizes. Verification is successful after a minimum number of successive plots in a sequence indicate agreement according to the tolerance thresholds established in the sequential sampling workbook provided by the Reserve. The evaluation of the three themes that utilize sequential sampling (CO_2e estimates from plots, current tree canopy area, and historical tree canopy area) shall utilize separate worksheets and include a copy of the results within the verification report.

Where sequential data calculated from the verifier result in a trend of agreement with the Project Operator, verification can proceed toward a finding of accuracy. The minimum number of plots measured by the verifier and the tolerance bounds are established by the Reserve and described in the Quantification Guidance. Where a high level of agreement is found between the Project Operator and the verifier, a finding of acceptable accuracy may be established with the minimal number of plots required by the Reserve. As divergence between verifier estimates and Project Operators increases, the number of plots measured by the verifier must increase in order to work toward establishing a finding of acceptable accuracy. In cases where continued verifier effort does not result in convergence, the Project Operator must decide whether continued investment in verification effort is justified. Alternatively, verification can be suspended while the Project Operator improves the quality of the inventory and revises related project documentation. Verification of measured and/or sampled data must be reinitiated following any modifications to measured and/or sampled data during verification activities.

The sequential sampling workbook provided by the Reserve includes the established stopping rules. Where agreement between the verifier estimates and the Project Operator estimates is within specified tolerance bounds, verification of plot data is successful. Sequential sampling is described in greater detail in the next section.

For the verification of canopy area used to generate ratio estimators, CO_2e estimates from ground-based plots and stratification of urban forest classes, the verifier must randomly select an initial set of 40 ground-based sample plots from the full set of plots measured by the Project Operator, maintaining the order of their selection in sequential order (1 – 40). The verifier must develop an initial strategy to efficiently visit (both in the office and in the field) the first 20 plots (1 – 20) in the list. The plots do not need to be visited and measured sequentially, but they all need to be visited prior to entering the data in the sequential sampling works. The entries of plot summaries into the sequential sampling workbook provided by the Reserve must be in the same order the plots were randomly selected.

The verifier shall visit the same plots in the field to continue verification for the following elements in Table 8.4.

Table 8.4. Verification Guidance for Field Inventories

Verification Element	Description	Verification Frequency
I	If a project has chosen to implement stratification within the Project Area, the verification of accurate stratification must occur simultaneously with the verification of ground-based plots (described below) for carbon estimates. The verifier must determine if the stratum identified for each plot is appropriate or not based on characteristics present during the field visit using professional judgment with the consideration for minimum mapping units described in the Quantification Guidance. The project must achieve a 90% approval rating from the set of the 20 selected plots. **Consequences of failing to meet the accuracy requirements for stratification:** In the event that adequate accuracy cannot be confirmed from the first 20 plots, the verifier must visit and evaluate the second set of 20 randomly selected plots as above. The 90% approval rating must be achieved by the full set of 40 visited plots. If the project does not succeed following evaluation of 40 plots, the Project Operator must refine their stratification and update the plot association with urban forest classes before continuing with verification activities.	Initial full verification. For projects using project-specific ratio estimators, full site verification is required each time the project opts to update its field-based inventory and ratio estimator(s).
II	Ensuring that the CO_2e estimates from individual plots are accurate. The verifier must independently calculate per-acre estimates of CO_2e for each of the 20 plots randomly selected by the verifier, utilizing the sampling methodology described in the Quantification Guidance. The verifier shall measure the trees on each plot, calculating the CO_2e values represented by the trees using the appropriate biomass equations (provided on the Reserve's website), conversion and expansion factors (provided in the Quantification Guidance). The results from the verifier's calculations shall be compared with the Project Operator's estimates for the same 20 plots using the sequential sampling worksheet provided by the Reserve. Measurement standards for verifiers include: a. Measuring every diameter (DBH) to the nearest inch. b. Measuring every height (total height) to the nearest foot. Measuring every tree that is 'borderline' to determine if the tree is either in the plot or out of the plot.	Initial full verification. For projects using project-specific ratio estimators, full site verification is required each time the project opts to update its field-based inventory and ratio estimator(s).

Where the Project Operator and verifier are not in agreement after the verifier data from the 20 initial verification plots has been inputted into the sequential sampling worksheets for each of the themes, additional sets of 20 plots (in 20 plot lots as described for the initial set) may be randomly selected to add to the total set of verification plots. The decision to add additional plots to the total set of verification plots is primarily the Project Operators, based on an assumption

that random chance caused the initial test to fail and convergence towards agreement would occur with additional verification effort.

The results of any additional verification plot may also be inconclusive and require additional verification plots for a determination to be made. For effective application of the sequential sampling statistics in the field, the determination of when the stopping rule is met is done at the end of the measurement of a batch of plots (20 plots) in the field.

Worksheets are provided on the Reserve's website[17] for use by verifiers to assist in verifying sampled data. The Reserve has established a ten percent allowance as an acceptable level of agreement between the verifier and the Project Operator.

8.4 Completing the Verification Process

After completing the core verification activities for a project, the verification body must do the following to complete the verification process:

1. Complete a detailed List of Findings containing both immaterial and material findings (if any) and deliver it to the Project Operator (private document).
2. Exchange correspondence as necessary to resolve issues detailed in the List of Findings, until all material misstatements and nonconformances have been addressed.
3. If a reasonable level of assurance opinion is successfully obtained, complete a Verification Report to be delivered to the Project Operator (public document).
4. Complete the Verification Statement form, detailing the vintage and the number of GHG reductions and removals verified and deliver it to the Project Operator (public document).
5. Verify that the number of GHG reductions and removals, as well as the reversal risk rating, specified in the Verification Report and Statement match the number entered into the Reserve software.
6. Conduct an exit meeting with the Project Operator to discuss the Verification Report, List of Findings, and Verification Statement.
7. Upload electronic copies of the Verification Report, List of Findings, Verification Statement, and Verification Activity Log into the Reserve.

The recommended content for the verification report, list of findings, and verification statement can be found in the Reserve's Verification Program Manual.[18] The Verification Program Manual also provides further guidance on quality assurance, negative verification statements, use of an optional project verification activity log, goals for exit meetings, dispute resolution, and record keeping.

[17] Available at http://www.climateactionreserve.org/how/protocols/urban-forest/.
[18] Available at http://www.climateactionreserve.org/how/program/program-manual/.

9 Glossary of Terms

Additionality	GHG emission reductions should occur as a result of specific GHG mitigation incentives; additionality is achieved when GHG reductions are beyond what would occur under business as usual operation and result from activities that are not mandated by regulation.
Assessment Area	Geographically discrete regions used to identify appropriate default ratio estimators for projects. Such regions are defined by the Reserve based on sampled cities and terrestrial ecoregions. Maps of the Assessment Areas and the associated data may be found on the Reserve's website.
Avoidable Reversal	An avoidable reversal is any reversal that is due to the project operator's negligence, gross negligence, or willful intent, including harvesting, development, and harm to the project area.
Baseline	An estimate of GHG emissions and removals that would have occurred in absence of the project under business as usual operations.
Best Management Practices	Management practices determined by a state or designated planning agency to be the most effective and practicable means (including technological, economic, and institutional considerations) of controlling point and nonpoint source pollutants at levels compatible with environmental quality goals.[19]
Biological Emissions	For the purposes of the Urban Forest Management Project Protocol, biological emissions are GHG emissions that are released directly from forest biomass, both live and dead, including forest soils. Biological emissions are deemed to occur when the reported tonnage of onsite carbon stocks, relative to baseline levels, declines from one year to the next.
Biomass	The amount of living matter comprising, in this case, a tree.
Bole	The trunk or main stem of a tree.
Buffer Pool	The buffer pool is a holding account for urban forest project CRTs administered by the Reserve. It is used as a general insurance mechanism against unavoidable reversals for all UFM projects registered with the Reserve.
Business As Usual	The activities, and associated GHG reductions and removals that would have occurred in the project area in

[19] Helms, J.A. (1998). The dictionary of forestry. Bethesda, MD: Society of American Foresters.

	the absence of incentives provided by a carbon offset market.
Carbon Pool	A reservoir that has the ability to accumulate and store carbon or release carbon. In the case of forests, a carbon pool is the forest biomass, which can be subdivided into smaller pools. These pools may include above-ground or belowground biomass or roots, litter, soil, bole, branches and leaves, among others.
Carbon Sink	A carbon sink is any process, activity or mechanism that removes carbon dioxide from the atmosphere.
Carbon Source	A carbon source is any process or activity that releases carbon dioxide into the atmosphere.
Carbon Stock	A pool of stored carbon. Urban forest carbon stocks include biomass of the project trees. Include living and standing dead vegetation, woody debris and litter, organic matter in the soil, and harvested stocks such as wood for wood products and fuel.
Carbon Stock Change or Carbon Sequestration	The annual incremental change in carbon stocks.
CO_2-equivalent (CO_2e)	The quantity of a given GHG multiplied by its total global warming potential. This is the standard unit for comparing the degree of warming which can be caused by different GHGs.
Certified Arborist	Certified Arborist is the rank of a Registered Consulting Arborist (or above), as certified by the International Society of Arboriculture.
Certified Forester	A professional with certified forester credentials managed by the Society of American Foresters (see www.certifiedforester.org). See also, Professional Forester.
Certified Urban Forester	An urban forester meeting the criteria and having passed the test created by the California Urban Forests Council, and now administered nationally by the Society of American Foresters.
Climate Reserve Tonnes (CRT)	One metric ton (tonne) of verified CO_2 equivalent emission reduction or sequestration.
Entity	The individual, organization, agency or corporation that owns, controls, or manages urban trees.
Global Warming Potential (GWP)	Factors used to convert emissions from GHGs other than carbon dioxide to their equivalent carbon dioxide emissions.

Greenhouse Gas (GHG)	Greenhouse gases mean carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6).
GHG Assessment Boundary	The GHG Assessment Boundary defines all the GHG sources, sinks, and reservoirs that must be accounted for in quantifying a project's GHG reductions and removals.
KML	KML (Keyhole Markup Language) is an XML-based file format used to display geographic data in an Earth browser such as Google Earth, Google Maps, and Google Maps for mobile.
Leakage	According to the Intergovernmental Panel on Climate Change: "the unanticipated decrease or increase in greenhouse gas benefits outside of the project's accounting boundary as a result of project activities."
Municipality	A city or town that has corporate status and local government
Permanence	The requirement that GHGs must be permanently reduced or removed from the atmosphere to be credited as carbon offsets. For UFM projects, this requirement is met by ensuring that the carbon associated with credited GHG reductions and removals remains stored for at least 100 years.
Places	Places are defined by the U.S. Census Bureau and are composed of Incorporated Places and Census-Designated Places. Generally, an Incorporated Place is an area that is legally incorporated under the laws of its respective state, whereas a Census-Designated Place is a community that lacks a separate government but otherwise resemble incorporated places, with a residential core, relatively high population density, and a degree of local identity. The most recent definition provided by the U.S. Census Bureau can be found at https://www.census.gov/geo/reference/gtc/gtc_place.html
Primary Effect	The project's intended change in carbon stocks, GHG emissions or removals.
Professional Forester	A professional engaged in the science and profession of forestry. A professional forester is credentialed in jurisdictions that have professional forester licensing laws and regulations. Where a jurisdiction does not have a professional forester law or regulation then a professional forester is defined as having the certified forester credentials managed by the Society of American Foresters (see www.certifiedforester.org).
Project Activity	The carbon storage, emission reductions, and emissions due to an urban forest management project.

Project Area	The area inscribed by the geographic boundaries of a project.
Project Start Date	The start date is initiated by activities that increase carbon inventories and/or decrease emissions relative to the baseline.
Project Life	Refers to the duration of a project and its associated monitoring and verification activities.
Project Inventory	The inventory of trees eligible to generate emission reductions or removals in a project. Developed according to the guidelines in the Quantification Guidance.
Project Operator	One of the urban forest owners or a legally created entity to represent the urban forest owners that is responsible for undertaking a project.
Project Submission Date	The date that a project is submitted for listing in the Reserve program. The Reserve considers a project to be "submitted" when all of the appropriate forms have been uploaded to the Reserve's software system, and the project operator has paid a project submission fee.
Registered Consulting Arborist	An arborist meeting the criteria and having passed all the qualification requirements of the American Society of Consulting Arborists (http://www.asca-consultants.org/about/rca.cfm).
Reporting Period	The time period for which an entity is reporting its project activity and quantifying GHG reductions. This period will typically be 12 months, except for 1) the initial reporting period which begins at the project commencement date and may be more than 12 months, and 2) the second reporting period, which may be less than 12 months.
Reversal	A reversal is a decrease in the stored carbon stocks associated with quantified GHG reductions and removals that occurs before the end of the project life. Under this protocol, a reversal is deemed to have occurred if there is a decrease in the difference between project and baseline onsite carbon stocks from one year to the next, regardless of the cause of this decrease (i.e., if the result of (Δ AC_{onsite} - Δ BC_{onsite}) in Equation 5.1 is negative).
Sampled Cities	Places and urban areas, as defined by the U.S. Census Bureau, that have been discretely sampled for the development of ratio estimators and serve as the basis, along with terrestrial ecoregions, for the definition of Assessment Areas.
Secondary Effects	Unintended changes in carbon stocks, GHG emissions, or GHG removals caused by the project.
Sequestration	The process by which trees remove carbon dioxide from the atmosphere and transform it into biomass.

Terrestrial Ecoregions	Areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources, as delineated by the Commissions for Environmental Cooperation, which serve as the basis, along with sampled cities, for the definition of Assessment Areas.
Tree	A woody perennial plant, typically large and with a well-defined stem or stems carrying a more or less definite crown with the capacity to attain a minimum diameter at breast height of five inches and a minimum height of 15 feet with no branches within three feet from the ground at maturity.[20]
Unavoidable Reversal	An unavoidable reversal is any reversal not due to the project operator's negligence, gross negligence or willful intent, including windstorms or disease that are not the result of the project operator's negligence, gross negligence or willful intent.
Urban Area	Urban areas are defined by the U.S. Census Bureau and are composed of urbanized areas (areas with populations ≥50,000 people) and urban clusters (populations ≥2,500 and <50,000). The most recent urbanized area definition provided by the U.S. Census Bureau can be found at http://www.census.gov/geo/maps-data/maps/2010ua.html.
Urban Forest Management Project (UFM Project, project)	A planned set of activities designed to increase removals of CO_2 from the atmosphere, or reduce or prevent emissions of CO_2 to the atmosphere, through increasing and/or conserving urban forest carbon stocks. An urban forest management (UFM) project focuses on activities that maintain or increase carbon inventories relative to baseline levels of carbon within the project boundary. Eligible activities may include, but are not limited to, increasing the urban forest productivity by removing diseased and suppressed trees, reducing emissions by avoiding tree clearing, and planting additional trees on available and appropriate sites.
Urban Forest Owner	A corporation, legally constituted entity (such as a utility), city, county, state agency, individual(s), or combination thereof that has legal control (e.g., right to plant or remove, etc.) of any amount of urban forest carbon within the project area.
Verification	The process of reviewing and assessing all of a project's reported data and information by an ISO-accredited and Reserve-approved verification body, to confirm that the project operator has adhered to the requirements of this protocol.

[20] Helms, J.A. (1998). The dictionary of forestry. Bethesda, MD: Society of American Foresters.

Verification Cycle	The Reserve requires full verification of projects every five reporting periods, but project operators can choose to have more frequent 'desktop' verifications. In between site visits, desk reviews of project reports can be completed by an approved verification body. The Reserve will only issue CRTs for verified emission reductions.
Verification Period	The period of time over which GHG reductions/removals are verified. A verification period may cover up to five reporting periods. The end date of any verification period must correspond to the end date of a reporting period.