

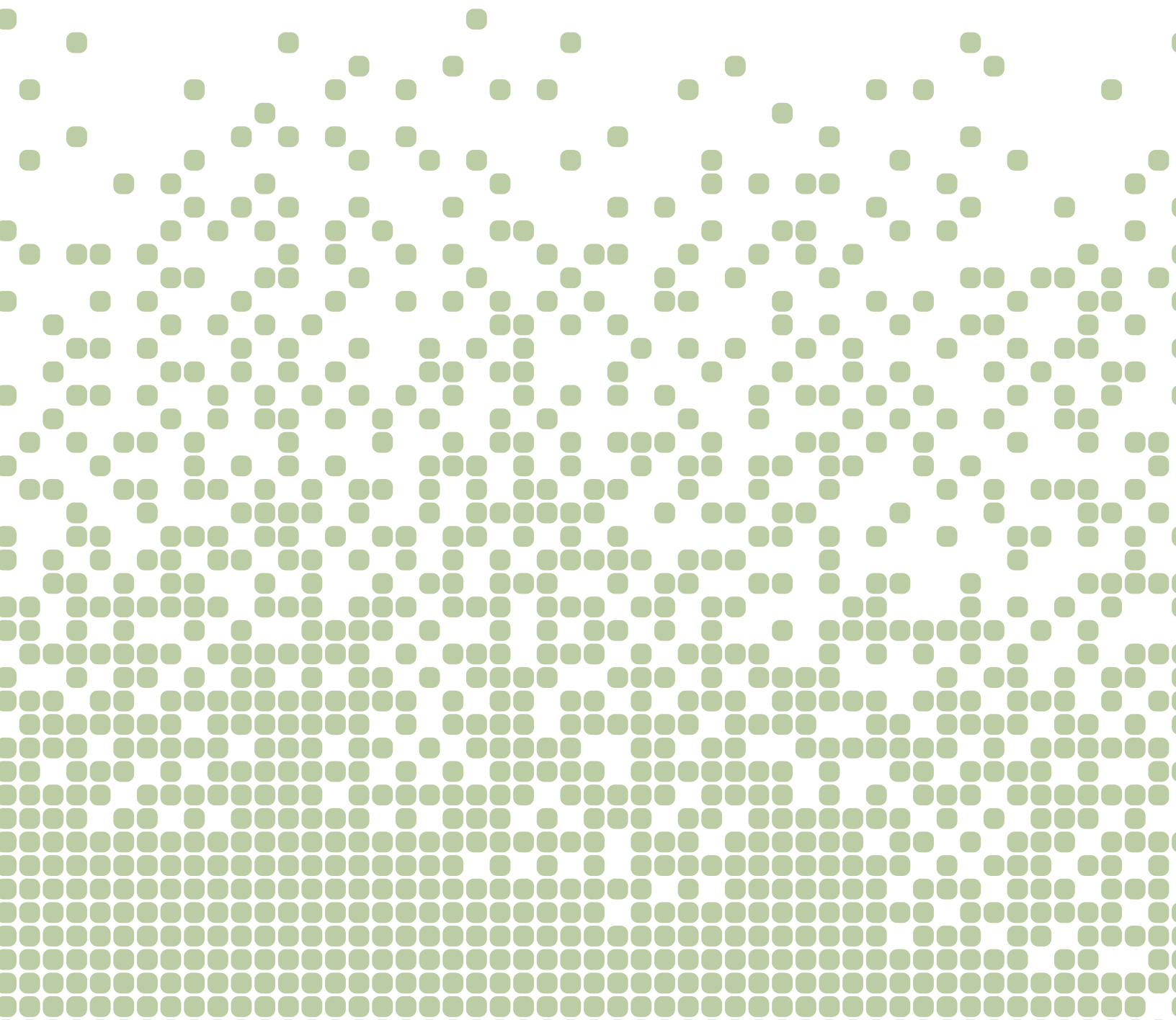


CLIMATE  
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# Urban Forest Management

## Project Protocol



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## Abbreviations and Acronyms

C	Carbon
CAL FIRE	California Department of Forestry and Fire Protection
CH <sub>4</sub>	Methane
CO <sub>2</sub>	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 <sub>2</sub> O	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<sub>2</sub>) 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<sup>1</sup> 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.<sup>2</sup>

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<sub>2</sub>, a leading greenhouse gas that contributes to climate change. Trees, through the process of photosynthesis, naturally absorb CO<sub>2</sub> 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<sub>2</sub> 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).

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<sup>1</sup> See the WRI/WBCSD GHG Protocol for Project Accounting (Part I, Chapter 4) for a description of GHG reduction project accounting principles.

<sup>2</sup> For more information, please visit [www.climateactionreserve.org](http://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<sub>2</sub> into the atmosphere. The quantity and rate of CO<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> from the atmosphere, or reduce or prevent emissions of CO<sub>2</sub> 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<sup>3</sup> within the Project Area.

Only counties, municipalities, educational institutions, and utilities/ special districts, or 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. Aggregated projects may only include the carbon controlled by permission as described in Section 2.3.

Only municipalities and/or counties can be identified as Project Operators (defined below) for projects that involve aggregation. No more than one aggregated project can exist within the limits of a Project Area.

Control of urban forest carbon means the Urban Forest Owner has the legal authority to effect changes to urban forest carbon quantities (right to plant or remove, for example). Control of urban forest carbon occurs, for purposes of satisfying this protocol, through fee ownership, perpetual contractual agreements, and/or deeded encumbrances. 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*<sup>4</sup> interests without fee ownership are precluded from the definition of Urban Forest Owner.

<sup>3</sup> See definition of Carbon Stock in the glossary.

<sup>4</sup> *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 legally created entity 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, subject to any conditions imposed by any of the Urban Forest Owners to include or disallow any carbon they control and any provisions 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 Urban Forest Management Project Protocol.

### 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.

#### 3.1 Project Location

Only those activities that occur within the Urban Area boundaries, defined by the most recent publication of the United States Census Bureau (<http://www.census.gov/geo/maps-data/maps.html>), are eligible to develop a project under this protocol. Projects must be entirely within the defined Urban Area boundary as of Project Commencement.

#### 3.2 Project Area

The Project Area is the geographic extent of the project. The Project Area may be made up of consolidated or disaggregated polygons within an Urban Area polygon established by the U.S. Census Bureau.

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. 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 OPO should consider the use of a protocol that addresses the carbon stored in harvested wood products, such as the Reserve's Forest Protocol or the California Air Resource's Board Compliance Forest Protocol. Exceptions to the prohibition of harvesting commercial timber products are recognized where the provision of commercial timber products might be generated where harvests are 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. UFM Projects must be a minimum of 50 acres, or 50% of the Urban Area (whichever is smaller) and can be made up of one or many participating Forest Owners.

#### 3.3 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.

#### 3.4 Project Commencement

The commencement 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 commencement 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 commencement date includes:

- Submitting the project to the Reserve. The Project Commencement is the date of submittal.
- Dated planning documents that indicate the date in which the activities were initiated.

To be eligible, the project must be submitted to the Reserve no more than six months after the project commencement date.<sup>5</sup> Projects may always be submitted for listing by the Reserve prior to their start date.

### 3.5 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.<sup>6</sup>

Projects must satisfy the following tests to be considered additional.

#### 3.5.1 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, and contractual agreements, collectively referred to as Legal Agreements, may effectively control urban forest carbon and possess ownership rights to the carbon inventories controlled. Similarly, deeded encumbrances, tree planting and management ordinances, and contractual agreements may have an effect on urban forest carbon inventories beyond the control of any of the Urban Forest Owners.

The baseline trend for UFM Projects is based on comparison of historic data with current data and includes the effects of legal requirements. Therefore, no further consideration is needed. A subsequent evaluation of additionality will occur at the initiation of the subsequent crediting period.

#### 3.5.2 Performance 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, as defined by the requirements described below.

##### 3.5.2.1 Performance Standard for Urban Forest Management Projects

The performance standard is to exceed the project baseline for UFM Projects as described in Section 5.1.

### 3.6 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 crediting period. While the project can be renewed

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<sup>5</sup> Projects are considered submitted when the project developer has completed and uploaded the appropriate project submittal forms to the Reserve software.

<sup>6</sup> Available at <http://www.climateactionreserve.org/how/program/program-manual/>.

indefinitely, the baseline must be renewed at the end of the crediting period. Any previously issued credits are respected for the life of the project.

### 3.7 Minimum Time Commitment

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

### 3.8 Social and Environmental and 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 tree planting template that outlines elements that need to be addressed and provides important considerations that may be helpful in decision-making.<sup>7</sup> The template provides considerations that will enable verifiers to ensure progress is being achieved over time.

#### 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, tree planting 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 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).

**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 a number of environmental benefits as well as create negative

<sup>7</sup> Available at <http://www.climateactionreserve.org/how/protocols/urban-forest/>.

externalities. Projects have the potential to improve air quality and reduce storm water runoff and energy usage. 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.

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

Environmental Provisions	Elements to Include in the Project Design Document (PDD)
Biodiversity	<p>Describe how UFM Project activities will maintain and enhance biodiversity, including:</p> <ol style="list-style-type: none"> <li>1. Benefits of tree species selection and composition to biodiversity within the project area.</li> <li>2. Use of specific tree species, sizes and/or distributions to support unique habitat elements.</li> </ol>
Native species	<p>Describe how UFM Project activities will promote the use of native species, including:</p> <ol style="list-style-type: none"> <li>1. Strengths and limitations of using native trees in the project.</li> <li>2. Preferential treatment of native species.</li> </ol>
Non-native species	<p>Describe how UFM Project activities will limit and target the use of any non-native species, including:</p> <ol style="list-style-type: none"> <li>1. Strengths and limitations of using non-native trees in the project.</li> <li>2. Resistance to insects and disease.</li> </ol>
Climate change resilience	<p>Describe how UFM Project activities will enhance the resilience of the urban forest to climate change, including:</p> <ol style="list-style-type: none"> <li>1. Ability of urban forest to adapt to climate change.</li> <li>2. Resistance to natural disturbances.</li> </ol>
Air quality	<p>Describe how UFM Project activities will enhance air quality benefits, including:</p> <ol style="list-style-type: none"> <li>1. Tree selection and distribution to reduce air pollutants.</li> <li>2. Tree selection and distribution to reduce emissions of Biogenic Volatile Organic Compounds (BVOCs).</li> <li>3. Design tree maintenance activities to reduce fossil fuel emissions.</li> </ol>
Physical characteristics	<p>Describe how UFM Project activities will enhance physical characteristics of the urban environment, including:</p> <ol style="list-style-type: none"> <li>1. Tree shading.</li> <li>2. Wind protection.</li> <li>3. Minimize disturbance to city infrastructure (e.g. sidewalks, power lines, etc.)</li> </ol>
Water management	<p>Describe how UFM Project activities will improve water management, including:</p> <ol style="list-style-type: none"> <li>1. Increase infiltration and recharge of groundwater.</li> <li>2. Reduce stormwater runoff.</li> <li>3. Conserve water from urban forest management.</li> </ol>

## 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 <sub>2</sub>	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 <sub>2</sub>	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 <sub>2</sub>	Included	Standing dead wood is expected to be a small, but may be substantial in rare cases, portion of UFM Projects.
UF-4	Lying dead wood carbon	Reservoir / Pool	CO <sub>2</sub>	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 <sub>2</sub>	Excluded	Litter and duff carbon is 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 <sub>2</sub>	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 <sub>2</sub>	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 <sub>2</sub>	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 <sub>2</sub> O	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 <sub>2</sub>	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 <sub>2</sub>	Excluded	Mobile combustion CO <sub>2</sub> emissions from site preparation are not quantified since projects that involve intensive site preparation activities are not eligible.
			CH <sub>4</sub>	Excluded	Changes in CH <sub>4</sub> emissions from mobile combustion associated with site preparation activities are not considered significant.
			N <sub>2</sub> O	Excluded	Changes in N <sub>2</sub> O 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 <sub>2</sub>	Excluded	Mobile combustion CO <sub>2</sub> 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 <sub>4</sub>	Excluded	CH <sub>4</sub> emissions from mobile combustion associated with ongoing project operation and maintenance activities are not considered significant.
			N <sub>2</sub> O	Excluded	N <sub>2</sub> O 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 <sub>2</sub>	Excluded	Stationary combustion CO <sub>2</sub> 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 <sub>4</sub>	Excluded	CH <sub>4</sub> emissions from stationary combustion associated with ongoing project operation and maintenance activities are not considered significant.
			N <sub>2</sub> O	Excluded	N <sub>2</sub> O emissions from stationary combustion associated with ongoing project operation and maintenance activities are not considered significant.

## 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 ISO-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). The Reserve provides an Urban Forest Calculation Tool on its website to assist with the annual calculation of reductions and removals.

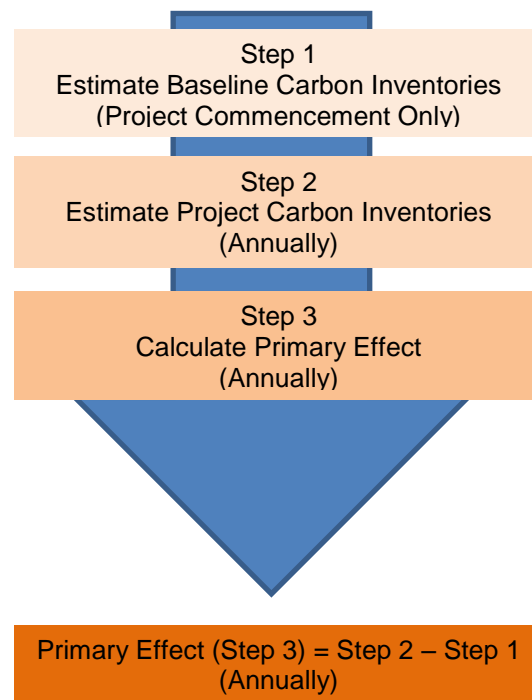
Quantification proceeds according to the steps below.

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 performance test from Section 3.5.2 of this protocol to the Project Onsite Inventory at Project Commencement. The Project Onsite Inventory must have been 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 this period 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 forest carbon inventory for the current year, following the guidance in this section and in the Urban Forest Management Quantification Guidance. The estimate of actual onsite carbon stocks must be adjusted by an appropriate confidence deduction, as described in the 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. Taking the difference between actual onsite carbon stocks for the current year and actual onsite carbon stocks for the prior year.<sup>8</sup>
  - b. Subtracting from (a) the difference between baseline onsite carbon stocks for the current year and baseline onsite carbon stocks for the prior year.
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 and Secondary Effects. If 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).<sup>9</sup>

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<sub>2</sub>e) metric tons.

<sup>8</sup> For the purposes of calculating the project's Primary Effect, actual and baseline carbon stocks prior to the Project Commencement Date are assumed to be zero.

<sup>9</sup> 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.



**Equation 5.1. Annual Net GHG Reductions and Removals**

$QR_y = (\Delta AC_{onsite} - \Delta BC_{onsite})$		
<i>Where,</i>		<u>Units</u>
$QR_y$	= Quantified GHG reductions and removals for year y	tCO <sub>2</sub> e
$\Delta AC_{onsite}$	= $(AC_{onsite, y}) - (AC_{onsite, y-1})$	tCO <sub>2</sub> e
<i>Where,</i>		
	$AC_{onsite, y}$ = Actual carbon (CO <sub>2</sub> e) as inventoried for year y (y may be less than a year for the first Reporting Period following Project Commencement).	tCO <sub>2</sub> e
	$AC_{onsite, y-1}$ = Actual carbon (CO <sub>2</sub> e) as inventoried for year y-1	tCO <sub>2</sub> e
$\Delta BC_{onsite}$	= $(BC_{onsite, y}) - (BC_{onsite, y-1})$	tCO <sub>2</sub> e
<i>Where,</i>		
	$BC_{onsite, y}$ = Baseline onsite carbon (CO <sub>2</sub> e) as estimated for year y (y may be less than a year for the first Reporting Period following Project Commencement).	tCO <sub>2</sub> e
	$BC_{onsite, y-1}$ = Baseline onsite carbon (CO <sub>2</sub> e) as estimated for year y-1	tCO <sub>2</sub> e

**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 historic estimate must be between 10 and 20 years prior to the Project Commencement. More recent images may be requested and permitted (in writing) by the Reserve if data are not available in the

Project Area jurisdiction. Both estimates are developed by first estimating tree canopy area for each time period from remotely sensed data and developing a ratio of CO<sub>2</sub>e to tree canopy area from ground sampling. The resulting trend is extended 20 years into the future, provided legal constraints have not changed substantially (other than changes associated with this protocol) during the 20 year period, at which point the baseline is held steady for the balance of the 100-year projection. A description of how legal constraints affect baseline considerations and technical issues associated with the baseline are described in the Quantification Guidance.

## 6 Ensuring the Permanence of Credited GHG Reductions and Removals

Changes in urban forest management have the potential to enhance the rate of CO<sub>2</sub> 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 onsite 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 causes (including natural disturbances such as fires, pest infestations or disease outbreaks).

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 the human activities like land conversion. Under this protocol, Reversals due to controllable agents are considered “avoidable”. As described in this section, Project Operators must contribute to the Reserve Buffer Pool to insure against Reversals. 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 compensation 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<sub>2</sub>). The Buffer Pool therefore acts as a general insurance mechanism against Unavoidable Reversals for all projects registered with the Reserve. 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 fluctuate significantly from the current evaluation of risks.

## 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.

## 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.

### 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<sub>2</sub>-equivalent metric tons (i.e. QR<sub>y</sub>, 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.
  - b. The retired CRTs must be designated in the Reserve's software system as compensating for the Avoidable Reversal.
4. Within a year 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, wildfires or disease that are not the result of the Project Operator's negligence, gross negligence or willful intent. 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 one year so that the Reversal can be quantified (in units of CO<sub>2</sub>-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 size of the Reversal in CO<sub>2</sub>-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 Commencement Date.
Project Design Document	Once, prior to initial verification.
Signed Attestation of Title Form	Prior to issuance of credits. Required at initial verification, onsite verification, and every optional desktop verification.
Signed Attestation of Regulatory Compliance Form	Prior to issuance of credits. Required at initial verification, onsite 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, onsite verification, and every optional desktop verification.
Verification Statement	Upon completion of verification and prior to issuance of credits. Required at initial verification, onsite verification, and every optional desktop verification.
Project Implementation Agreement	Upon completion of verification and prior to issuance of credits. Required at initial verification, onsite verification, and every optional desktop verification.

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

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. The Reserve will create a file of all verified forest carbon projects on Google Maps for public dissemination.

### **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. A PDD template has been prepared by the Reserve and is available on the Reserve's website.<sup>10</sup> The template is arranged to assist in ensuring that all requirements of the UFMPP are addressed. The template is required to be used by all projects. The template is designed to manage the varying requirements based on project type.

Each project must submit a PDD at the project's first 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.

## **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 forest carbon inventory, entering the updated inventory into the UFM Project's calculation worksheet, and submitting it 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 calculation worksheet. The project's calculation worksheet includes:

1. An updated estimate of the current year's carbon stocks in the reported carbon pools. Acceptable methodologies for updating the project's inventory are provided in the Quantification Guidance. The update is determined by:
  - a. Including any new forest inventory data obtained during the Reporting Period.
  - b. Applying growth estimates to existing inventory.

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<sup>10</sup> <http://www.climateactionreserve.org/how/protocols/urban-forest/>.

- c. Updating inventory estimates for removals and/or disturbances that have occurred during the Reporting Period.
- 2. The baseline carbon stock estimates for the current year, 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 year, following the requirements in Section 5.
- 4. \*A preliminary calculation of the project’s Buffer Pool contribution.

In addition to data reported using the project calculation worksheet, the following must be submitted to the Reserve as part of a monitoring report.

Conditional reporting, as pertinent:

- 1. If a Reversal has occurred during the previous year, 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

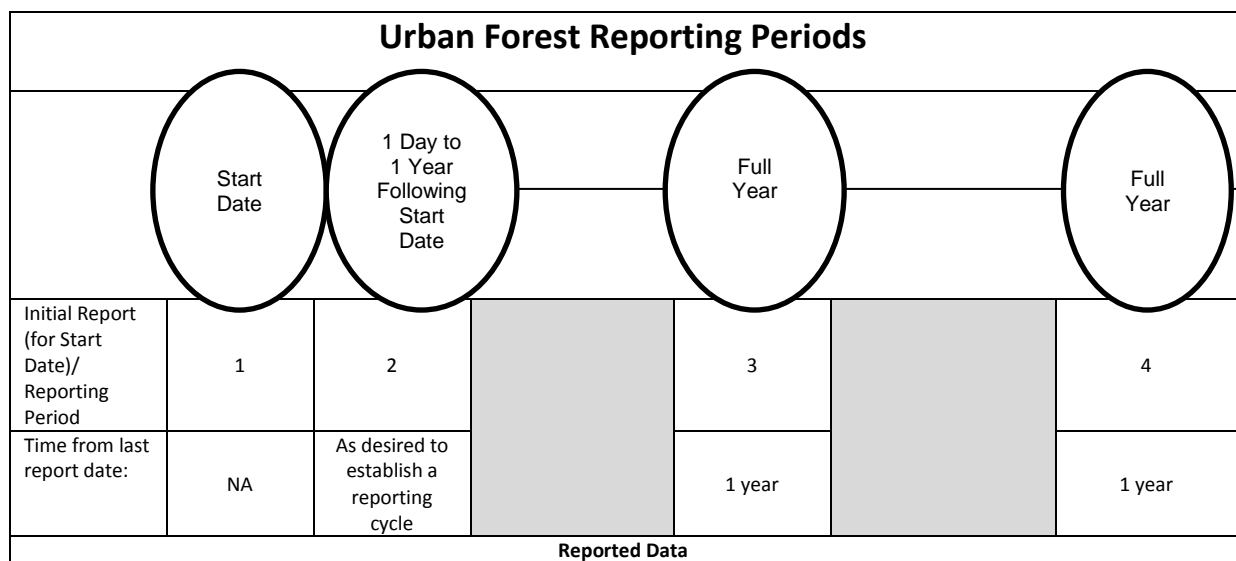
This section describes the required reporting and verification cycles. A UFM Project is considered automatically terminated (see Section 6.3) if the Project Operator chooses not to report data and undergo verification at required intervals.

#### 7.3.1 Reporting Period Duration and Cycles

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

Figure 7.1 displays the Reporting Periods in graphical form.

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.



Project Onsite Carbon Stocks	Yes	Yes		Yes		Yes
CRTs Issued upon Successful Verification?	No	Yes		Yes		Yes

**Figure 7.1.** Urban Forest Management Project Reporting Periods

### 7.3.2 Verification Cycles

All projects must be initially verified within 30 months of being submitted to the Reserve. The initial verification of all project types must include a site visit, confirm the project's eligibility, and confirm that the project's initial inventory and the baseline have been established in conformance with the UFMPP. Subsequent verification may include multiple Reporting Periods and 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 onsite 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 Requirements of Onsite Verifications

Onsite verification is a verification in which project inventory data are verified through a process that audits data in the office as well as data in the field. 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 the Verification Period that coincides with Project Commencement and the end of every fifth Reporting Period following the Project Commencement Date. Buffer Pool contributions are also verified during onsite verifications.

### 7.3.4 Desk Review Verification

In between onsite 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. Where the reported data are not within acceptable parameters, onsite verification is needed to verify the data. The Reserve will hold back 20% of the credits issued during desk review verifications to insure against credit over-issuance. The credits held back will be distributed to the Project Operator's account upon completion of the subsequent onsite verification.

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 onsite verifications or desk reviews. Onsite verification may determine that earlier desk reviews overestimated onsite 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,<sup>11</sup> 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 (this document)
- 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/>.

The verification of reports that reference carbon stocks must be conducted with the oversight of a Certified Arborist, a Professional Forester, or a Certified Forester,<sup>12</sup> managed by the Society of American Foresters, so that professional standards and project quality are maintained. Any Certified Arborist, Professional Forester or Certified Forester who is not currently working with urban forest activities within the Project Area must consult with a Certified Arborist, a Professional Forester, Certified Forester, or planning agency familiar with the practice of urban forestry in that jurisdiction to understand all laws and regulations that govern urban forest practice within the jurisdiction. The Reserve may evaluate and approve alternative professional credentialing requirements if requested, but only for jurisdictions where laws or regulations that govern professional urban forest management do not exist.

### 8.1 Standard of Verification

The Reserve's standard of verification for UFM Projects is the Urban Forest Management Project Protocol (UFMPP), 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

<sup>11</sup> Found on the Reserve website at <http://www.climateactionreserve.org/how/program/program-manual/>.

<sup>12</sup> See [www.certifiedforester.org](http://www.certifiedforester.org).

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 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, onsite 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 initial verification must include onsite verification. 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 Onsite Verification**

Onsite verification involves review of the project's quantification, relevant attestations, soil carbon emissions associated with management activities, adherence to environmental and social safeguards (if applicable), and risk of Reversal ratings. After a project's initial verification, subsequent site visits must assess and assure accuracy in measurement and monitoring techniques and onsite record keeping practices. Onsite verifications must be completed during the initial verification and for every fifth subsequent reporting cycle. That is, onsite verification is required every 5-years.

### **8.2.3 Optional Annual Desk Review Verification**

Optional annual verifications can occur according to preferences of the Project Operator. Credits can be verified and registered as the result of an optional annual verification. Optional annual verification occurs in the interim years between onsite verifications. The main focus of optional annual verifications is to assure that annual monitoring reports are complete and that reported project carbon inventories are within acceptable bounds, as described in the Quantification Guidance. Where the reported data are not within acceptable parameters, onsite verification is needed to verify the data. The Reserve will hold back 20% of the credits issued during desk review verifications to insure against credit over-issuance. The credits held back will

be distributed to the Project Operator's account upon completion of the subsequent onsite verification.

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

**Table 8.1.** Verification Items and Related Schedules

Verification Items	Section of UFMPP	Initial	Site	Optional	Apply Professional Judgment <sup>13</sup> ?
<b>1. Project Definition</b>	2.1 Urban Forest Management	X			Yes
<b>2. Urban Forest Owner</b>	2.2 Urban Forest Owners	X	X		Yes
<b>3. Project Operator</b>	2.3 Project Operators	X	X		No
<b>4. Project Implementation Agreement</b>	2.4 Project Implementation Agreement	X	X	X	No
<b>5. Project Location</b>	3.1 Project Location	X			No
<b>6. Project Area</b>	3.2 Project Area	X			No
<b>7. Limits to Site Preparation</b>	3.3 Limits to Site Preparation	X	X		Yes
<b>8. Project Commencement</b>	3.4 Project Commencement	X			Yes
<b>9. Additionality</b>	3.5.1 Legal Requirement Test	X	X		Yes
	3.5.2 Performance Test				
	3.5.2.1 Performance Standard for Urban Forest Management Projects	X			
<b>10. Project Crediting Period</b>	3.6 Project Crediting Period	X	X		No
<b>11. Minimum Time Commitment</b>	3.7 Minimum Time Commitment	X	X		No
<b>12. Social and Environmental Co-Benefits</b>	3.8 Social and Environmental Co-Benefits	X	X		Yes for public entities only
<b>13. Social Co-Benefits</b>	3.8.1 Social Co-Benefits	X	X		Yes for public entities only
<b>14. Environmental Co-Benefits</b>	3.8.2 Environmental Co-Benefits	X	X		Yes for public entities only
<b>15. GHG Assessment Boundaries</b>	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.					
<b>16. Quantifying Net GHG Reductions and Removals</b>	5 Quantifying Net GHG Reductions and Removals 8.3 Verifying Carbon Inventories Urban Forest Management Quantification Guidance	X	X	X	No
<b>17. Urban Forest Protocol Baselines</b>	5.1 Urban Forest Management Baseline Urban Forest Management Quantification Guidance: Baseline Development for Urban Forest Management Projects	X			No

<sup>13</sup> Verifiers must use professional judgment to verify protocol criteria which are not quantitative or can be measured completely with objective analysis.



<b>18. Permanence and Buffer Pool Contributions</b>	6.1 Contributions to the Buffer Pool	X	X		No
<b>19. Permanence and Compensating for Reversals</b>	6.2 Compensating for Reversals 6.2.1 Avoidable Reversals 6.2.2 Unavoidable Reversals	X	X	X	No

### 8.3 Verifying Carbon Inventories

Verification bodies are required to verify carbon stock inventory calculations of all sampled and/or measured carbon pools within the Project Area. Inventories of carbon stocks are used to determine the project baseline and to quantify GHG reductions and removals against the project baseline over time. The method of verification of carbon inventories varies depending on whether the verification is part of the initial verification, onsite verification, or an optional verification. The verification elements and their periodicity are explained in this section.

Verification Item	Item Description	Frequency of Verification
1 – Historical Tree Canopy Area	Confirming that the methodology for quantifying the historical tree canopy area specified in the Quantification Guidance was implemented correctly and that the estimates (if not completely measured) meet minimum confidence requirements stated in the quantification guidance, as part of the initial onsite verification.	Initial onsite verification.
2 – Current Tree Canopy Area	Confirming that the methodology for quantifying current tree canopy area specified in the Quantification Guidance was implemented correctly and that the estimates (if not completely measured) meet minimum confidence requirements stated in the quantification guidance, as part of onsite verification.	Initial onsite verification and every subsequent 5-year onsite verification following initial onsite verification.
3 – Carbon Estimates for Transfer Functions	Confirming that the methodology and requirements for quantifying carbon estimates specified in the Quantification Guidance were implemented correctly and that the field measurements, use of biomass equations, and summary of project data meet minimum tolerance standards for accuracy, as part of onsite verification.	Initial onsite verification and every subsequent 10-year onsite verification following initial onsite verification.
4 – Transfer Functions and Summary Calculations	Confirming that transfer functions are correctly calculated and expansions to the Project Area are performed correctly, as part of onsite verification.	Initial verification and every subsequent 5 years.
5 – Updated Data	Confirming that updated data are within acceptable bounds.	Optional, in years in between onsite verifications.

### 8.3.1 Verifying Urban Forest Management Projects

The verifier shall progress through each successive step according to the guidance below. Verification activities may proceed to field verification activities only once the following items have been successfully verified:

Verification Element	Description	Verification Frequency
1	Prior to verification of project inventories, items 1- 16 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 site verification only.
2	Confirm the entire Project Area is stratified for urban forest classes. Verifier shall inspect the project map and determine if the entire Project Area is stratified. The appropriateness of stratification will occur during plot audits.	Initial site verification and every 10-year site verification.
3	Confirm ground-based plots have been properly allocated and attributed per the Quantification Guidance.	Initial site verification and every 10-year site verification, only if ground-based plots have been moved or new plots added.
4	Confirm that ground-based plots have been randomly ordered and organized per the Quantification Guidance.	Initial site verification and every 10-year site verification, only if ground-based plots have been moved or new plots added.
5	Confirm that the Project Operator included the required minimum sample plots for each urban forest class per the Quantification Guidance.	Initial site verification and every 10-year site verification.
6	Confirm the correct biomass equations and conversion factors (Quantification Guidance) were used in calculating carbon values.	Initial, 5-year, and 10-year site verifications.
7	Confirm that the calculation of transfer functions and expansion to urban forest classes and Project Area, for historical estimates and current estimates, were implemented correctly.	Historical estimates verified at initial site verification only, other data verified at initial site verification, 5-year, and 10-year verifications.
8	Confirm that confidence statistics for canopy cover were correctly calculated and meet minimum requirements per the Quantification Guidance.	Initial, 5-year, and 10-year site verifications.

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. The evaluation of the three themes that utilize sequential sampling (CO<sub>2</sub>e 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 worksheet 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 transfer functions, CO<sub>2</sub>e 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 worksheet provided by the Reserve must be in the same order the plots were randomly selected. Prior to initiated field verification activities, the verifier must:

Verification Element	Description	Verification Frequency
9	<p>Confirm that the estimates of <b>current tree canopy area</b> are accurate.</p> <p>The verifier must independently calculate the canopy area for each urban forest class using a randomized or systematic application of points. 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</p>	Initial and every subsequent 5-year onsite verification.

	<p>estimate provided by the Project Operator.</p> <p>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.</p> <p>The i-Tree Canopy tool may be used to perform the analysis.</p>	
10	<p>Confirming that estimates of historical tree canopy area are accurate (first verification only). The verifier must independently calculate the canopy area for each urban forest class using a randomized or systematic application of points. 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.</p> <p>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.</p> <p>The i-Tree Canopy tool may be used to perform the analysis.</p>	Initial verification only.

**8.3.1.1 Field-based Inventory Verification Activities**

The verifier shall visit the same plots (from above) in the field to continue verification for the following themes:

Verification Element	Description	Verification Frequency
11	<p>Ensuring that the urban forest classes are accurately assigned. 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 urban forest class 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</p>	Initial verification and every subsequent 10-year onsite verification.

	<p>a 90% approval rating from the set of the 20 selected plots.</p> <p><b>Consequences of failing to meet the accuracy requirements for stratification:</b> 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.</p>	
<p>12</p>	<p>Ensuring that the CO<sub>2</sub>e estimates from individual plots are accurate. The verifier must independently calculate per-acre estimates of CO<sub>2</sub>e 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<sub>2</sub>e 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.</p> <p>Measurement standards for verifiers include:</p> <ul style="list-style-type: none"> <li>a. Measuring every diameter (DBH) to the nearest inch.</li> <li>b. Measuring every height (total height) to the nearest foot.</li> </ul> <p>Measuring every tree that is 'borderline' to determine if the tree is either in the plot or out of the plot.</p>	<p>Initial verification and every subsequent 10-year onsite verification.</p>

Where 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<sup>14</sup> 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.

<sup>14</sup> Available at <http://www.climateactionreserve.org/how/protocols/urban-forest/>.

Verification Element	Description	Verification Frequency
13	Ensuring that the updated reported inventory estimate for all reported carbon pools are within tolerance bounds in years when no onsite verification occurs. A UFM Project's reported inventory meets verification requirements if the change in reported CO <sub>2</sub> e for the current reporting year is within 4% of the previous reporting year.	Initial verification and every subsequent 10-year onsite verification.
14	A desk verification is optional for Project Operators in reporting years when onsite verifications are not required. Verifiers shall compare current reported data with previously verified data and calculate if the reported data are within acceptable tolerance bounds. Data that are not within tolerance bounds must undergo the requirements for a 5-year or 10-year onsite verification (depending on the time since the previous verification) and verify the current estimate of urban tree canopy area. Additionally, the verifier shall inspect the calculations of transfer functions and expansions to the Project Area.	In interim years between onsite verifications.

## 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 verification report to be delivered to the Project Operator (public document).
2. Complete a detailed list of findings containing both immaterial and material findings (if any), and deliver it to the Project Operator (private document).
3. Prepare a concise verification statement detailing the vintage and the number of CRTs verified, and deliver it to the Project Operator (public document).
4. Verify that the number of CRTs specified in the verification report and statement match the number entered into the Reserve software.
5. Conduct an exit meeting with the Project Operator to discuss the verification report, list of findings, and verification statement and determine if material misstatements (if any) can be corrected. If so, the verification body and Project Operator should schedule a second set of verification activities after the Project Operator has revised the project submission.
6. If a reasonable level of assurance opinion is successfully obtained, upload electronic copies of the verification report, list of findings, verification statement, and verification activity log into the Reserve.
7. Return important records and documents to the Project Operator for retention.

The recommended content for the verification report, list of findings, and verification statement can be found in the Reserve's Verification Program Manual.<sup>15</sup> 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.

<sup>15</sup> 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.
Allometric Equation	An equation that utilizes the genotypical relationship among tree components to estimate characteristics of one tree component from another. Allometric equations allow the below ground root volume to be estimated using the above-ground bole volume.
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. <sup>16</sup>
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 the absence of incentives provided by a carbon offset

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<sup>16</sup> (Helms, 1998)

	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.
$C_{emis}$	CO <sub>2</sub> and other GHG emissions from project maintenance activities, for example, due to vehicular or equipment use.
$C_{proj}$	Project carbon, i.e. carbon stored annually in project trees, reported as CO <sub>2</sub> .
CO <sub>2</sub> -equivalent (CO <sub>2</sub> e)	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 <a href="http://www.certifiedforester.org">www.certifiedforester.org</a> ). 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 <sub>2</sub> equivalent emission reduction or sequestration.
Dry weight (DW) biomass	The weight of aboveground tree biomass when dried to 0% moisture content. Also known as oven-dry and bone-dry biomass. Convert from green biomass to dry weight biomass by multiplying by 0.56 for hardwoods or 0.48 for



	softwoods.
Entity	The individual, organization, agency or corporation that owns, controls, or manages urban trees.
Freshweight or green biomass	The weight of aboveground tree biomass when fresh (or green), which includes the moisture present at the time the tree was cut. The moisture content of green timber varies greatly among different species. The Reserve assumes that the moisture content of fresh weight biomass is 30%.
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 <sub>2</sub> ), methane (CH <sub>4</sub> ), nitrous oxide (N <sub>2</sub> O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF <sub>6</sub> ).
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.
Inherent Uncertainty	The scientific uncertainty associated with calculating carbon stocks and greenhouse gas emissions.
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."
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.
Primary Effects	The project's intended changes 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 <a href="http://www.certifiedforester.org">www.certifiedforester.org</a> ).

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 an project.
Project Commencement (Project Commencement Date)	The commencement 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 Onsite 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 ( <a href="http://www.asca-consultants.org/about/rca.cfm">http://www.asca-consultants.org/about/rca.cfm</a> ).
Reporting Uncertainty	The level of uncertainty associated with an entity’s chosen method of sampling and/or inventorying carbon stock and calculation methodologies. Contrast with inherent uncertainty.
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 $(\Delta AC_{\text{onsite}} - \Delta BC_{\text{onsite}})$ in Equation 5.1 is negative).
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.
Start Date	See Project Commencement.
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. <sup>17</sup>
Tree Residue	Aboveground biomass from urban trees (as distinguished from construction debris) that can be salvaged for reuse, such as mulch, wood products, or fuel for biomass power plant.
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	The most recent Urbanized Area definition provided by the United States Census Bureau at <a href="http://www.census.gov/geo/maps-data/maps/2010ua.html">http://www.census.gov/geo/maps-data/maps/2010ua.html</a> .
Urban Forest Management Project (UFM Project, project)	<p>A planned set of activities designed to increase removals of CO<sub>2</sub> from the atmosphere, or reduce or prevent emissions of CO<sub>2</sub> to the atmosphere, through increasing and/or conserving urban forest carbon stocks.</p> <p>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.</p>
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.

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<sup>17</sup> (Helms 1998)

Verification Cycle	The Reserve requires onsite verification of projects every five years, 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 multiple reporting periods. The end date of any verification period must correspond to the end date of a reporting period.