

Regional Greenhouse Gas Initiative  
CO<sub>2</sub> Budget Trading Program



**Massachusetts  
Department of Environmental Protection**

**Massachusetts CO<sub>2</sub> Budget Trading Program**

**Offset Project Consistency Application  
Instruction Packet**

**Afforestation**

Version 1.0

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## 1. Overview

To demonstrate that an afforestation offset project qualifies for the award of carbon dioxide (CO<sub>2</sub>) offset allowances, a Project Sponsor must submit to the Massachusetts Department of Environmental Protection (MassDEP) in accordance with these instructions, a fully completed *Massachusetts Offset Project Consistency Application – Afforestation Version 1.0 (Consistency Application)*, including the coversheet and all forms and related attachments. An incomplete *Consistency Application* will not be reviewed to determine consistency. Following these instructions will ensure that the *Consistency Application* contains all necessary information and is submitted properly.

Each Project Sponsor should review the Massachusetts CO<sub>2</sub> Budget Trading Program regulations, 310 CMR 7.70(10), for information regarding offset projects and the award of CO<sub>2</sub> offset allowances. All Massachusetts offset application materials and other documents are available at <http://www.rggi.org/offsets>.

Before the *Consistency Application* can be completed, the Project Sponsor must establish a general account and obtain an offset project ID code through the Regional Greenhouse Gas Initiative (RGGI) CO<sub>2</sub> Allowance Tracking System (COATS). The Project Sponsor identified in the *Consistency Application* must be the same as the Authorized Account Representative for the RGGI COATS general account identified in the Massachusetts *Consistency Application*. For information about establishing a RGGI COATS general account and offset project ID code, consult the RGGI COATS User's Guide, available at <http://www.rggi-coats.org>.

Key eligibility dates and application submittal requirements for offset projects are as follows:

- For offset projects commenced between December 20, 2005 and December 31, 2008, the *Consistency Application* must be submitted by June 30, 2009.
- For offset projects commenced on or after January 1, 2009, the *Consistency Application* must be submitted within six (6) months after the project is commenced.
- For an offset project located solely in one (1) participating state, the *Consistency Application* must be filed with the appropriate regulatory agency in that state.
- For an offset project located in more than one (1) participating state, the *Consistency Application* must be filed in the participating state where the majority of the carbon sequestration due to the offset project is expected to occur.

## 2. Submission Instructions

The Project Sponsor should submit the completed *Consistency Application*, and all attachments, via RGGI COATS at <http://www.rggi-coats.org> as described above. For information about submitting a *Consistency Application* via RGGI COATS, consult the RGGI COATS User's Guide, available at <http://www.rggi-coats.org>.

The *Consistency Application* has three (3) parts, as described below. Each part comprises specified forms and required documentation. The *Consistency Application* has been created as a Microsoft Word document with editable fields. Enter information directly into the fields provided or submit information or documentation as an attachment, as directed. Include headers on all attachments indicating the form to which each is attached, the offset project name, and offset project ID code. If attachments are being submitted as separate electronic documents, please include the form numbers in the file names of the documents.

When submitting documents electronically via RGGI COATS, it is not necessary to submit a scanned or paper hardcopy of the application forms. The Project Sponsor must retain the completed original copy of the *Consistency Application* with the original signed documents. MassDEP reserves the right to request the original signed application documents at any time.

A completed hardcopy and/or CD of the *Consistency Application* may also be mailed to: Climate Strategies Group, Massachusetts Department of Environmental Protection, Bureau of Waste Prevention, 6<sup>th</sup> Floor, One Winter Street, Boston, MA 02108-4747.

Questions about this form and how to submit it should be directed to [climate.strategies@state.ma.us](mailto:climate.strategies@state.ma.us) or 617-574-6815.

### **3. Consistency Application Forms**

The *Consistency Application* includes eleven (11) forms divided into three (3) parts, as follows.

#### **Part 1. General Information Forms**

- Form 1.1 – Coversheet
- Form 1.2 – General Information
- Form 1.3 – Attestations
- Form 1.4 – Project Sponsor Agreement
- Form 1.5 – Disclosure of Greenhouse Gas Emissions Data Reporting

#### **Part 2. Category-Specific Information and Documentation Forms**

- Form 2.1 – Project Description
- Form 2.2 – Demonstration of Eligibility
- Form 2.3 – Sequestration Baseline
- Form 2.4 – Monitoring and Verification Plan
- Form 2.5 – Carbon Sequestration Permanence

#### **Part 3. Independent Verification Form**

- Form 3.1 – Independent Verifier Certification Statement and Report

The following instructions address each of the forms in numerical order. Note that the forms themselves include many embedded instructions.

## Part 1. General Information Forms

The five (5) forms in Part 1 of the *Consistency Application* address general requirements applicable to afforestation offset projects. Instructions for the Part 1 forms are provided below.

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### Form 1.1 Coversheet

Enter the requested information in the editable text fields in the form.

Check the boxes to indicate which forms are being submitted. For information about entering the Project Sponsor (RGGI COATS Authorized Account Representative), offset project name and offset project ID code, and RGGI COATS account name and number, see instructions below for Form 1.2, General Information.

Submit all required forms including the Coversheet. If a required form is not submitted, the *Consistency Application* will not be considered complete for commencement of review by MassDEP.

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### Form 1.2 General Information

Enter the requested information in the editable text fields in the form. If a text field is not applicable or is unanswerable, enter "NA." Note the following:

Offset Project ID Code: Enter the offset project ID code. The offset project ID code is the alphanumeric code generated when the Project Sponsor creates a record of the offset project in the RGGI CO<sub>2</sub> Allowance Tracking System (RGGI COATS). See the RGGI COATS User's Guide for more information about creating an offset project record in RGGI COATS, available at <http://www.rggi-coats.org>.

Project Information: Enter project information. The name of the offset project should be the same name entered by the Project Sponsor when creating a project record in RGGI COATS. The project location entered should be the primary location of the project if the project consists of actions at multiple locations. The summary narrative of the project should indicate all locations where project actions occur or will occur.

Project Sponsor: Identify the Project Sponsor and provide his or her contact information. The Project Sponsor is the natural person who is the Authorized Account Representative for the RGGI COATS general account identified in the *Consistency Application*.

Project Sponsor Organization: Provide the full legal name of the organization the Project Sponsor represents, including any alternative names under which the organization also may be doing business (e.g., John Doe Enterprises, Inc., d/b/a JDE). If the Project Sponsor is representing himself or herself as an individual, enter "NA".

RGGI COATS General Account Name and Number: Enter the RGGI COATS general account name and number. The RGGI COATS general account identified in the *Consistency Application* is the RGGI COATS account into which any awarded CO<sub>2</sub> offset allowances related to the offset project will be transferred.

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### **Form 1.3      Attestations**

Sign and date the form. Submit the form via RGGI COATS as directed in the submittal instructions above. Note that the Project Sponsor must retain the completed original copy of the *Consistency Application* and attachments with all original signed documents. MassDEP reserves the right to request the original signed application documents at any time.

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### **Form 1.4      Project Sponsor Agreement**

Sign and date the form. Submit the form via RGGI COATS as directed in the submittal instructions above. Note that the Project Sponsor must retain the completed original copy of the *Consistency Application* and attachments with all original signed documents. MassDEP reserves the right to request the original signed application documents at any time.

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### **Form 1.5      Disclosure of Greenhouse Gas Emissions Data Reporting**

Check the appropriate box in the form to indicate whether greenhouse gas emissions data related to the offset project have been or will be reported to any voluntary or mandatory programs, other than the Massachusetts CO<sub>2</sub> Budget Trading Program. For each program for which data have been or will be reported, provide the program name, the program type (voluntary or mandatory), program contact information (website or street address), the categories of emissions data reported, the frequency of reporting, when the reporting began or will begin, and reporting status (prior, current, future). The Project Sponsor must disclose future reporting related to current commitments made to voluntary programs as well as future reporting mandated by current statutes, regulations, or judicial or administrative orders.

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## Part 2. Category-Specific Information and Documentation Forms

The five (5) forms in Part 2 of the Consistency Application address category-specific requirements and documentation for afforestation offset projects. Instructions for the Part 2 forms are provided below.

### Form 2.1 Project Description

Attach a detailed narrative of the actions to be taken as part of the offset project. The attached narrative must include a header that indicates it is an attachment to Form 2.1 and includes the offset project name and offset project ID code. If attachments are being submitted as separate electronic documents, please include the form number in the file name of the document. Check the boxes in Form 2.1 to indicate that the narrative includes the required components. The narrative must include the following information:

1. Land Owners. Identify the owner(s) of the land within the offset project boundary. Attach a copy of the deed or title filed with the state or local registrar of deeds. State whether the landowner(s) leased subsurface or surface rights to other parties. Provide a table that includes each owner's name, status (individual, corporation, LLC, partnership, LLP, trust, foundation, cooperative, government entity), ownership share, and expected role, if any, in the management of the offset project. The table should be formatted in a manner consistent with the example below and include a row for each distinct land owner:

<i>Names on Fee Title</i>	<i>Status</i>	<i>Percent Ownership</i>	<i>Role in Offset Project</i>

2. Detailed Map(s). Attach a map(s) to scale that clearly shows the following elements:

- Offset project property boundaries, including all non-contiguous areas and all areas immediately adjacent to project boundaries;
- Topography of project area;
- Major transportation systems (private and public permanent roads) used throughout the year by the public or landowners;
- Permanently flowing watercourses and bodies of water;
- Latitude/longitude; and
- Land cover, by broad vegetative communities (e.g., conifer, oak woodlands) (color coded or shown in different patterns).

3. Permanent Conservation Easement. Attach a copy of the permanent conservation easement (either an executed copy or a copy of the to-be-executed easement) that requires that the land within the offset project boundary be maintained in a forested state in perpetuity, that the carbon density within the offset project boundary be maintained at long-term levels at or above that achieved as of the end of the final CO<sub>2</sub> offset allocation period, and that the land be managed in accordance with environmentally sustainable forestry practices.

4. Plant Species. Provide a table that lists each of the plant species to be planted or established via natural regeneration, indicating which are native, the area to be covered, estimated planting dates, and the number of trees expected per unit area. The table should include a row for each distinct plant species and be formatted in a manner consistent with the example below:

<b>Species Common Name</b>	<b>Species Scientific Name</b>	<b>Native or Not</b>	<b>Area (specify acres or hectares)</b>	<b>Estimated Planting Date</b>	<b>Number of Trees per Acre or Hectare (specify)</b>

5. Forest Management Plan. Provide a forest management plan, either embedded as part of the narrative or as an accompanying attachment to the narrative. The narrative itself should identify and describe the goals of the forest management plan, which may include but may not be limited to the following:

- Restoration of native forest
- Development of plantations for timber production
- Development of plantations for pulp production
- Development of plantations for bioenergy production
- Planting of trees for non-timber forest products such as nuts or maple syrup
- Planting of trees as wind breaks or boundaries
- Private recreation
- Public recreation
- Biodiversity protection or enhancement as functional habitat for endemic plant and wildlife species
- Development of lands for hunting

If timber harvesting is planned within the offset project boundary, describe the following in the narrative: (1) the form of planned forest management (even-aged management or uneven-aged management); (2) the organization expected to provide certification of environmentally sustainable forestry practices (e.g., American Tree Farm System (ATFS), Forest Stewardship Council (FSC), Sustainable Forestry Institute (SFI), or a similar organization approved by MassDEP; and (3) an evaluation of the forest management plan against the criteria specified by the identified certification organization.

## **Form 2.2 Demonstration of Eligibility**

Attach documentation to Form 2.2 to demonstrate offset project eligibility. Each attachment must include a header that indicates it is an attachment to Form 2.2 and includes the offset project name and offset project ID code. If attachments are being submitted as separate electronic documents, please include the form numbers in the file names of the documents. Check the boxes in Form 2.2 to indicate that required documentation is attached.



The following documentation must be provided:

1. Documentation of Non-forested Condition. Attach documentation that the land within the offset project boundary has been in a non-forested condition for at least the 10 years preceding the submission of the *Consistency Application* or the commencement of the offset project, whichever happened earlier. For the definition of “non-forested condition” see 310 CMR 7.70(10)(b).

Attach documentation from one (1) or more of the following sources:

1. Deeds and/or official government documents (local, state or Federal) describing property status;
2. Aerial photographs or satellite imagery from 10 years preceding offset project commencement;
3. Cadastral maps that incorporate details on land cover; or
4. Affidavit from an independent authoritative source(s) concerning the state of the property for at least 10 years prior to offset project commencement.

Documentation must be provided from the available source of information that is highest in the hierarchy of information in the list above, with source number 1 (deeds and official government documents) being the highest in the hierarchy and source number 4 (affidavit) being the lowest in the hierarchy.

2. Forest Management Plan. Attach documentation that describes how the forest management plan is consistent with widely accepted environmentally sustainable forestry practices and designed to promote the restoration of native forests by using mainly native species and avoiding the introduction of invasive species. Documentation must include the following:

- a. Side-by-side comparison of the criteria used to determine environmentally sustainable forestry by nationally recognized organizations and the corresponding provisions of the forest management plan. Nationally recognized organizations include, but may not be limited to, American Tree Farm System (ATFS), Forest Stewardship Council (FSC), and Sustainable Forestry Institute (SFI).
- b. Demonstration that at least 75% of the proposed plantings identified in the forest management plan consist of native species (i.e., species consistent with the forest types and forest soils native to the area).
- c. A signed statement from an independent authoritative source, such as a professional forester, stating that invasive species will not be introduced by the project through planting or use of contaminated soils.

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### **Form 2.3      Demonstration of Sequestration Baseline**

Provide documentation of the sequestration baseline where indicated in Form 2.3 or as an attachment to Form 2.3, as directed below. Each attachment must include a header that

indicates it is an attachment to Form 2.3 and includes the offset project name and offset project ID code. Multiple attachments may be integrated into a single document, as appropriate, as long as each element is clearly identified, as specified below. Each spreadsheet must be provided as a distinct electronic file or files (distinct spreadsheets may be incorporated into a single spreadsheet file, as appropriate, as long as each element is clearly identified, as specified below). Check the boxes in Form 2.3 to indicate that required documentation is attached and includes the required components. Please include the form numbers in the file names on each submitted electronic document.

The following documentation must be provided:

1. Baseline Period. Enter the dates (may include a range) when the sequestration baseline measurements were made, where requested in the form. Note that baseline sequestration must be measured before offset project commencement, using measurements made no more than 12 months prior to project commencement.

2. Baseline Carbon Pools. Enter calculated carbon content in short tons of CO<sub>2</sub>-equivalent (CO<sub>2</sub>e) for the carbon pools included in the baseline, where requested in Form 2.3:

- Live above-ground tree biomass (required)
- Live below-ground tree biomass (required)
- Soil carbon (required)
- Dead organic matter and coarse woody debris (required, unless the baseline measurement for this carbon pool is at or near zero, in which case measurement of this carbon pool is optional)
- Live above-ground non-tree biomass (optional)
- Dead organic matter, forest floor (optional)
- Grand total, all carbon pools

Values for all required carbon pools must be entered. Note that optional carbon pools included in the baseline must also be included in subsequent reporting periods. Optional carbon pools not included in the baseline are not allowed to be included in carbon calculations for subsequent reporting periods.

3. Baseline Description. Attach a map to scale that provides a description of the practices/management (e.g., regular mowing, intensive grazing, chaining, recreation, etc.) and land cover currently in place within the offset project boundary. Identify on the map the following land covers as applicable:

- Cropland (specify the crop)
- Grassland (specify use)
- Urban (specify urban land use)
- Pasture (specify animals)
- Residential areas
- Public parks
- Roads and rights of way
- Power line clearings
- Non-census water

4. Designation of Baseline Sub-populations. Attach a map to scale showing how the area within the offset project boundary was divided into baseline sub-populations that form relatively homogenous units. The map or an accompanying attachment must include a description of how vegetation and tree species – both currently on the property and those to be planted for the offset project – and site factors (e.g., soil type, elevation, slope, age class) were considered in designating sub-populations.

5. Baseline Sampling Plots. Attach a description of the methodology used for determining the numbers, sizes, and locations of sampling plots for each sub-population. The description must include photos and locations of sampling plots with distinct identifiers to provide for verification of the baseline by an independent verifier or MassDEP.

The attached description must demonstrate that the minimum number of sampling plots for each sub-population was determined consistent with the following equation:

$$n = [(s \times 1.960) / (\text{mean} \times \text{re})]^2$$

where:

- n = required number of sampling plots for each sub-population
- s = standard deviation of mean carbon content for the sampling plots
- mean = mean reported carbon content for the sampling plots
- re = 0.08, which is the level of sampling error to assure a total maximum error of 10% for the 95% confidence interval, assuming total error due to measurement error of 0.02

The description must state how the value of “s” in the equation above was estimated when calculating the minimum number of sampling plots for the baseline in the absence of a known value for the standard deviation. Estimation of “s” can be based on pilot studies on the project property or experience on similar non-forested properties.

The description must state how the value of “mean” was estimated when calculating the minimum number of sampling plots for the baseline in the absence of a known value for the mean. Estimation of “mean” can be based on pilot studies on the project property or experience on similar non-forested properties.

The description must demonstrate that the process for determining the minimum number of sampling plots was repeated for each sub-population.

Note that the number, size, and locations of sampling plots used in the baseline need not be the same as those used during subsequent reporting periods for calculating carbon sequestration due to the offset project.

6. Direct Measurement Procedures for Each Carbon Pool in Each Sampling Plot. Attach a list for each carbon pool of all measurement procedures that were used to calculate baseline sequestered carbon, including the following:

- Measurement methods
- Measurement equipment
- Size of sampling plots and/or quadrats

- Minimum size (and if applicable maximum size) of trees or dead wood per sampling plot, transect, or quadrat
- Length of transects
- Basal area prism factors
- Depth of soil carbon probes
- Number of soil carbon samples per sampling plot

For all measurement procedures listed, the attachment must demonstrate how each is consistent with current forestry good practice and guidance contained in Section 3.4 of the U.S. Department of Energy, *Technical Guidelines -- Voluntary Reporting of Greenhouse Gases (1605(b)) Program*; Chapter 1, Emissions Inventories; Part 1 Appendix: Forestry; Section 3: Measurement Protocols for Forest Carbon Sequestration (March 2006). (Also available as Pearson et al., *Measurement Guidelines for the Sequestration of Forest Carbon*, U.S. Forest Service General Technical Report NRS-18 (2007).) Identify the corresponding page number(s) and section(s) that demonstrate consistency with the *Guidelines*.

7. Field Measurement Data. Attach a spreadsheet that contains the field measurement data collected from each sampling plot for determining biomass and carbon for each carbon pool. Data that should be included in field measurement datasheets and must be entered in the spreadsheet include:

- Sampling plot names
- Sampling plot dimensions
- Sampling plot slopes
- Tree diameters
- Tree heights
- Standing dead wood diameters, heights, and decomposition classes
- Dead wood transect lengths
- Dead wood diameters and decomposition classes
- Non-tree vegetation and forest floor quadrat sizes
- Non-tree vegetation and forest floor field sample weights
- Non-tree vegetation and forest floor laboratory sample dry weights
- File names for plot photographs

8. Documentation of Biomass and Carbon Equations and Default Parameters.

Provide an attachment that documents all equations or default parameters used to convert field measurement data into biomass and/or carbon. For example, direct measurements of sampling plots typically produce estimates of biomass for different carbon pools. Biomass generally is converted to units of carbon using a factor of 0.5 unless more specific data are available. The attachment must include a table that lists all equations with the variable calculated, the equation, the source of the equation, and a justification of the applicability of the equation. Similarly, the attachment must include a table that lists all default parameters with the source of each parameter and a justification of its applicability.

Include equations such as:

- Equations calculating biomass per acre from biomass of individual trees or soil carbon cores, or quadrats of litter or non-tree vegetation
- Allometric equations linking diameter and/or height to biomass or volume

- Equations linking volume with total tree biomass
- Equations calculating volume of down dead wood

Include default parameters such as:

- Wood densities
- Percentage carbon of biomass

An illustrative example is provided below:

Variable Calculated	Equation	Source	Justification
Tree Biomass	$= 0.5 + (25000 \times \text{DBH}^{2.5}) / (\text{DBH}^{2.5} + 246872)$	Schroeder et al. 1997	This equation has a high $r^2$ value and is applicable to hardwood species on the East Coast
Dead Wood Volume	$= \pi^2 * [(d1^2 + d2^2 \dots \dots dn^2) / 8L]$	Pearson et al. 2007	This equation is the standard method in the literature for calculation of dead wood volume along transects
Soil Carbon	$= [\text{soil bulk density (g/cm}^3\text{)} \times \text{soil depth (cm)} \times \text{\% C}] \times 100$	Pearson et al. 2007	The standard literature approach

9. Documentation of Carbon Calculations. Attach a spreadsheet that documents all carbon calculations. The spreadsheet must include the following:

- Document use of the sampling plot data to estimate area-based carbon for each carbon pool in each sub-population. Document that the sampling plot data for each carbon pool in each sub-population were averaged to obtain the mean carbon stock and standard deviation of area-based carbon in the sub-population. Document the calculation of the 95% confidence interval of the area-based carbon for each carbon pool for the sub-population area based on the number of sampling plots, the standard deviation, and the corresponding standard error.
- Document that the estimate of area-based carbon for each carbon pool in each sub-population was converted into CO<sub>2</sub>-equivalent (CO<sub>2</sub>e) short tons for each carbon pool in each sub-population as follows:

$$TC_j = \sum_{i=1}^n (C_{i,j} * A_i) * 44/12 / 0.9072$$

where:

- TC<sub>j</sub> Total carbon in each sub-population in each carbon pool *j* in short tons of CO<sub>2</sub>e
- C<sub>i,j</sub> Total carbon in each carbon pool *j* in metric tons per acre or hectare in sub-population *i*
- A<sub>i</sub> Area of sub-population *i*

- i 1, 2, 3 ...*n* sub-populations in the baseline
  - j 1, 2, 3 ...*m* carbon pools in the baseline (the carbon pools are: “latb” – live above-ground tree biomass; “lbtb” – live below-ground tree biomass; “s” – soil carbon; “lantb” – live above-ground non-tree biomass; “doff” – dead organic matter, forest floor; “docwd” – dead organic matter, coarse woody debris)
- 44/12 The ratio of molecular weights of carbon dioxide to carbon
- 0.9072 Factor for conversion between metric tons and short tons

- c. Document that the estimates of carbon in each carbon pool were summed across all of the sub-populations to determine the total carbon content of each carbon pool for all land within the offset project boundary, represented in short tons of CO<sub>2</sub>-equivalent (CO<sub>2</sub>e).
- d. Document that the grand total carbon stock for all land within the offset project boundary, represented in short tons of CO<sub>2</sub>-equivalent (CO<sub>2</sub>e), was calculated by summing across all carbon pools:

$$TC_{pb} = TC_{latb} + TC_{lbtb} + TC_s + TC_{lantb} + TC_{doff} + TC_{docwd}$$

where:

- TC<sub>pb</sub> Total carbon content in short tons of CO<sub>2</sub>e within the offset project boundary (sum of carbon content of all carbon pools in all sub-populations)
- TC<sub>latb</sub> Sum of carbon content in short tons of CO<sub>2</sub>e of live above-ground tree biomass in all sub-populations
- TC<sub>lbtb</sub> Sum of carbon content in short tons of CO<sub>2</sub>e of live below-ground tree biomass in all sub-populations
- TC<sub>s</sub> Sum of carbon content in short tons of CO<sub>2</sub>e of soil carbon in all sub-populations
- TC<sub>lantb</sub> (Optional) Sum of carbon content in short tons of CO<sub>2</sub>e of live above-ground non-tree biomass in all sub-populations
- TC<sub>doff</sub> (Optional) Sum of carbon content in short tons of CO<sub>2</sub>e of dead organic matter, forest floor in all sub-populations
- TC<sub>docwd</sub> (Mandatory/optional, as applicable pursuant to 310 CMR 7.70(10)(e)3.c.i.iv.). Sum of carbon content in short tons of CO<sub>2</sub>e of dead organic matter, coarse woody debris in all sub-populations

10. Demonstration of Quantified Accuracy. Attach a spreadsheet that documents quantified accuracy for the baseline combined carbon pool measurement such that there is 95% confidence that the reported value is within 10% of the true value. The spreadsheet must document that quantified accuracy was calculated as follows:

- a. Document that the percentage uncertainty in the baseline combined carbon stocks in short tons of CO<sub>2</sub>-equivalent (CO<sub>2</sub>e) was calculated as follows:

$$U_{pb} = \sqrt{\left( \sum_{i=1}^n U_{sp,i}^2 \right)}$$

where:

- $U_{pb}$  Total percentage uncertainty in the combined baseline carbon pools below:
  - $U_{latb}$  Percentage uncertainty (expressed as a percentage of the mean at the 95% confidence interval) for carbon stock in live above-ground tree biomass
  - $U_{lbtb}$  Percentage uncertainty (expressed as a percentage of the mean at the 95% confidence interval) for carbon stock in live below-ground tree biomass
  - $U_s$  Percentage uncertainty (expressed as a percentage of the mean at the 95% confidence interval) for soil carbon stock
  - $U_{lantb}$  (Optional) Percentage uncertainty (expressed as a percentage of the mean at the 95% confidence interval) for carbon stock in live above-ground non-tree biomass
  - $U_{doff}$  (Optional) Percentage uncertainty (expressed as a percentage of the mean at the 95% confidence interval) for carbon stock in dead organic matter, forest floor
  - $U_{docwd}$  (Mandatory/optional, as applicable pursuant to 310 CMR 7.70(10)(e)3.c.i.iv.) Percentage uncertainty (expressed as a percentage of the mean at the 95% confidence interval) for carbon stock in dead organic matter, coarse woody debris
- $U_{sp, i}$  Percentage uncertainty (expressed as a percentage of the mean at the 95% confidence interval) for carbon stock in all carbon pools in sub-population  $i$
- $i$  1, 2, 3, ... $n$  sub-populations

- b. Document that the uncertainty in the carbon stocks in each carbon pool was summed across sub-populations as follows:

$$U_j = \sqrt{\left( \sum_{i=1}^n U_{j,i}^2 \right)}$$

where:

- $U_j$  Percentage uncertainty (expressed as a percentage of the mean at the 95% confidence interval) for carbon stock in carbon pool  $j$

- U<sub>j,i</sub> Percentage uncertainty (expressed as a percentage of the mean at the 95% confidence interval) for carbon stock in carbon pool *j* in sub-population *i*
- j* 1, 2, 3...*m* carbon pools in the baseline (the carbon pools are: “latb” – live above-ground tree biomass; “lbtb” – live below-ground tree biomass; “s” – soil carbon; “lantb” – live above-ground non-tree biomass; “doff” – dead organic matter, forest floor; “docwd” – dead organic matter, coarse woody debris)
- i* 1, 2, 3 ...*n* sub-populations in the baseline

## Form 2.4 Monitoring and Verification Plan

Provide the Monitoring and Verification Plan (M&V Plan) as multiple attachments to Form 2.4. Each attachment must include a header that indicates it is an attachment to Form 2.4 and includes the offset project name and offset project ID code. If attachments are being submitted as separate electronic documents, please include the form numbers in the file names of the documents. Multiple attachments may be integrated into a single document as long as each element is clearly identified, as specified below. Check the appropriate boxes in Form 2.4 to indicate that required documentation is attached to the form.

The M&V Plan must include the following:

1. Designation of Sub-Populations. Attach a map to scale showing how the area within the offset project boundary will be divided into reporting period sub-populations that form relatively homogenous units. The map or an accompanying attachment must include a description of how vegetation and tree species – both currently on the property and those planted for the offset project – and site factors (e.g., soil type, elevation, slope, age class) will be considered in designating reporting period sub-populations that form relatively homogenous units.

Note that the number, size, and locations of sub-populations used for calculating sequestration due to the offset project need not be the same as those used in determining the sequestration baseline.

2. Sampling Plots. Attach a description of the methodology for determining the number, sizes, and locations of sampling plots to be used for calculating project sequestration for each sub-population. The methodology must include provisions for taking photos and documenting locations of sampling plots with distinct identifiers to provide for verification of monitoring reports by an independent verifier or MassDEP.

The attached description must demonstrate that the minimum number of sampling plots for each sub-population will be determined consistent with the following equation:

$$n = [(s \times 1.960) / (\text{mean} \times \text{re})]^2$$

where:

*n* = required number of sampling plots for each sub-population



- s = standard deviation of mean carbon content for the sampling plots
- mean = mean carbon content for the sampling plots
- re = 0.08, which is the level of sampling error to assure a total maximum error of 10% for the 95% confidence interval, assuming total error due to measurement error of 0.02

The description must state how the value of “s” in the equation above will be estimated when calculating the minimum number of sampling plots to be used for project monitoring in the absence of a known value for the standard deviation. Estimation of “s” can be based on pilot studies on the project property, applicable baseline results, or experience on similar properties.

The description must state how the value of “mean” will be estimated when calculating the minimum number of sampling plots to be used for project monitoring in the absence of a known value for the mean. Estimation of “mean” can be based on pilot studies on the project property, applicable baseline results, or experience on similar properties.

The description must demonstrate that the process for determining the minimum number of sampling plots will be repeated for each sub-population.

Note that the number, size, and locations of sampling plots to be used for calculating sequestration due to the offset project need not be the same as those used for the baseline.

### 3. Direct Measurement Procedures for Each Carbon Pool in Each Sampling Plot.

Attach a list for each carbon pool of all measurement procedures that will be used to calculate sequestered carbon due to the offset project, including the following:

- Measurement methods
- Measurement equipment
- Size of sampling plots and/or quadrats
- Minimum size (and if applicable maximum size) of trees or dead wood per sampling plot, transect, or quadrat
- Length of transects
- Basal area prism factors
- Depth of soil carbon probes
- Number of soil carbon samples per sampling plot

For all measurement procedures listed, the attachment must demonstrate how each measurement procedure is consistent with current forestry good practice and guidance contained in U.S. Department of Energy, *Technical Guidelines -- Voluntary Reporting of Greenhouse Gases (1605(b)) Program*; Chapter 1, Emissions Inventories; Part 1 Appendix: Forestry; Section 3: Measurement Protocols for Forest Carbon Sequestration (March 2006). (Also available as Pearson et al., *Measurement Guidelines for the Sequestration of Forest Carbon*, U.S. Forest Service General Technical Report NRS-18 (2007).) Identify the corresponding page number(s) and section(s) that demonstrate consistency with the *Guidelines*.

### 4. Documentation of Biomass and Carbon Equations and Default Parameters.

Provide an attachment that documents all equations or default parameters that will be used to convert field measurement data into biomass and/or carbon. For example, direct measurements of sampling plots typically produce estimates of biomass for different carbon

pools. Biomass is generally converted to units of carbon using a factor of 0.5 unless more specific data are available. The attachment must include a table that lists all equations to be used with the variable to be calculated, the equation, the source of the equation, and a justification of the applicability of the equation. Similarly, the attachment must include a table that lists all default parameters to be used with the source of the parameter and a justification of its applicability.

Include equations such as:

- Equations calculating biomass per acre from biomass of individual trees or soil carbon cores, or quadrats of litter or non-tree vegetation
- Allometric equations linking diameter and/or height to biomass or volume
- Equations linking volume with total tree biomass
- Equations calculating volume of down dead wood

Include default parameters such as:

- Wood densities
- Percentage carbon of biomass

An illustrative example is provided below:

Parameter Calculated	Equation	Source	Justification
Tree Biomass	$= 0.5 + (25000 \times \text{DBH}^{2.5}) / (\text{DBH}^{2.5} + 246872)$	Schroeder et al. 1997	This equation has a high $r^2$ value and is applicable to hardwood species on the East Coast
Dead Wood Volume	$= \pi^2 * [(d1^2 + d2^2 \dots \dots \dots dn^2) / 8L]$	Pearson et al. 2007	This equation is the standard method in the literature for calculation of dead wood volume along transects
Soil Carbon	$= [\text{soil bulk density (g/cm}^3) \times \text{soil depth (cm)} \times \% \text{ C}] \times 100$	Pearson et al. 2007	The standard literature approach

5. Forest Management Practices if Timber Harvesting is Planned. If commercial timber harvesting is planned within the offset project boundary during the offset project's allocation period (the next 20 years), provide an attachment that describes the type of planned forest management (e.g., even-aged management or uneven-aged management) and the organization expected to provide certification that the project is managed in accordance with environmentally sustainable forestry practices (American Tree Farm System (ATFS), Forest Stewardship Council (FSC), Sustainable Forestry Institute (SFI)) or such similar organizations as may be approved by MassDEP.

6. Documentation of Data Quality Assurance Practices. Provide an attachment that documents all procedures to be used to ensure accuracy in data collection, data analysis, and data storage (including retention of original field data sheets). Quality assurance procedures must include procedures to record the dates of occurrence and the areas impacted by natural disturbances and the volume of timber and/or biomass extracted from the forest by timber harvesting activities.

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## **Form 2.5      Carbon Sequestration Permanence (Optional)**

Submit optional Form 2.5 only if long-term insurance has been or will be retained by the Project Sponsor that guarantees replacement of any lost sequestered carbon (due to a reversal) for which CO<sub>2</sub> offset allowances are awarded by MassDEP. Note that the form and terms and conditions of such long-term insurance are subject to approval by MassDEP.

Check the box in the form to indicate that such insurance has been or will be retained by the Project Sponsor. Attach a copy of the executed policy or to-be-executed policy that includes all terms and conditions of the policy. The attachment must include a header that indicates it is an attachment to Form 2.5 and includes the offset project name and offset project ID code. If attachments are being submitted as separate electronic documents, please include the form numbers in the file names of the documents.

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## Part 3. Independent Verification Form

The form in Part 3 of the *Consistency Application* addresses the requirements and documentation related to the independent verifier certification statement and report. Instructions for the form in Part 3 are provided below.

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### Form 3.1 Independent Verifier Certification Statement and Report

An accredited independent verifier must sign and date the form. Attach the accredited independent verifier report. The attached verifier report must include a header that indicates it is an attachment to Form 3.1 and includes the offset project name and offset project ID code. If attachments are being submitted as separate electronic documents, please include the form numbers in the file names of the documents. Note that the Project Sponsor must retain the completed original copy of the *Consistency Application* and attachments, including the verifier's original signed documents. MassDEP reserves the right to request the original signed documents at any time. The verifier report must document the following:

1. The verifier has reviewed the entire *Consistency Application* and evaluated the contents of the application in relation to the applicable requirements of 310 CMR 7.70(10).
2. The verifier has evaluated the adequacy and validity of information supplied by the Project Sponsor to demonstrate that the offset project meets the applicable eligibility requirements of 310 CMR 7.70(10)(c) and (e).
3. The verifier has evaluated the adequacy and validity of information supplied by the Project Sponsor to demonstrate baseline CO<sub>2</sub>-equivalent (CO<sub>2</sub>e) sequestration, pursuant to the applicable requirements of 310 CMR 7.70(10)(e)3.
4. The verifier has evaluated the adequacy of the monitoring and verification plan submitted pursuant to 310 CMR 7.70(10)(e)3.

The verifier report must include the following contents, in the order listed below:

- Cover page with report title and date
- Table of contents
- List of acronyms and abbreviations
- Executive summary
- Description of objective of report
- Identification of the client, including name, address, and other contact information
- Identification of the offset project
- Description of evaluation criteria (applicable regulatory provisions and documentation requirements specified in *Consistency Application*)
- Description of the review and evaluation process, including any site visits and interviews
- Identification of individuals performing the verification work, including the verification team leader and key personnel, and contact information for the team leader
- Description of the materials provided to the verifier by the Project Sponsor
- Evaluation conclusions and findings, including level of assurance provided