Comments on CAR Urban Tree Planting Project Protocol

April 2014

Mark McPherson

Although the Reserve staff and Work Group put in long hours and much effort, one of the central goals of the revision effort, which was to streamline and make more feasible the Urban Forest protocol, has not been realized in the comment draft.

The Urban Forest Management Project Protocol is a very useful step toward canopy quantification. This document will be an extremely valuable tool toward advancing and refining the various tools and methods discussed in it. But issues of carbon ownership and owners opting in or out will cripple the practical use of that protocol.

That makes the Tree Planting protocol even more important as a practical protocol for urban forest carbon projects. As drafted, the Tree Planting protocol remains too complicated and burdensome to be of practical use.

To provide a realistic alternative to the Reserve draft, I have drafted a simpler, more feasible Tree Planting protocol. I believe that if the Reserve wants a tree planting protocol that will in fact be used, it needs to re-draft the current tree planting protocol. My draft below would be a good place to start in drafting a feasible protocol for urban forest tree planting projects.

Urban Forest Tree Planting Project Protocol Draft

March 17, 2014

Mark McPherson

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3 Abbreviations and Acronyms

4 Introduction

This Urban Forest Tree Planting Project Protocol sets forth the requirements for tree planting carbon credit projects in urban areas.

The Reserve is a national offsets program working to ensure integrity, transparency and financial value in the North American carbon market. It does this by establishing regulatory-quality standards for the development, quantification and verification of GHG emissions reduction projects in North America; issuing carbon offset credits known as CRTs generated from such projects; and tracking the transaction of credits over time in a transparent, publicly-accessible system. Adherence to the Reserve's high standards ensures that emissions reductions associated with projects are real, permanent and additional, thereby instilling confidence in the environmental benefit, credibility and efficiency of the U.S. carbon market.

5 Urban Forest Tree Planting Project Requirements

5.1 Project Operators

An Urban Forest Tree Planting Project, referred to hereafter as a "Project," requires one and no more than one Project Operator, who undertakes a Project, registers 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.

A Project Operator must be

1) A county, acting in its unincorporated areas only, or
2) A municipality, including quasi-municipal entities, or
3) An educational institution, or
4) A utility, including special use or improvement districts.

5.2 Project Implementation Agreement

A Project Operator must sign a Project Implementation Agreement (PIA) with the Reserve setting forth the Project Operator's obligation to comply with this Protocol.

5.3 Project Location

Projects must be entirely within the Urban Area boundary, defined by the most recent publication of the United States Census Bureau (http://www.census.gov/geo/maps-data/maps.html).

5.4 Land Upon Which Project Trees Are Planted

The Project Operator must either:

1) Own the land upon which the Project trees are planted; or
2) Have a written agreement from the landowner giving the Project Operator permission to plant and maintain trees. A written agreement includes but is not limited to recorded instruments such as covenants, easements, or deeds.

5.5 Project Commencement

The commencement date for a Project is the date at which the Project Operator either submits an application with the Reserve or begins planting trees. The commencement date can be as early as August 1, 2008 (the date of the adoption of the Urban Forest Protocol Version 1.0 by the Reserve's Board); however no credits can be issued more than two years prior to the Project Submission Date.

5.6 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 (available at http://www.climateactionreserve.org/how/program/program-manual/).

Projects must satisfy the following tests to be considered additional:

5.6.1 Legal Requirement Test

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. Trees planted to fulfill a legal requirement are ineligible. Legal requirements include any requirement issued by authority of a federal, state, or local jurisdiction to plant trees for any reason.

5.6.2 Performance Test

Projects must achieve GHG reductions or removals above and beyond the 'Common Practice' level of tree planting. The Common Practice statistic is the carbon associated with the average

number of trees planted over the past 5 years from entities similar to the project entity. The Common Practice statistics are organized by region, by entity class (utility, educational institution, and municipality), and by size of entity. The Common Practice statistic can be found on the Urban Forest Project Data link on the Reserve's Urban Forestry webpage (http://www.climateactionreserve.org/how/protocols/urban-forest/ - pending).

Individual trees are not designated as Common Practice trees. Rather, the Common Practice trees are calculated as a percentage of all trees planted and the percentage is applied to project trees planted. See section 10 below on Quantification for more information on Common Practice.

5.7 Project Approval Period

The approval period for Projects is 25 years. Projects may be renewed for additional approval periods and may incorporate updated technology into the project analysis. A Project can be renewed indefinitely and maintain the initial baseline developed for the Project provided the Project is in good standing as of the renewal date. A Project in good standing has a current inventory, has no outstanding obligations to balance project credits with reversals, is current with its monitoring and verification reports, and provides a complete project renewal form.

5.8 Minimum time Commitment

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

6 Quantification of Carbon for Credits

The Reserve will issue Climate Reserve Tonnes (CRTs) to a Project upon confirmation by an ISO-accredited and Reserve-approved verification body that Project trees have sequestered carbon. Project Operators must meet the Quantification requirements, including the Common Practice additionality requirement set forth in section 10 below and Appendix A.

7 Ensuring the Permanence of Credited GHG Reductions and Removals

The Reserve requires that credited GHG reductions and removals be effectively "permanent;" i.e., that the carbon associated with credited Projects 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 Project trees, submit regular monitoring reports, and submit to regular third-party verification of those reports along with periodic verification site visits 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 and Reversal Pool to provide insurance against reversals of GHG reductions and removals due to unavoidable causes (including natural disturbances such a fires, pest infestations or disease outbreaks). All Project Operators must contribute 10% of earned CRTs to a Buffer Pool and also plant and maintain a Reversal Pool consisting of 10% of the Project trees.

7.1 Other Insurance Options for Reversals

It is the Reserve's expectation that other options to insure against reversals will develop for projects in the future. These options may include direct insurance or bonding. Alternative insurance mechanisms could be used to directly reduce the required Reversal Pool contributions for a Project. The Reserve must review and approve alternative insurance mechanisms before they may be used.

7.2 Compensating for Reversals

The Reserve requires that all reversals be compensated through the retirement of CRTs or withholding of future earned CRTs. If a reversal associated with a 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 either using CRTs from Reversal Pool trees or surrendering CRTs from its Reserve account or from future issuance of earned CRTs.

7.2.1 Avoidable Reversals

An Avoidable Reversal is any reversal that is due to the Project Operator's negligence or willful intent, including harvesting, development, and harm to the Project Area due to the Project Operator's 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 a year of receiving the avoidable reversal notice, the Project Operator must provide the Reserve with a verified estimate of current onsite carbon stocks;
4. Within four months of receiving the avoidable reversal notice, the Project Operator must retire a quantity of CRTs from its Reserve account equal to the size of the reversal in CO_2-equivalent metric tons. In addition:
    a. The retired CRTs must be those that were issued to the Project, or that were issued to other Urban Forest Projects registered with the Reserve.
    b. The retired CRTs must be designated in the Reserve's software system as compensating for the Avoidable Reversal.

7.2.2 Unavoidable Reversals

An Unavoidable Reversal is any reversal not due to the Project Operator's negligence or willful intent, including 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_2-equivalent metric tons).

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

7.3 Disposition of Projects after a Reversal

If a project suffers reversals equal to or greater than 50% of its total potential CRTs, 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, another 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.

8 Project Documentation

8.1 Project Documentation for Submission

Project Operators must provide the following documentation to the Reserve to register a project.

Document	When Submitted/Required
Project Submittal Form	Once, at project initiation or within 2 years of tree planting.
Project Design Document	Once, prior to Initial Verification
Signed Attestation of Title or Contractual Permission Form	Prior to issuance of credits. Required at Initial Verification and Site Verification
Signed Attestation of Regulatory Compliance Form	Prior to issuance of credits. Required at Initial Verification, Site Verification
Signed Attestation of Voluntary Compliance 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, Site Verification, and subsequent Verifications
Verification Statement	Upon completion of verification and prior to issuance of credits. Required at Initial Verification, Site Verification, and subsequent Verifications
Project Implementation	Upon completion of verification and prior to issuance of credits.

Agreement	Required at Initial Verification, Site Verification, and subsequent Verifications

Project submittal forms can be found at http://www.climateactionreserve.org/how/projects/register/project-submittal-forms/.

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.

8.1.1 Project Design Document

The urban forest Project Design Document (PDD) is a required document for reporting information about a project. The document is submitted at the initial verification. The required PDD template has been prepared by the Reserve and is available on the Reserve's website (pending).

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.

9 Reporting and Verification Cycle

This section describes the required reporting and verification cycles. A Project is considered automatically terminated if the Project Operator does not to report data and undergo verification at required intervals.

9.1 Reporting Period Duration and Cycle

Project Operators must monitor and report their project inventories and any quantification data required by Section 10 and Appendix A every five years with the exception of the reporting period immediately following the project Start Date, which can be any length of time up to one year.

9.2 Monitoring Report

Project Operators must submit monitoring reports with each five-year Reporting Period. 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 reports must be provided to verification bodies whenever a Project undergoes verification.

In addition to the required inventory and quantification data reported, the following must be submitted to the Reserve as part of a monitoring report:

1. An explanation for any decrease over any ten-year consecutive period in the carbon calculation.

2. Any changes in the status of the Project Operator.
3. 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.

9.3 Verification Cycle

All Urban Forest 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 and confirm the project's eligibility. Subsequent verifications must include a site visit, must be done at least every ten years, and must cover one or two Reporting Periods.

Verification must be completed within 12 months of the end of the Reporting Period(s) being verified. 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.

9.3.1 Requirements of Verifications

An approved third-party verification body must verify all reported data and information for a Project and conduct a site visit for that Verification Period.

9.4 Issuance and Vintage of CRTs

The Reserve will issue Climate Reserve Tonnes (CRTs) for quantified GHG reductions and removals that have been verified.

9.5 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.

9.6 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.

10 Verification Guidance

This section provides guidance to verification bodies and supplements the Reserve's Verification Program Manual,[1] which provides verification bodies with the general requirements for a standardized approach for independent and rigorous verification of GHG emission reductions

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

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.

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

1. Urban Forest Tree Planting Project Protocol (this document)
2. Reserve Program Manual
3. Reserve Verification Program Manual
4. Reserve software
5. 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 Urban Forest 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,[2] managed by the Society of American Foresters, so that professional standards and project quality are maintained. Any Certified Arborist, Professional Forester or Certified Forester verifying a project in an unfamiliar jurisdiction must consult with a Certified Arborist, a Professional Forester or Certified Forester practicing 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 certification credentials if requested, but only for jurisdictions where laws or regulations that govern professional urban forest management do not exist.

10.1 Standard of Verification

The Reserve's standard of verification for Urban Forest Tree Planting Projects is this protocol, the Reserve Program Manual, and the Reserve Verification Program Manual.

Verification bodies will determine if there exists reasonable assurance that the data submitted on behalf of the Project Operator to the Reserve addresses each requirement in this protocol.

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/.

[2] See www.certifiedforester.org.

10.2 Project Verification Activities

10.2.1 Initial Verification

Verifiers must ensure that the project has met the requirements for eligibility, including Project operator status, location of project, ownership or permission to plant and maintain trees, project commencement, additionality, permanence, and quantification. The verification must include a site visit verification. The verification body must assess and ensure the completeness and accuracy of all required reporting elements submitted in the Urban Forest Project Design Document.

10.2.2 Subsequent Verifications

For all verifications after the Initial Verification, the verifiers must conduct a site visit, review all monitoring reports and other documents submitted to the Reserve by the Project Operator, and review all quantification data, using the standard described in Section 10.1 above.

10.3 Completing the Verification Process

After completing the 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.[3] 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.

[3] Available at http://www.climateactionreserve.org/how/program/program-manual/.

11 Quantification Guidance

This section provides requirements and guidance for quantifying a Project's carbon stocks, both for purposes of estimating a project's baseline as well as providing ongoing estimates of project carbon stocks throughout the project life.

11.1 Reporting Requirements for Urban Forest Carbon Pools

For Urban Forest Tree Planting Projects, only Standing Live Trees can be included in quantifying project baselines and project estimates.

For standardized reporting, all estimates of forest carbon stocks must be provided in terms of tonnes (metric) of CO_2 –equivalent (CO_2e) on a project basis. Unless otherwise required in the referenced biomass equations, the following conversion formulae shall be used:

Base Unit	Conversion		Final Unit
Biomass	.5 * biomass	=	Carbon
Carbon	3.67 * carbon		CO_2-e
Tons	0.90718474 * tons		Metric Tons (MT) or Tonnes
Hectares	0.404686 * hectares		Acres

11.2 Methodology for Quantifying CO_2-e in Urban Tree Planting Projects

11.2.1 Baseline Development for Urban Tree Planting Projects

The baseline of Urban Tree Planting Projects is determined using a 'Common Practice' statistic. The Common Practice statistic is the CO_2-e associated with the average number of trees planted over the past 5 years from entities similar to the project entity. The Common Practice statistics are organized by region, by entity class (utility, educational institution, and municipality), and by size of entity. The Common Practice statistic can be found on the Urban Forest Project Data link on the Reserve's Urban Forestry webpage (http://www.climateactionreserve.org/how/protocols/urban-forest/ - pending).

The Common Practice is the number of trees assumed to be planted on an annual basis. Trees planted in excess of this number, called Project trees, store CO_2-e deemed to be additional to the baseline. For quantification purposes, Common Practice trees and Project trees are pooled and their total CO_2-e is calculated. The amount of that total deemed additional to the baseline is a direct function of the ratio of Project trees to total trees planted. For example, if the entity plants 100 Common Practice trees and 100 Project trees, 50% of the 200 trees planted are Project trees. Therefore, 50% of the CO_2-e stored by the 200 trees is deemed additional to the baseline. Pooling of Common Practice and Project trees eliminates potential bias in estimating the amount of CO_2-e associated with the Common Practice trees. Also, it incentivizes maintenance of all planted trees.

11.2.2 Allocating CO_2-e to Program Trees

As Common Practice and Program trees are planted over time, the baseline CO_2-e trend will increase as carbon stocks grow.

Table 1 illustrates how the baseline CO_2-e trend is calculated for Common Practice (Com. Prac.) trees and CO_2-e deemed additional is calculated for Project trees. The Common Practice planting statistic is 50 trees per year, 400 trees over eight years. The number of Project trees planted varies yearly from 0 (Years 4 and 6) to 654 (Year 2). Over the eight years, 2,638 program trees are planted. These Program trees account for 86.8% of all 3,038 trees planted during the eight years.

In practice, the total amount of CO_2 stored will be calculated annually for the pooled Common Practice and Program trees based on periodic tree measurements and projected growth. In the top shaded row of this example, the total amount of CO_2 increases from 16 to 546 t over the eight years. To allocate this total amount of CO_2 stored to the portion stored by Program trees, the total is multiplied by the cumulative ratio Project trees to total trees planted. During Year 1 this ratio is 87.5% (350/400). This percentage multiplied by the total CO_2 stored after Year 1 (16 t) results in 14 t allocated to Project trees and 2 t allocated to Common Practice trees. After eight years, 546 t are stored by the pooled tree population and 86.8% of planted trees are Project trees. Therefore, 474 t (86.8% x 546 t) are allocated to Project trees and deemed additional, while 72 t are allocated to common Practice trees and deemed baseline.

Table 1. This example illustrates how total CO_2 estimated for the pooled population of Common Practice and Project trees (top shaded row) is allocated based on the cumulative ratio of Project trees to total trees planted (bottom shaded row)

Project Year	1	2	3	4	5	6	7	8	Sub-Total
Calculated CO2 - All Yrs. (t)	16	72	143	155	194	208	390	546	
Com. Prac. Trees Plt. In Pro. Yr.	50	50	50	50	50	50	50	50	400
Project Trees Plt in Pro. Yr.	350	654	539	0	101	0	556	438	2,638
Total Trees Plted in Pro. Yr.	400	704	589	50	151	50	606	488	3,038
Total Trees Plted - All Yrs.	400	1,104	1,693	1,743	1,894	1,944	2,550	3,038	
% Prog. Trees Plt. - All Yrs.	87.5%	90.9%	91.1%	88.5%	86.8%	84.6%	86.3%	86.8%	
Allocated CO2 (t)	1	2	3	4	5	6	7	8	Sub-Total
CO2 - C.P. Trees - All Yrs. (t)	2	7	13	18	26	32	54	72	222
CO2 - Project Trees - All Yrs. (t)	14	66	130	137	169	176	337	474	1,503
Total CO2 - All Yrs. (t)	16	72	143	155	194	208	390	546	1,725

11.2.3 Quantifying Tree Carbon Stocks

Each year, the project developer estimates the amount of carbon stored in eligible Project trees (carbon stocks) and then uses these data to calculate an annual incremental carbon stock change (carbon sequestration). Carbon stocks are reported in units of carbon dioxide equivalent (CO_2e). The annual change in carbon stocks is the basis for estimating project carbon sequestration, and is calculated as follows:

$$\textit{Annual Project } CO_2 \textit{ Sequestration} = CO_2 \textit{ stock (year x)} - CO_2 \textit{ stock (year x-1)}$$

There are three approved approaches to quantifying the annual carbon stocks, each of which is based on direct measurements of trees and approved urban tree growth and carbon models ("allometric equations"). Consult the CAR website for detailed guidance on implementing the approved equations. Approved approaches for quantifying carbon stocks:

1. Measure all trees in Project tree sites during a single year at 10-year intervals, following the verification cycle. Use the measurement data with approved allometric equations to estimate carbon stocks. In the intervening years when measurements are not implemented, use approved growth equations to predict annual carbon stocks. Such methods employ growth assumptions and allometric equations to estimate carbon stocks and are referred to below as growth models. Direct tree measurements or remote sensing techniques may be used. Data from direct tree measurements (i.e. tree diameter at breast height and height) can be input directly into approved allometric equations. Remote sensing can be used to estimate tree crown area, from which tree trunk diameter is inferred. Tree height can be inferred from LiDAR data.

2. Measure all trees in Project tree sites every 10 years using a rolling sample, which means a minimum of 10% of the tree sites are measured each year and after 10 years 100% of the tree sites have been measured. Use the measurement data with approved allometric equations to estimate carbon stocks. For trees that are not measured in a given year, use approved methods ("growth models") to predict annual changes in carbon stocks. As described above in Approach 1, direct measurement or remote sensing techniques may be used to estimate tree carbon stock.

3. Measure a sample of trees in the Project and Baseline tree populations each year, use the measurement data with approved allometric equations to estimate carbon stocks in the samples, and extrapolate the carbon stock estimates to the entire tree population. As described above in Approach 1, direct measurement or remote sensing techniques[5] may be used to estimate tree carbon stock.

11.3 Updating Project Inventories

Project inventories must be reported to the Reserve on an annual basis. Such inventories are in constant flux due to tree growth and mortality or removal and therefore must be updated on an annual basis for reporting. The inventory must be updated annually through a combination of projecting existing inventory data and/or remeasuring inventory data with an objective of reporting inventory data that reflects actual conditions in the field.

Measured data on individual trees can be 'grown', or projected for a maximum of 10 years, after which additional field work is required to update the data. It is important to note that the basis of a successful verification depends on alignment (within tolerance bands defined in the verification guidance) between verifier data and project developer data, therefore these guidelines do not ensure successful project verification. The actual timeframe between remeasurement may need to be reduced to less than 10 years if the updates of inventory data prove projected growth to be inaccurate.

Since the biomass of sampled trees is determined through the use of equations that are based on diameter (breast height) and total height variables, updating tree growth can be accomplished through the use of projections of inventory data in the database that mimic the diameter and height increment of trees in the field. Appendix X provides a list of publications that reference urban forest growth rates. The references in Appendix X may be useful for project developers in designing an appropriate mechanism to 'grow' their trees.

Most references address the annual increment of diameter (DBH). Height growth also needs to be addressed to ensure the most accurate comparison of tree records in the database to actual conditions in the field. Heights can be estimated through regression analysis by comparison of measured diameters to measured heights for a given species. It is recommended that, rather than simply relying on the height estimate from the regression analysis, that project developers apply the height increment derived from the regression analysis to the height that was measured in the field.

In any case, plot data that is updated to reflect current conditions with the use of predicted increments of height and diameter data, as well as updates for removals, will be used during site verifications to compare against verifiers field measurements using the sequential sampling techniques described in the verification section. This provision ensures that plot measurements and update processes are within accuracy thresholds.

12 Appendix A: Data to Record for Measurements

Measurement standards for urban forest trees in Urban Tree Planting Projects.

For Each Tree		
Attribute	**Description**	
Date of Tree Visit	Day/Month/Year	
Latitude of Tree Center	From GPS	
Longitude of Tree Center	From GPS	
Navigational Feature 1	Description of a resilient feature that can be used to help relocate the tree in the future. Features might include manhole covers, building corners, street signs, etc.	(fire hydrant, street sign, building corner, etc.)
	Distance from feature to the tree	Feet
	Azimuth from feature to the tree	Degrees
Navigation Feature 2	Description of a resilient feature that can be used to help relocate the tree in the future. Features might include manhole covers, building corners, street signs, etc.	(fire hydrant, street sign, building corner, etc.)
	Distance from feature to the tree	Feet
	Azimuth from feature to the tree	Degrees
Urban Forest Class	Enter the Urban Class Code associated with the tree.	
Tree Number	Enter the unique tree number for the tree.	
Inventory Personnel	Enter the initials of the inventory technicians responsible for measuring and recording data for the tree.	
Species	Enter the species code for the tree. The species code can be found for each species in the corresponding reference document on the Reserve's website. The species code is based on the first two letters of the genus and the first two letters of the species for any given species.	
DBH	Measure and record Diameter at Breast Height (DBH) to the nearest inch using a diameter tape and wrapping the tree at a height of 4.5 feet from the base of the tree on the uphill side.	

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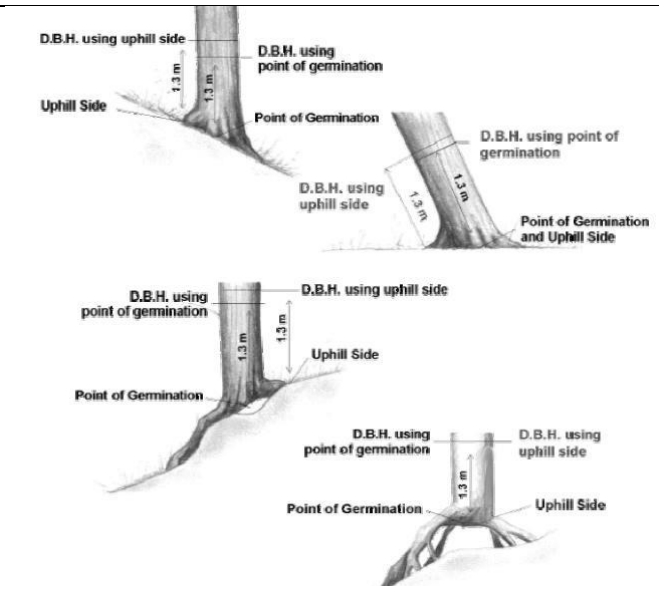
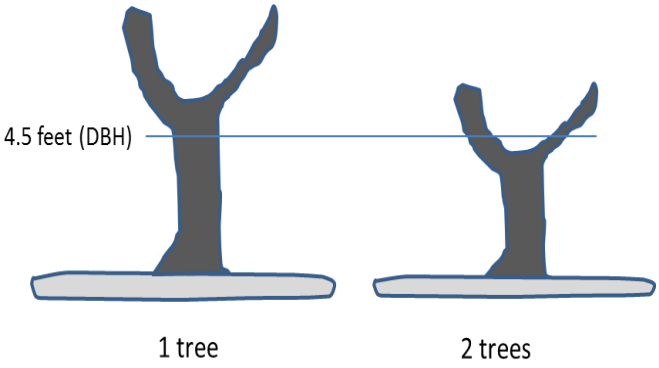


Forked trees above DBH are counted as one tree. Forked trees below DBH are counted as two trees (or however many forked stems exist).


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<tr><td>Total Height</td><td>Measure of total height (height from base of tree to top) to the nearest foot.</td></tr>
<tr><td>Growth Condition</td><td>An attribute of ‘Open’ or ‘Closed’ must be assigned to the tree according to the description below:
<table>
<tr><th>Class</th><th>Description</th></tr>
<tr><td>O</td><td>An open attribute is assigned to trees growing in non-natural settings. Tree species may be a variety of native and non-native species. Most often, trees exist in areas where disturbance of natural areas and conversion to another land use has occurred.</td></tr>
<tr><td>C</td><td>A closed attribute is assigned to trees growing in natural settings. Trees present are characteristic of the species diversity and structure in forested areas outside the urban area.</td></tr>
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<tr><td>Vigor</td><td>Provide a rating of the tree’s apparent vigor. Determination of vigor based on consideration of color of foliage, crown proportion and appearance, retention of</td></tr>
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<tr><td></td><td colspan="2">leaves/needles, appearance of apical growth, length between growth whorls, and presence of cavities and fungal growth. The code is assigned based on the following classes:</td></tr>
<tr><td></td><td>Code</td><td>Description*

*based on conditions present during growing periods. Professional judgment need be applied if sampling conducted outside of growing periods.</td></tr>
<tr><td></td><td>1</td><td>Excellent – Tree exhibits high level of vigor and no barriers (soil, light, etc.) to continued vigor. No decay or broken branches are observed.</td></tr>
<tr><td></td><td>2</td><td>Good - Tree exhibits high level of vigor and some minor barriers (soil, light, etc.) to continued vigor. No decay or broken branches are observed.</td></tr>
<tr><td></td><td>3</td><td>Fair – Tree appears generally healthy. Barriers (soil, light, etc.) affect the trees vigor. Tree’s crown may be smaller proportionally than in healthier trees. Decay and/ or broken branches, if observed, are not likely to have negative impacts in the short term.</td></tr>
<tr><td></td><td>4</td><td>Poor – Tree appears notably unhealthy, as determined by reduced crown, presence of decay and/or broken branches and/or significant barriers to future growth. Observed problems have high likelihood of being rectified through management of said tree and trees surrounding it.</td></tr>
<tr><td></td><td>5</td><td>Critical – Tree appears notably unhealthy, as determined by reduced crown, presence of decay and/or broken branches and/or significant barriers to future growth. Observed problems have low likelihood of being rectified through management of said tree and trees surrounding it.</td></tr>
<tr><td></td><td>6</td><td>Dying - Tree is unhealthy. Minimal live crown is present; portions of bark may be missing and/or substantial levels of broken stems and branches. Tree may exhibit advanced decay. No further investment in restoring the tree to a higher vigor is deemed worthwhile.</td></tr>
<tr><td></td><td>7</td><td>Dead- No live material is observed in the tree.</td></tr>
<tr><td>Defect – Bottom 33%</td><td colspan="2" rowspan="3">For each portion of the tree, provide an ocular estimate of the portion of tree that is missing (as a percentage of the section) as the result of breakage or cavities.</td></tr>
<tr><td>Defect – Mid 33%</td></tr>
<tr><td>Defect – Top 33%</td></tr>
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