



**Avoided Wildfire Emissions
Forecast Methodology**
PUBLIC COMMENT DRAFT

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Acknowledgements

(alphabetical)

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Abbreviations and Acronyms

CO	Carbon monoxide
CO ₂	Carbon dioxide
CH ₄	Methane
FFE-FVS	Fire and Fuels Extension to the Forest Vegetation Simulator
FOFEM	First Order Fire Effects Model
FVS	Forest Vegetation Simulator
g	gram
GHG	Greenhouse gas
t	Metric ton (or tonne)
NMVOC	Non-methane volatile organic compounds
N ₂ O	Nitrous oxide
PM _{2.5}	Particulate matter, 2.5 micrometers or smaller
Reserve	Climate Action Reserve
SSR	Source, sink, and reservoir

1 Introduction

The Climate Action Reserve (Reserve) is an environmental nonprofit organization that promotes and fosters the reduction of greenhouse gas (GHG) emissions through credible market-based policies and solutions. Based in Los Angeles, the Reserve is the foremost carbon offset registry in North America with internationally recognized expertise in project-level GHG accounting. The Reserve establishes regulatory-quality standards for the development and quantification of GHG emission reduction projects; issues GHG emission reduction credits for use in compliance and voluntary carbon programs; and tracks the transaction of credits over time in a transparent, publicly-accessible registry system. Adherence to the Reserve's standards ensures that emission reductions associated with projects are real, permanent, and additional, thereby instilling confidence in the environmental benefit, credibility, and efficiency of carbon markets.

Climate Forward, a greenhouse gas mitigation program of the Climate Action Reserve, provides a practical solution to companies and organizations seeking cost-effective mitigation of anticipated (i.e., future) operational and/or project related GHG emissions. Climate Forward facilitates investments in GHG reduction activities that are practical, scientifically-sound, transparent, and aligned with forward-looking mitigation needs such as the California Environmental Quality Act (CEQA). Climate Forward will drive forward-looking investment into actions expected to result in GHG reductions, with a goal of expanding the scope and scale of feasible emission reduction project types.

Climate Forward is designed to provide companies, organizations, developers, and other entities with a conservative, robust, and methodologically rigorous option to mitigate an estimate of expected GHG emissions, on a voluntary or compliance basis, using FMUs generated from mitigation projects under this program. Climate Forward fundamentally differs from existing carbon credit programs through its focus on projecting and crediting estimated emission reductions on an *ex ante* basis. Under Climate Forward, estimated GHG reductions from the mitigation project are recognized as Forecasted Mitigation Units (FMUs), which are each equal to one metric ton of carbon dioxide equivalent (CO₂e) expected to be reduced or sequestered. FMUs can be retired for multiple purposes, including for CEQA mitigation or for other voluntary mitigation purposes.

The Avoided Wildfire Emissions methodology quantifies GHG emission reductions from the implementation of fuel treatments in forests that are at risk for high severity wildfire due to fire-suppression and past harvesting history. Projects involve the strategic placement of fuel treatments to modify fire behavior such that fire severity, and its related impacts on forest vegetation, are reduced compared to the baseline of no fuel treatment.

Fuel treatments are typically not considered a feasible project activity under traditional carbon offset crediting programs owing to the initial carbon loss resulting from the removal or manipulation of forest biomass to reduce wildfire risks and the length of time over which ongoing monitoring, reporting and verification would be required before a project likely would achieve net climate benefits and be credited for them. Additionally, high project initiation costs would have to be borne by project proponents until net climate benefits could be shown and payments for resulting credits are received. This misalignment between project costs and potential revenues from credit generation provides a barrier to entry that would be difficult to overcome by most would-be project proponents. The *ex ante* approach under this methodology recognizes and credits for the future climate benefits resulting from fuel treatment activities, thus helping to finance a substantial portion of project activity costs. In doing so, the methodology expands the scope of GHG mitigation projects recognized by the market.

The methodology is applicable across forested portions of the Western United States. Fuel treatments may consist of thinning, focused mainly on the removal of smaller diameter trees and understory vegetation, and reducing surface fuels through chipping, piling and burning, and/or prescribed fire. The implementation of fuel treatments reduces high severity wildfire which, in turn, moderates GHG emissions. The effects of fuel treatments can extend beyond the treatment areas to broader areas, referred to as ‘shadow areas’, where fire behavior is moderated as well. Shadow areas may extend across multiple landowners. This methodology defines the project area as the geographic location of the treatment areas as well as treatment shadow areas which are determined through modeling fire behavior. Since multiple treatment sites are likely to occur in a project area, the project area is expected to also contain some sections that do not experience a change in fire behavior between treatment sites.

The type, size, and distribution of fuel treatments greatly affects their effectiveness in changing fire behavior.^{10,11} High severity fire can result in the forest remaining in an early successional shrub phase for prolonged periods^{19–24} whereas reduced severity fires resulting from fuel treatments can ensure improved conditions for forest regeneration. The treatments can also result in reduced individual fire size compared to the baseline of no fuel treatment activity.^{1–9} Other non-GHG benefits of strategically placed treatment areas included enhanced suppression near human infrastructure.

The quantification of reduced emissions from fuel treatments includes accounting for forest carbon, wood products, and mobile emissions, both within the treatment area and within the balance of the project area, for both the baseline (without treatment) and project (with treatment). Forest vegetation data is modeled for growth, disturbance from wildfire, and regeneration, both with and without fuel management treatments where wildfire is integrated based on a probabilistic fire return interval (Figure 1).

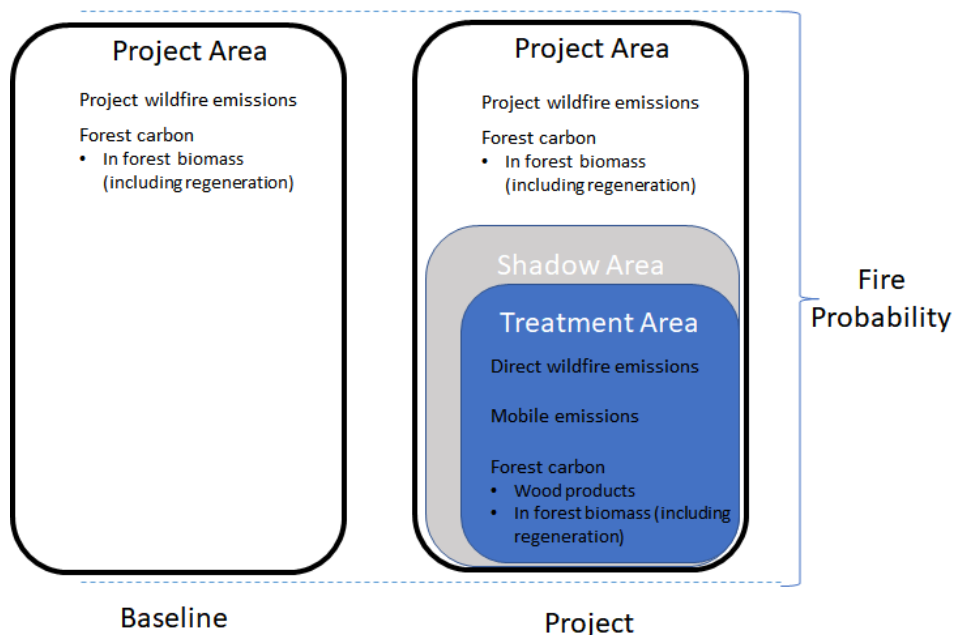


Figure 1.1 Avoided Wildfire Emissions Project Conceptual Outline

In summary, the AWE methodology quantifies the GHG benefits from fuel treatments (fuel reduction thinning, prescribed fire) that restore forests to desired structural conditions and fire regimes.²⁶ Fuel treatments reduce wildfire severity and potential size in frequent-fire forests that are at risk of high-severity wildfire. This methodology is designed to ensure the complete, consistent, transparent, accurate, and conservative *ex ante* quantification and confirmation of GHG emission reductions and removals associated with AWE projects.¹ Programmatic monitoring of project sites over time by the Reserve provide the opportunity for adjustments to be made to the methodology to improve the accuracy and conservativeness of the FMUs quantified and issued to projects registering under this methodology.

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

2 The GHG Reduction Project

2.1 Project Definition

An avoided wildfire emissions project is an activity, or set of activities, on forestlands that results in reduced wildfire emissions compared to wildfire emissions under business-as-usual activities, which are assumed to be the absence of fuel treatments to reduce fuel loading. Project activities are limited to the following fuel reduction activities:

- Mastication: “Mastication grinds, shreds, or chops noncommercial sized trees or shrubs into small chunks or pieces. The method does not reduce biomass; rather, the operator creates these small pieces and places them in contact with the soil surface to decompose.”² (Jain et al. 2018)
- Broadcast, prescribed, or cultural burning: “Broadcast burns are controlled applications of fire to fuels, under specified environmental conditions that allow fire to be confined to a predetermined area and produces the fire behavior and fire characteristics required to meet forest health objectives identified in a burn plan.”³ (USDA 2021)
- Thinning: Removal of selected trees by hand or mechanical means, which may include the removal of some merchantable trees. Typical silvicultural prescriptions include the removal of biomass to a target stand density index (SDI), trees per acre, basal area, increase of canopy base height, minimum and/or maximum diameter at breast height (DBH) limit, and species selection:⁴
 - Thin from below: the removal of non-dominant trees; increasing canopy base height
 - Crown thinning: Increase spacing between crowns
 - Selection cut: Removal of trees with a larger diameter range with the intent to shift species composition

Under this methodology, thinning operations must achieve the following minimum outcomes:

- The Quadratic Mean Diameter of thinned forest stands must increase following fuel reduction activities on average across the stands thinned.
- Basal area shall be reduced following thinning to no less than 50 square feet of basal area per acre on average across the stands thinned.
- Pruning: Removal of branches on the lower segments of a tree to reduce torching risk, i.e., crown ignition by providing surface fires climbing into crowns
- Mechanical removal of surface fuels: E.g., yarding and/or aggregating dead biomass such as branches and tops after a harvest to a designated location with the intent to pile-burn or dispose off-site

Projects may consist of an individual fuel reduction activity or a combination of multiple activity types within a single project, as long as the activities occur within a 3-year timeframe following the initiation of the first activity. Subsequent activities will require that a new project be initiated, as described in Section 3.2.

² Jain, Theresa; Sikkink, Pamela; Keefe, Robert; Byrne, John. 2018. To masticate or not: Useful tips for treating forest, woodland, and shrubland vegetation. Gen. Tech. Rep. RMRS-GTR-381. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 55 p.

³ https://www.fs.usda.gov/detail/arp/landmanagement/resourcemanagement/?cid=fsm91_058292 [Accessed 1/20/2022]

⁴ Agee, J. K., & Skinner, C. N. 2005. Basic principles of forest fuel reduction treatments. *Forest Ecology and Management*, 211(1–2), 83–96.

2.2 The Project Proponent

The “project proponent” is an entity that has an active account on the Climate Forward registry, submits a project for listing and registration with Climate Forward, and is ultimately responsible for all project reporting and confirmation. The project proponent is the entity undertaking (organizing, planning, and/or implementing or overseeing the implementation of) the actions that will generate GHG reductions and therefore owns the GHG reductions and removals attributed to the project. In all cases, the project proponent must attest to the Reserve that they have exclusive claim to the GHG reductions and removals resulting from the project. At the time a project is confirmed, the project proponent must attest that no other entities are reporting or claiming (e.g., for voluntary reporting or regulatory compliance purposes) the GHG reductions or removals claimed by the project. The Reserve will not issue FMUs for GHG reductions or removals that are reported or claimed by entities other than the project proponent. See Section 3.6 for additional information about FMU ownership and Section 8.4.1 for guidance around confirmation of this requirement.

3 Eligibility Rules

AWE projects must fully satisfy the following eligibility rules to register with Climate Forward. The criteria only apply to projects that meet the definition of a GHG reduction project (Section 2.1). See the remainder of this section for full details about all eligibility requirements.

Eligibility Rule I:	Location	→	Under forest cover for at least 20 years
		→	On privately owned and public (state and federal) timberlands within an eligible state
		→	May be on land previously registered as an AWE project, as well as on land where another forest project as long as the project is in good standing
Eligibility Rule II:	Project Start Date and Crediting Period	→	Project start date is based on the date fuel treatment activities are initiated, with a crediting period of 40 years.
Eligibility Rule III:	Additionality	→	Meet performance standard by not being on lands where fuel treatments have been performed within the previous 3 years
		→	Exceed regulatory requirements
Eligibility Rule IV:	Environmental and Social Safeguards	→	No negative environmental and social impacts & compliance with all applicable laws
Eligibility Rule V:	Regulatory Compliance	→	Project activities comply with all relevant rules and regulations, including acquisition of all relevant permits
Eligibility Rule VI:	Ownership and Double Counting	→	Must not receive credits from more than one program, where GHG boundaries overlap
		→	Demonstrate ownership of rights to GHG emission reductions/removals from the project

3.1 Location

AWE projects can be implemented on private or public lands in the Western United States (Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, and Washington, Wyoming), for registration with Climate Forward provided requisite data are available for project quantification, as described in Section 6, and provided they meet all other eligibility requirements described in this methodology. AWE projects must be located on lands under forest cover (i.e., having greater than ten percent tree⁵ canopy cover) for at least 20 years. Projects may be located on either public or privately-owned land, including tribal lands, with the project area defined by those areas where fire behavior is influenced by the activities listed in Section 2.1, as delineated based on the requirements specified in Section 6.2.1.

Projects in tribal areas must demonstrate that the land on which treatment areas are located is owned by a tribe or a private entity.

Additionally, since forest conditions change and fuel treatment effectiveness diminishes over time, projects may be located on sites where a project has been previously registered under this methodology (based on project area or specific activity areas within a project area), so long as all other eligibility requirements under the version of this methodology in effect at the time of project submission are met, including the additionality requirements specified in Section 3.3, and vegetation and fuel model data serving as the basis for modeling is updated to reflect the conditions resulting from the previously registered project, as described in Section 6.2.1. Furthermore, AWE projects may be located on sites where existing forest projects are located, so long as such forest projects are in good standing (whether project is currently active or has been completed) at the time of confirmation of any co-located AWE project. Project proponents must obtain approval and guidance from the Reserve prior to such project stacking, as further described in Section 3.6.

3.2 Project Start Date and Crediting Period

The project start date is the date fuel treatment activities are initiated in accordance with the project definition described in Section 2.1. Projects with start dates on or after 12 months preceding the publication date of this methodology are eligible. The project must be submitted to Climate Forward no more than one year after the project start date or the publication date of this methodology, whichever is later. The confirmation of the project must be completed no later than one year after the last activity has been completed, with project activities being completed within three years after the project start date, though projects may be allowed to complete project activities beyond three years with approval from the Reserve.

All projects that pass the eligibility requirements set forth in this AWE methodology as of the project start date are eligible to register FMUs with Climate Forward for the duration of the project's crediting period. A crediting period is the length of time over which GHG emission reductions are forecasted and quantified. Emission reductions for each project will be calculated as the sum of the forecasted emission reductions realized over a crediting period of 40 years.

3.3 Additionality

The Reserve registers only projects that yield surplus GHG reductions that are additional to what would have occurred in the absence of the project.

⁵ For purposes of this methodology, a tree is defined as 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.

To ensure additionality, the baseline management scenario must be based on an analysis of the risks of emissions resulting from fire under the current forest structural and fuel conditions. The baseline scenario needs to clearly identify and justify the trajectory for forest structural and fuel conditions over the crediting period, as further described in Section 6.3.

AWE projects must satisfy the following tests to be considered additional:

1. The Performance Standard Test
2. The Legal Requirement Test

3.3.1 The Performance Standard Test

Projects pass the performance standard test by meeting a methodology-wide performance threshold – i.e., a standard of performance applicable to all prospective projects, established on an *ex ante* basis. The performance standard threshold represents “better than business as usual.” Given current hazardous fuel loading conditions of forests in the United States, the backlog of areas that would benefit from treatments, the low prevalence of fuel treatment activities, and their typical inability to provide revenues that fully cover the costs of such activities, project activities meet the performance standard to the extent they are forecasted to reduce GHG emissions below would have occurred under the “business as usual” scenario outlined by the baseline estimation requirements in Section 6.

3.3.2 The Legal Requirement Test

All projects are subject to a legal requirement test to ensure that the GHG reductions achieved by a project would not otherwise have occurred due to any law (including any rules, regulations, or other legally binding mandates) issued by any authority with jurisdiction over the project. The project proponent must also demonstrate that the project was not established or implemented and was not operated at any time prior to the start date, in anticipation of, or to avoid or satisfy the anticipated requirements of any law.

The legal requirement test is applied at the time of a project’s start date. To satisfy the legal requirement test, project proponents must submit a signed Attestation of Legal Additionality form prior to the commencement of confirmation activities. In addition to the attestation, the Project Implementation Report must include procedures that the project proponent will follow to ascertain and demonstrate that the project passes the legal requirement test at the time of a project’s start date. All projects that pass this test at the project’s start date are eligible to register reductions with Climate Forward for the duration of the crediting period, even if legal requirements change or new legal requirements are enacted during that period. The project proponent should include documentation to justify that the project passes the legal requirement test. The confirmation body must confirm the Attestation of Legal Additionality by reviewing evidence provided by the project proponent, and any other evidence they feel is necessary such as literature reviews, independent expert testimony, or letters from relevant government agency representatives, or other means.

3.3.3 Enhancement Payments

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

- California Climate Investments (CCI);
- USFS grants and agreements;
- NRCS grants and agreements.

Project proponents and/or landowners whose forests comprise fuel treatment areas as part of a project under this methodology may pursue enhancement payments that support fuel treatment activities. Projects receiving enhancement payments that cover 85% or less of the expected costs to implement fuel treatments are considered additional under this methodology. However, projects receiving or expecting to receive payments covering more than 85% of the expected fuel treatment implementation costs are not automatically considered additional under this methodology and must obtain approval from the Reserve, which maintains the right to determine whether such payment stacking impacts project eligibility since high levels of financing could call into question the additionality of a project. Project proponents are strongly encouraged to reach out to the Reserve as early as possible when considering stacking enhancement payments with a project in this way. Furthermore, they must disclose any such payments to the Reserve at the time of listing and to the confirmation body at the time of confirmation.

3.4 Environmental and Social Safeguards

AWE projects can create long-term climate benefits as well as provide other environmental benefits, including the sustaining of natural ecosystem processes. To be in conformance with this methodology, AWE projects, at the time of initial project confirmation, must demonstrate that the fuel treatments adhere to environmental regulations such as wildlife habitat restrictions, stream buffer zone management regulations, or cultural provisions, as further specified in Section 3.5. Projects involving the draining or flooding of wetlands are prohibited under this methodology.

Additionally, the project proponent must describe in the Project Implementation Report how the project will have impacts (positive or negative) on environmental and social issues such as air and water quality, endangered species and natural resource protection, and environmental justice. This may include discussion of how the project aligns with the United Nations' Sustainable Development Goals,⁶ as well as the optional quantification of any non-GHG benefits (such quantification is not specified by this methodology).

All projects must be conducted in consultation with local resource management groups involved in planning and implementing activities that reduce fuel loads. Consultation means:

1. Projects must be submitted with a fuels management plan that indicates proposed management activities over time and space for a planning period of at least 5 years into the future from the project start date.
2. Projects must be submitted with a signatory form that indicates majority approval in which the local fire response agency is in consent. A template for the signatory form is provided on the Climate Forward website [*provided in Appendix B for public comment*] and shall be used to indicate approval on the identified areas for consideration. If any of the identified stakeholders is not involved in fire management activities, including defensible space, insert an 'NA.'

3.5 Regulatory Compliance

The project proponent must sign an Attestation of Regulatory Compliance prior to the commencement of project confirmation activities, attesting that no laws have been broken in the

⁶ Additional information regarding the Sustainable Development Goals may be found online at <https://sustainabledevelopment.un.org/>.

implementation of each project. Any permitting requirements applicable prior to the implementation of the project activities addressed in this methodology (e.g., timber harvest plan, water quality permit) must be described in the Project Implementation Report, including a description of the status in regard to fulfilling any such requirements at the commencement of confirmation activities. The project proponent must provide existing applicable authorizations, permits, and certifications from the appropriate authorities required for project operations to the confirmation body at the commencement of confirmation activities. The project proponent must also provide an assessment of any aspects of the project which may present a risk of future regulatory violations. Where such risks are identified, the project proponent shall describe measures undertaken to reduce and/or mitigate these risks. The confirmation body shall endeavor to confirm that the project implementation did not result in any regulatory noncompliance.

3.6 Ownership and Double Counting

The project proponent must attest that the project is not being submitted for emission reductions credits under any other carbon crediting program, world-wide. By signing the Attestation of Title, the project proponent attests that the FMUs have not and will not be registered with, reported in, held, transferred or retired via any emissions registry or inventory other than the Climate Forward registry, or registered with Climate Forward under a different project title or location. However, as described in Section 3.3.3, projects for which enhancement payments are pursued by the project proponent may still be eligible. Furthermore, as described in Section 3.1, if the project area encompasses any land included as part of a prior AWE project or as part of a forest or other relevant carbon project types (whether closed or actively reporting) in good-standing with the program in which it was or is enrolled, the project may still be eligible, subject to the quantification requirements for such projects, as specified in Section 6.13, including the use of vegetation and fuels data that accurately reflect conditions present prior to the start of the project as impacted by prior or existing projects. Such project stacking must be disclosed to the Reserve when the project is submitted for listing, at which time Reserve staff will determine if stacking is approved and will provide guidance on any further adjustments that may be required of the project.

Under this methodology, emissions reductions achieved as a result of project activities, as quantified according to Section 6, are considered to be owned by, and consequently issued to, the project proponent, regardless of the location where such emissions reductions are forecasted to occur. Thus, emissions reductions forecasted to be derived from changes in fire behavior on lands within the project area owned by entities that are not party to the project (i.e., not directly undertaking fuel treatments on their land) would still be owned by and issued to the project proponent implementing the activities that result in such emissions reductions. Although landowners within the project area who are not participating in the project benefit from the changes in fire behavior on their land brought about by fuel treatments that are part of the project, they are not implementing any activities that produce avoided GHG emissions from the project as determined under this methodology and have no claim to the resulting credits.

The project proponent must provide a signed Attestation of Title document for each project, attesting to their ownership of all GHG emission reductions generated by the project. This signed attestation, and any necessary supporting evidence, must be provided to the confirmation body. In addition to the Attestation of Title, confirmation bodies may wish to review relevant contracts, agreements, and/or supporting documentation between project proponents and other parties that may have a claim to the FMUs generated by the project.

3.7 Project Resilience Measures

By implementing the project activities as outlined in Section 2.1, forest conditions are changed in ways that inherently achieve impacts on future wildfires in the project area relative to the baseline scenario, without further actions required to maintain or manage the forest in a particular way once fuel treatments are completed. In other words, additional measures are not required to be taken by the project proponent to ensure the projected climate benefits are achieved. Furthermore, project proponents are allowed to submit projects on locations where projects have been previously registered under this methodology, as described in Sections 3.1 and 3.6, and are thus incentivized to conduct fuel treatments again in the future to maintain the resilience of the forest.

Major risk categories for the emission of carbon stocks from the trees within a project area are generally the same (e.g., timber harvest, land use conversion), but these risks—including from wildfires—are either reduced by fuel treatments within the crediting period or are accounted for under both the baseline and project scenarios during credit quantification, as described in Section 6.3. Additionally, the risk of land use conversion in ways that would impact credit integrity is expected to be minimal since project areas under this methodology are anticipated to be in rural settings, where forest conversion typically focuses on rural residential development that removes relatively few trees and reduces surface fuels.

3.8 Ensuring Permanence

Although forest carbon stocks are inherently at risk of being released into the atmosphere, the focus of credit quantification under this methodology is on the emissions that are avoided by undertaking fuel treatment activities that lead to modifications in future wildfire behavior. As a result, none of the credits issued under this methodology are reversible. In fact, the loss of forest carbon within project areas is acknowledged as being likely during the crediting period of each project if and when wildfires or other disturbances occur. However, such losses are either reduced, as is the case in the event of a wildfire, as a result of the project activities or are factored into both baseline and project scenarios as a part of credit quantification, as described in Section 6.3.

3.9 Demonstration of Ex Ante Suitability

AWE activities are suitable for ex ante estimates because the activities have an understood effectiveness period following implementation and the emissions reductions are based on a projection of probabilistic future emissions from wildfires. The methodology allows for an estimate of the efficacy of the treatments for some period of time into the future. Furthermore, the climate benefits of fuel treatments, though more fully realized in the future, are based solely on the successful implementation of such treatments and the resulting conditions in the forest upon their completion. No further actions, including ongoing management activities, are required on the part of the project proponent to ensure the climate benefits, as quantified under this methodology, are achieved.

4 The Project Area

The project area is defined by the area having potentially reduced fire intensity or severity as a result of fuel treatment activities and is delineated through a modeling process outlined in Section 6.1. It consists of individual treatment areas (i.e., the spatial extent of where a given fuel treatment occurs) and untreated areas where the indirect effects from project activities are quantified. The project area must be a contiguous spatial unit, whereas treatment areas may be disparate but are otherwise within the spatial extent of the project area.

Treatment areas must be delineated according to the post-treatment spatial extent of fuel treatment activities. Where conditions allow, treatment area boundaries may be delineated using remotely sensed data. Otherwise, treatment area boundaries must be field-logged using a GPS device. Each treatment area must be delineated by treatment type (as defined in Section 2.1). 6.1 Depictions of treatment areas and the project area must be made available as maps and GIS shapefiles for project reporting and confirmation. Treatment and project area GIS layers are used to conduct the quantification of GHG reductions and removals, as described in Section 6.4 and are reviewed by the Confirmation Body during the confirmation process, as described in Section 9.4.2.

As previously stated in Section 2.2, projects may be composed of treatment areas on multiple ownerships and individual treatment areas may cross ownership boundaries.

5 The GHG Assessment Boundary

The GHG Assessment Boundary defines all the GHG sources, sinks, and reservoirs (SSRs) that must be assessed by project proponents in order to determine the net change in emissions caused by a project.⁷ The GHG Assessment Boundary encompasses all the GHG sources, sinks, and reservoirs that may be significantly affected by AWE project activities, including forest carbon stocks, sources of biological CO₂ emissions, and mobile combustion GHG emissions. For accounting purposes, the SSRs included in the GHG Assessment Boundary are organized according to whether they are predominantly associated with an AWE project's "primary effect" (i.e., the AWE project's intended changes in carbon stocks, GHG emissions, or GHG removals) or its "secondary effects" (i.e., unintended changes in carbon stocks, GHG emissions, or GHG removals caused by the AWE project). Secondary effects may include increases in mobile combustion CO₂ emissions associated with project implementation, as well as increased CO₂ emissions caused by the shifting of emissions from harvesting activities from the project area to other forestlands or from the shifting of product use (often referred to as "leakage"). See Section 5.1 for a discussion on secondary effects.

Table 5.1 provides a comprehensive list of the GHG SSRs that may be affected by an AWE project and indicate which SSRs must be included in the GHG Assessment Boundary for each AWE project. If an SSR is designated as a "reservoir/pool", this means that GHG reductions and removals are accounted for by quantifying changes in carbon stock levels. For SSRs designated as sources or sinks, GHG reductions and removals are accounted for by quantifying changes in GHG emission or removal rates, as described in the tables.

Table 5.1 Description of all Sources, Sinks, and Reservoirs.

SSR	SSR Description	Baseline/ Project	GHG	Included ?	Justification/Explanation
Primary Effect Sources, Sinks, and Reservoirs					

⁷ The definition and assessment of SSRs is consistent with ISO 14064-2 guidance.

1	Standing live carbon (carbon in all portions of living trees)	<p>Baseline: Modeled fire against untreated vegetation data</p> <p>Project: Modeled fire against treated vegetation data</p>	CO ₂	Yes	Changes in standing live trees and their associated carbon stocks are an important factor determining project outcomes relative to the baseline, both in relation to onsite carbon and potential emissions from wildfires. Fire can partially combust and/or modify live carbon in trees to dead carbon in trees. Emissions associated with combustion (see SSR 9) and the loss of future carbon sequestration in standing live trees is the largest primary effect of AWE projects.
2	Shrubs and herbaceous understory carbon	<p>Baseline: Modeled fire against untreated vegetation data</p> <p>Project: Modeled fire against treated vegetation data.</p>	CO ₂	Yes	Shrubs and herbaceous understory constitute a relatively small proportion of carbon stocks in an AWE project but play a considerable role in fire behavior (modeling). Shrubs and herbaceous understory carbon can be heavily combusted during wildfire events, which are modeled as part of determining project benefits. Fuel reduction treatments might considerably impact this pool through mastication, broadcast burning, etc. It is included in the standard growth and yield modeling approach. The data for this vegetation layer has to be also taken into account though for fire behavior modeling.
3	Standing dead carbon (carbon in all portions of dead, standing trees)	<p>Baseline: Modeled fire against untreated vegetation data (which includes estimates of dead trees).</p> <p>Project: Modeled fire against treated vegetation data (which includes estimates of dead trees).</p>	CO ₂	Yes	AWE projects may significantly increase non-wildfire related standing dead carbon stocks over time due to reduced wildfire severity potentially reducing this carbon stock considerably. A reduction in wildfire severity will increase retention of standing dead material at natural rates where it will slowly decompose.

4	Lying dead wood carbon	<p>Baseline: Modeled fire against vegetation data (which includes lying dead wood)</p> <p>Project: Modeled fire against treated vegetation data (which includes lying dead wood)</p>	CO ₂	Yes	<p>Lying dead wood constitutes a relatively small proportion of carbon stocks in an AWE project but plays a considerable role in fire behavior (modeling).</p> <p>Lying dead wood can be heavily combusted during wildfire events, which are modeled as part of determining project benefits. Fuel reduction treatments might considerably impact this pool through mastication, broadcast burning, etc. It is included in the standard growth and yield modeling approach. The modeling of vegetation data will account for lying dead wood, both from a fire behavior perspective and an emission perspective. .</p>
5	Litter and duff carbon (carbon in dead plant material)	<p>Baseline: Modeled fire against untreated vegetation data (which includes litter and duff)</p> <p>Project: Modeled fire against treated vegetation data (which includes litter and duff)</p>	CO ₂	Yes	<p>Litter and duff carbon constitute a relatively small proportion of carbon stocks in an AWE project but play a considerable role in fire behavior (modeling). Litter and duff are heavily combusted during wildfire events, which are modeled as part of determining project benefits.</p> <p>Fire reduction treatments might considerably impact this pool through mastication, broadcast burning, etc. It is included in the standard growth and yield modeling approach. The modeling of vegetation data will account for litter and duff, both from a fire behavior perspective and an emission perspective.</p>
6	Soil carbon	<p>Baseline: N/A</p> <p>Project: N/A</p>	N/A	No	<p>Soil carbon is not anticipated to change significantly as a result of AWE project activities. Roots of live and dead standing trees are included in the accounting of live and dead standing trees, separate from soil carbon.</p>
7	Carbon in harvested wood products	<p>Baseline: N/A</p> <p>Project: Estimated from modeled harvesting volumes</p>	CO ₂	Yes, but not counted for crediting if project is	<p>Although the harvesting of trees for conversion into wood products may occur for both baseline and project activities, the only difference between the modeled baseline and project activities is the harvesting of trees, if any, as</p>

				stacked with a project that accounts for carbon in wood products	<p>part of fuel treatments. Therefore, only biomass removed through fuel treatment activities are included for project accounting purposes.</p> <p>The quantification of harvested wood products is based on the contribution of the sequestered carbon over time based on estimates of product durability.</p>
8	Forest product carbon in landfills	<p>Baseline: N/A</p> <p>Project: Estimated from modeled harvesting volumes</p>	CO ₂	Yes, but not included for crediting if project is stacked with a project that accounts for carbon in wood products	<p>Although the harvesting of trees for conversion into wood products may occur for both baseline and project activities, the only difference between the modeled baseline and project activities is the harvesting of trees, if any, as part of fuel treatments. Therefore, only biomass removed through fuel treatment activities are included for project accounting purposes.</p> <p>The quantification of harvested wood products is based on the contribution of the sequestered carbon over time based on estimates of product durability.</p> <p>A portion of the wood products end up in landfills where their decomposition can be estimated.</p>
9	Biomass combustion emissions from fires (prescribed burns and wildfires)	<p>Baseline: Y</p> <p>Project: Y</p>	CO ₂	Yes	<p>Changes to forest fuel conditions is the primary driver of GHG benefits produced by AWE projects, resulting in modifications to CO₂ emissions from the combustion of biomass resulting from wildfires. Emissions from prescribed burns are also quantified to ensure conservative accounting.</p>
		<p>Baseline: Y</p> <p>Project: Y</p>	CH ₄	Yes	<p>Changes to forest fuel conditions is the primary driver of GHG benefits produced by AWE projects, resulting in modifications to CH₄ emissions from the combustion of biomass resulting from wildfires. Emissions from prescribed burns are also quantified to ensure conservative accounting.</p>

		Baseline: Y Project: Y	N ₂ O	Yes	Changes to forest fuel conditions are the primary driver of GHG benefits produced by AWE projects, resulting in modifications to N ₂ O emissions from the combustion of biomass resulting from wildfires. Emissions from prescribed burns are also quantified to ensure conservative accounting.
		Baseline: Y Project: Y	CO	Yes	Changes to forest fuel conditions is the primary driver of GHG benefits produced by AWE projects, resulting in modifications to CO emissions from the combustion of biomass resulting from wildfires. CO emissions from biomass combustion associated with AWE projects are considered to ensure comprehensive accounting. Emissions from prescribed burns are also quantified to ensure conservative accounting.
		Baseline: Y Project: Y	PM _{2.5}	Yes	Changes to forest fuel conditions is the primary driver of GHG benefits produced by AWE projects, resulting in modifications to PM _{2.5} emissions from the combustion of biomass resulting from wildfires. PM _{2.5} emissions from biomass combustion associated with AWE projects are considered to ensure comprehensive accounting. Emissions from prescribed burns are also quantified to ensure conservative accounting.
		Baseline: Y Project: Y	NM VOC	Yes	Changes to forest fuel conditions is the primary driver of GHG benefits produced by AWE projects, resulting in modifications to non-methane volatile organic compound (NM VOC) emissions from the combustion of biomass resulting from wildfires. NM VOC emissions from biomass combustion associated with AWE projects are considered to ensure comprehensive accounting. Emissions from prescribed burns

					are also quantified to ensure conservative accounting.
Secondary Effect Sources, Sinks, and Reservoirs					
10	Mobile combustion emissions	Baseline: N/A Project: Y	CO ₂	Yes	Mobile combustion CO ₂ emissions from project implementation, including forestry and the transport of harvested trees, are likely to be small in proportion to the emissions accounted for in other pools but will be included.
		Baseline: N/A Project: N/A	CH ₄	No	Changes in CH ₄ emissions from mobile combustion associated with ongoing project operation and maintenance activities are not considered significant.
		Baseline: N/A Project: N/A	N ₂ O	No	Changes in N ₂ O emissions from mobile combustion associated with ongoing project operation and maintenance activities are not considered significant.
11	Biological emissions from converting forestlands to other uses outside the project area	Baseline: N/A Project: N/A	CO ₂	No	AWE projects will not cause shifts in alternative land uses that might lead to clearing of forestland.
12	Biological emissions/removals from changes in harvesting on forestland outside the project area	Baseline: N/A Project: N/A	CO ₂	No	AWE projects are designed to improve forest resiliency and are anticipated to enable forest stands, both within the treatment areas and within the broader project area, to be more productive than under the baseline scenario. Due to the higher overall productivity, no shifting of harvests from the project area is expected.

13	Combustion emissions from production, transportation, and disposal of alternative materials to forest products	Baseline: N/A Project: N/A	CO ₂	No	AWE projects will not result in a shift of harvested wood products to other forest sites or to other building materials since AWE projects will result in greater forest productivity than the baseline case. It is conservative not to include these emissions.
		Baseline: N/A Project: N/A	CH ₄	No	Combustion-related CH ₄ emissions related to changes in the production, transportation, and disposal of alternative materials are not considered significant.
		Baseline: N/A Project: N/A	N ₂ O	No	Combustion-related N ₂ O emissions related to changes in the production, transportation, and disposal of alternative materials are not considered significant.
14	Biological emissions from decomposition of forest products	Baseline: Quantified as a component of calculating carbon stored for 100 years in wood products (SSR 7) and landfills (SSR 8) Project: Quantified as a component of calculating carbon stored for 100 years in wood products (SSR 7) and landfills (SSR 8)	CO ₂	Yes	CO ₂ emissions from the decomposition of forest products are built into calculations of how much forest product carbon will remain in in-use wood products and in landfills, averaged over 100 years (see SSR 7)
		Baseline: N/A Project: N/A	CH ₄	No	In-use wood products will produce little to no CH ₄ emissions. CH ₄ emissions can result from anaerobic decomposition of forest products in landfills. This methodology assumes that landfill CH ₄ emissions will be largely controlled in the near future due to federal and/or state regulations. Thus, changes in forest-product production are assumed to have no significant effect on future CH ₄ emissions from anaerobic decomposition of

					forest products in landfills. These emissions are therefore excluded from the GHG Assessment Boundary.
		Baseline: N/A Project: N/A	N ₂ O	No	Decomposition of forest is not expected to be a significant source of N ₂ O emissions.

5.1 Leakage Accounting

Leakage effects through activity shifting or market effects are not considered under this methodology since fuel treatment activities will include greater removal of forest products than in the baseline for projects involving thinning or other processes that remove biomass from the forest and will have equal removal of forest products (i.e., no additional removal relative to the baseline) for projects involving only prescribed burns.

6 Quantifying GHG Emission Reductions

GHG reductions are calculated by comparing the baseline to the forecasted mitigation project performance over the crediting period. GHG reductions are achieved when an AWE project results in lower GHG emissions to the atmosphere compared to what would have happened absent the mitigation project. GHG reductions are aggregated for the entire project area on a per-unit-area basis in five-year increments based on the quantification requirements specified in this section and as outlined in Equation 6.1. The Reserve provides project proponents with an Microsoft Excel-based file called the Avoided Wildfire Emissions FMU Calculation Worksheet⁸ to facilitate the calculations specified below, as derived from the modeling requirements outlined in this methodology.

Equation 6.1. Calculating GHG Emission Reductions

$$ER = \left(\sum_t [(E_{bsl} - C_{bsl}) - (E_{pr} - C_{pr})] \right) \times (1 - 0.1)$$

Where,

<i>ER</i>	= Total emission reductions across all years <i>t</i>	<i>Units</i> tCO ₂ e
<i>t</i>	= Year within the crediting period	Year
0.1	= Programmatic ex ante risk discount	

And

$$E = \left(\sum_i (W_i + C_{DR,i}) \times P_{Const} \right) + C_{OPS}$$

Where

<i>E</i>	= Total emissions associated with either the baseline (<i>E_{bsl}</i>) or project (<i>E_{pr}</i>) scenario for year <i>t</i>	tCO ₂ e
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⁸ Available on the Avoided Wildfire Emissions Forecast Methodology webpage at <https://climateforward.org/program/methodologies/AWE/> [pending final approval of methodology].

i	= Individual stratum within the project area	
W_i	= Wildfire emission or carbon stock loss from wildfire combustion for stratum i for year t	tCO_2e
$C_{DR,i}$	= Mean carbon stock loss from delayed reforestation based on the percentage of burned acres that would have been redirected in stratum i for year t (See Equation 6.4)	tCO_2e
P_{Const}	= Constant annual fire probability (See Equation 6.5)	%
C_{OPS}	= Direct fossil fuel GHG emissions associated with the management scenario (mechanical treatments or prescribed fire operations) for year t (project scenario only)	tCO_2e
And	$C = (C_{AG} + C_{BG} + C_{DW}) + C_{WP}$	
Where		
C	= Total carbon stocks associated with either the baseline (bsl) or project (pr) scenario for year t	tCO_2e
C_{AG}	= Carbon stock in above-ground portion of live trees for all strata for year t	tCO_2e
C_{BG}	= Carbon stock in below-ground portion of live trees for all strata for year t	tCO_2e
C_{DW}	= Carbon stock in dead wood pools for all strata for year t	tCO_2e
C_{WP}	= Carbon stocks in wood products derived from biomass removed during project activities for year t (project scenario only); excluded if project is stacked with another project type that has claim to the carbon in biomass removed from the project area	tCO_2e

The methods for quantification are the same in the baseline and project scenarios. Equation 6.1 and the equations in subsequent sections can be applied in either scenario, unless otherwise indicated. Thus, they are not presented twice. Rather, project proponents should add subscripts as needed to denote whether the parameters and results are relevant to the baseline scenario ("bsl") or the project scenario ("pr"), as is applied in Equation 6.1.

6.1 Overview of Quantification Approach

The following overarching quantification approach is the basis for the detailed guidance provided in subsequent sections regarding how project proponents are to calculate the forecasted GHG benefits associated with a project.

1. Conduct preliminary fire behavior modeling to determine project area (Figure 6.1) based on areas of fire spread from ignition points in the project vicinity. Only those burn areas coincident with the project's treatment areas are included in the project area.

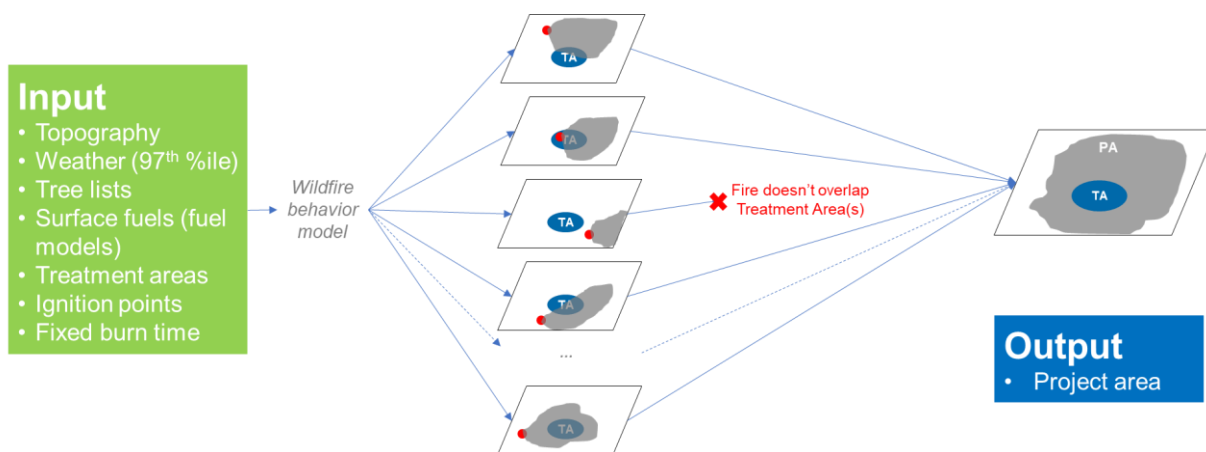


Figure 6.1. Determining the project area

2. Determine forest management scenarios applicable to the baseline and project scenarios, including background harvesting applied to both scenarios, and model changes to forest stand conditions over time in the absence of fire (Figure 6.2). Such modeling captures not only changes in live tree C stocks, but also changes to surface fuels over time and the removal of biomass during fuel treatments that are part of the project activity.

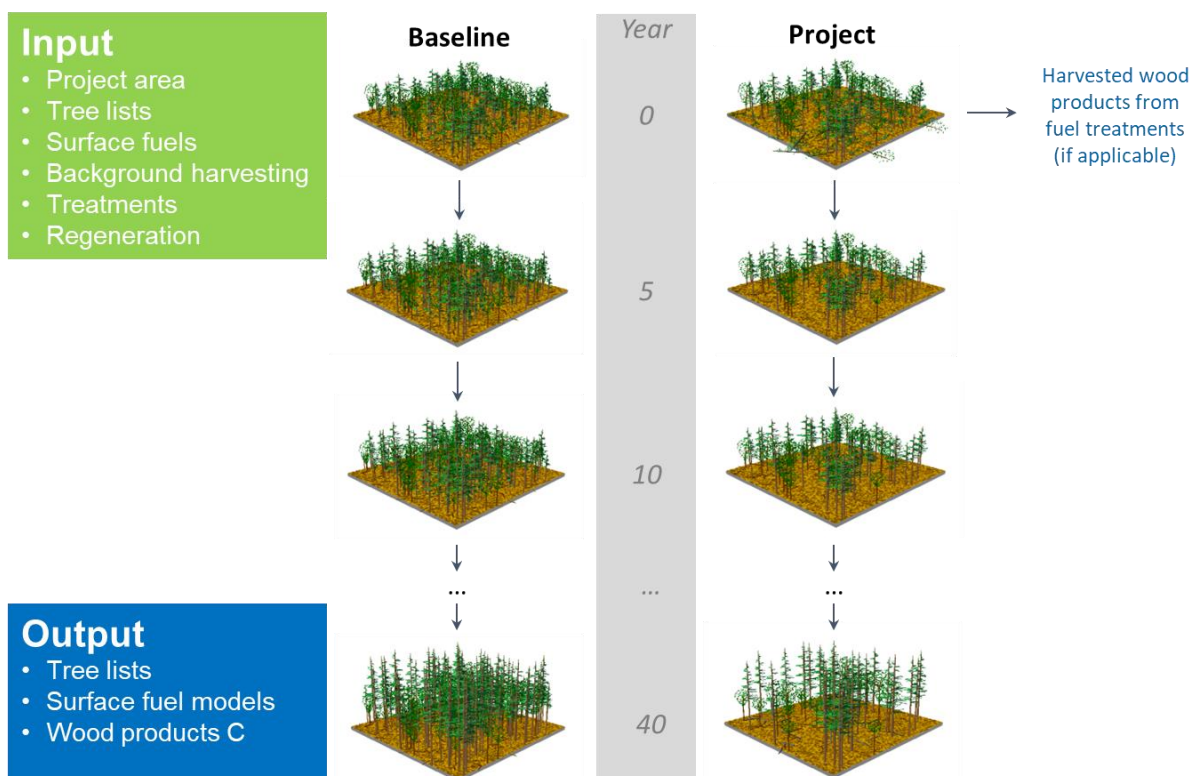


Figure 6.2. Modeling changes to forest conditions

3. Model a wildfire occurring across the project area for each modeling time step for both the baseline and project scenario to determine total gross emissions—including non-CO₂ emissions—that would occur during any given year throughout the project crediting period and calculate the GHG impacts from the ability of fuel treatments to modify fire severity in ways that prevent sites from being unable reestablish tree cover in a timely manner following the occurrence of a fire (Figure 6.3).

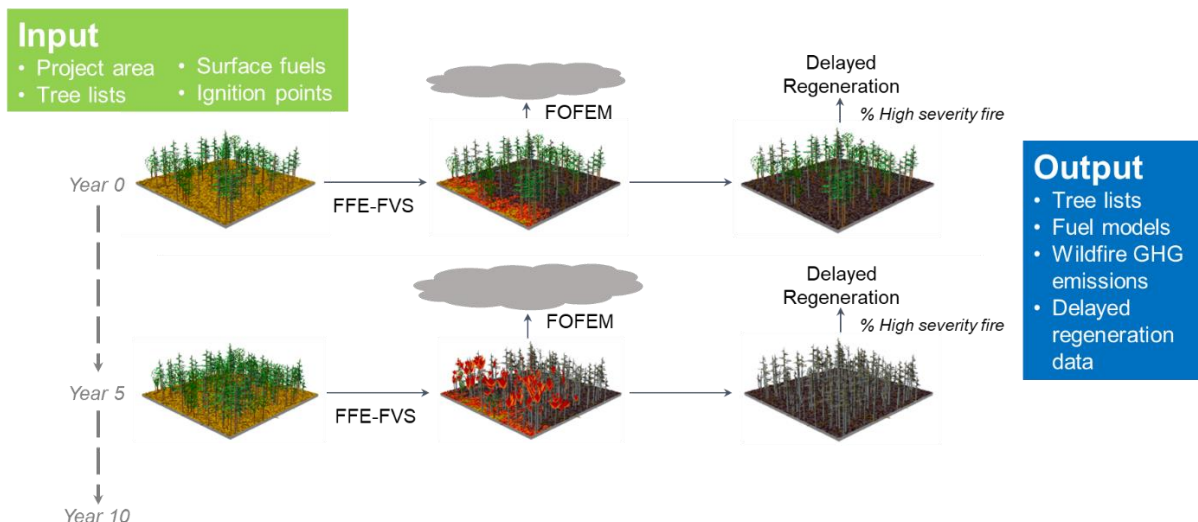


Figure 6.3. Modeling GHG emissions from wildfire and estimating delayed regeneration impacts

4. Model wildfire behavior from ignition points that served as the basis for project area delineation to determine the likelihood of a given location to burn if a fire ignites under specified conditions within the project area (i.e., conditional burn probability) and to calculate the resulting impacts of fuel treatments on fire behavior (Figure 6.4).

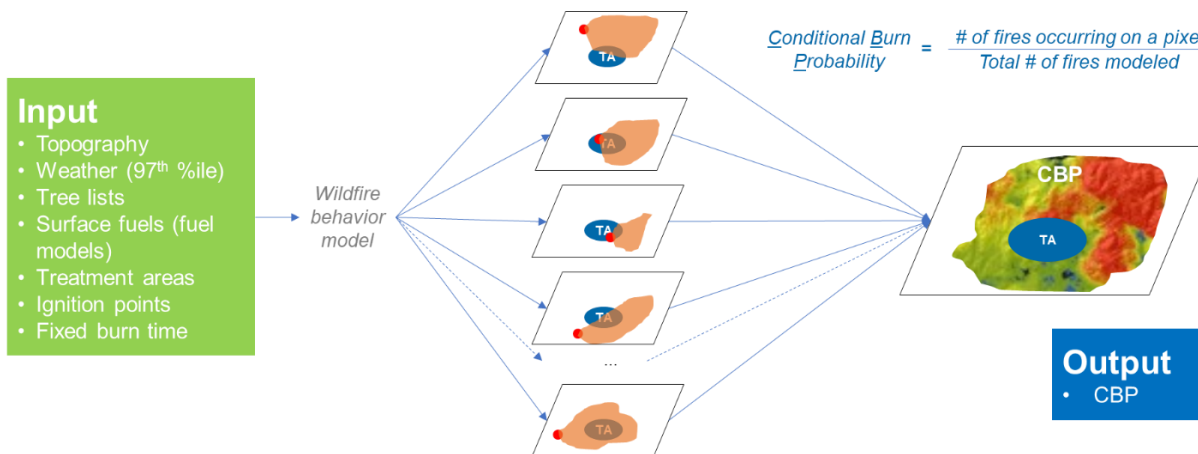


Figure 6.4. Determine likelihood of a given location to burn relative to other locations in the project area.

5. Quantify total GHG benefits by adjusting annual GHG emissions benefits from fuel treatments (relative to baseline conditions) based on the annual probability of a fire

occurring in the project area (Figure 6.5).

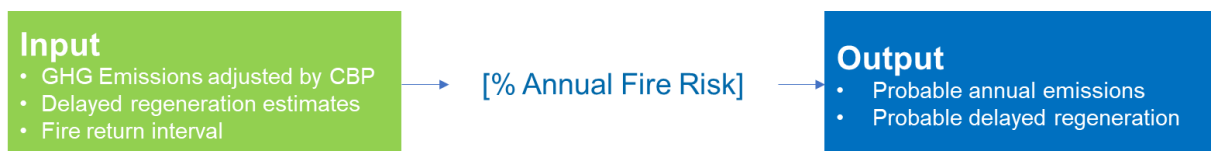


Figure 6.5. Adjust calculated GHG benefits by annual risk of fire.

6.2 Establishing the Project Area

This section provides guidance for the process of delineating the project area boundary, which involves a preliminary fire modeling exercise. The project area is intended to be an approximation of a fireshed that is a contiguous unit defined by a combination of site-specific fire regime, fuel condition classes, fire history, fire hazard and probability, and potential wildland fire behavior of a scale that allows the ecologically relevant integration of wildfire probability, wildfire hazard, and forest carbon accounting (Bahro et al., 2007). Under this methodology, the project area is delineated as the area determined to be impacted by a fire, with the potential to experience mitigating effects from the project's fuel treatment activities, based on a modeling approach that uses weather, topography (including slope, aspect, and elevation), vegetation/biomass (including surface fuels, canopy cover, canopy bulk density, and canopy height, both base and total height) and historical wildfire ignition points as input.

6.2.1 Topographic and Vegetation Data

Topographic data, tree inventory data, and surface fuel models are provided by the Reserve and can be retrieved from the [Climate Forward website](#). Once retrieved, such data must be updated to represent baseline disturbances (e.g., wildfire, harvest, insect infestations) and growth between the current and year represented by the retrieved data. This includes any modifications to vegetation and fuel conditions resulting from prior projects submitted under this methodology and on which a project is being stacked. Stand polygons cannot be used. The growth and yield modeling needs to be performed on a pixel basis using the tree inventory data as input. Depending on the size of the project and computational resources available, aggregating pixels up to a 90m resolution (into 'stands') is allowed.

6.2.2 Weather Data

The project proponent needs to use weather data as provided by the Reserve and available via the [Climate Forward website](#) to create a realistic weather scenario based on historical patterns. At least two weather data points must be used but ideally there would be at least one data point per eighth-field watershed. Extreme fire weather is likely to become more common in the near future such that the current 99th percentile weather conditions could drop to 95th percentile conditions by 2030 (e.g., Mann et al., 2016). Therefore, the project proponent is to employ a weather scenario based on 97th percentile conditions. The project proponent must analyze weather conditions observed during at least one significant, severe wildfire representing fire behavior that could be expected in or very near the project area to demonstrate the appropriateness of the weather conditions used for modeling purposes. If wind gust speed data

are not available, Table 6.1, as derived from Crosby and Chandler (2004)⁹, is to be used to convert average windspeeds to wind gust speeds.

Table 6.1. Crosswalk for conversion of steady windspeed to wind gust speed.

Standard 10 Minute Average (Miles per Hour)	Probable Average Wind Gust (Miles per Hour)	Standard 10 Minute Average (Miles per Hour)	Probable Average Wind Gust (Miles per Hour)	Standard 10 Minute Average (Miles per Hour)	Probable Average Wind Gust (Miles per Hour)
1	6	11	23	21	37
2	8	12	25	22	38
3	11	13	26	23	39
4	13	14	28	24	40
5	15	15	29	25	41
6	16	16	30	26	43
7	17	17	32	27	44
8	19	18	33	28	45
9	20	19	34	29	46
10	22	20	35	30	47

Software such as FireFamily Plus (FF+; Bradshaw and McCormick, 2000) can be used to summarize the weather data. Specifications (wind speed, wind direction, gust speed, fuel and foliar moisture values) and potential deviations from weather stations due to local particularities need to be described and justified. Peer-reviewed future climate projections can be used to modify weather-related modeling parameters if desired.

6.2.3 Ignition Data

Standardized spatial data for ignition sites to be used for modeling under this methodology is provided by the Reserve and can be retrieved from the [Climate Forward website](#). Ignition data must be evaluated to determine the density of ignition points, as described below. Sufficient ignition points (which will represent individually simulated wildfires) are needed to ensure that all burnable areas encounter wildfires at least once. At least 0.6 ignition points per hectare are required under this methodology. If the ignition dataset does not provide this level of ignition density for the project area, GIS processing may be required to increase the density, as described in Step 5 of Section 6.2.4, while preserving the historical ignitions-based spatial distribution.

6.2.4 Project Area Delineation

The project area is delineated based on fire regime, condition class, fire history, fire hazard and probability, and potential wildland fire behavior of a scale that allows the ecologically relevant

⁹ Crosby, J. S., and C. C. Chandler. 2004. Get the most from your windspeed observation [reprinted from 1966]. Fire Management Today, v. 64, no. 1, p. 53-55. http://www.fs.fed.us/fire/fmt/fmt_pdfs/fmt64-1.pdf.

integration of wildfire probability, wildfire hazard, and forest carbon accounting (Bahro et al., 2007). To delineate the project area, the project proponent uses the following steps:

1. Spatially delineate treatment areas in a GIS layer.
2. Identify the prevailing wildfire-relevant fuel models, topographic data, vegetation data, and weather conditions, as indicated above.
3. Run wildfire spread simulations (one simulation for each ignition point within the area of analysis) using a wildfire behavior model approved in advance by the Reserve and listed on the [Climate Forward website](#), as further described in Section 6.6) based on a runtime of 8 hours to identify the minimum areas impacted around the treatment activities.
4. Define the project area boundary by identifying the area comprising all burn areas that include the project's treatment area(s). Such burn areas will be based on ignition points that are either upwind of or within the treatment area(s).
5. If the density of ignition points within the project area is less than 0.6 ignition points per hectare,¹⁰ add ignition points with spatial distribution skewed based on historical ignition points. Once the density of ignition points is at or above 0.6 ignition points per hectare, repeat steps 3 and 4.

6.3 Determining Forest Management Scenarios

Forest management practices determine changes to forest carbon stocks and wildfire conditions within the project area. Proponents must define the forest management practices that serve as the basis for growth and yield modeling under both the baseline and project scenarios.

The project proponent must apply the following to determine the background harvesting conditions, which are applied to both the baseline and project modeling scenarios:

Background scenarios must be based on harvest assumption data provided on the [Climate Forward website](#). *[Data source and process for incorporation into modeling TBD.]* Since this dataset may be derived from multiple sources with varying accuracy, the project proponent must confirm and adjust background harvest assumptions based on verifiable documentation. Additionally, any known harvest plans that are already approved for locations where state-permitting requirements necessitate approval by a state agency prior to harvest operations or are on government-owned lands for which all harvest planning requirements have been completed (i.e., are ready for operations to commence) must be incorporated into harvest assumptions for the project area.

For the project scenario, the project proponent must also define the details of the fuel treatment(s) applied, including:

- Fuel reduction and silvicultural prescriptions
- Location(s), spatially defined in GIS layer
- Timing
- Fate(s) of residues.

6.4 Modeling Changes to Forest Carbon Stocks

Once the project area has been delineated and forest management scenarios are defined, changes in forest carbon must be projected over the 40-year crediting period within the project

¹⁰ See Ager et al., 2010, 2007

area for both the baseline scenario and the project scenario. Modeling of forest growth must be completed with the regionally applicable variant of the Forest Vegetation Simulator (FVS) using five-year output intervals across the entire crediting period. The model must be parameterized (e.g., regeneration inputs) for the specific conditions of the project using verifiable sources. For converting biomass into carbon outputs, the default combination of FVS defaults must be used. The output of the models must include projected volume in live aboveground tree biomass by stratum.

The results from FVS modeling are entered into Equation 6.1 for the variables C_{AG} (live above ground), C_{BG} (live below-ground), and C_{DW} (dead and down wood) for both the baseline and project scenario.

6.5 Estimating Forest Biomass Removals

As a part of forest carbon stock modeling, project proponents must estimate the amount of carbon sequestered in wood products as a result of biomass removed under the project. Since background harvesting is applied to both the baseline and project scenarios, as described in Section 6.3, only the biomass removed during fuel treatment activities is included in project accounting.

An estimate of carbon in wood products based on modeled harvest volumes and the fate and average stock levels over 100 years for both in-use wood products and those in landfills is provided as standardized output from FVS and is inserted into Equation 6.1 for the variable C_{WP} .

Furthermore, if an AWE project is stacked (i.e., spatially and temporally overlapping) with another project type that accounts for carbon in harvested wood products, carbon stocks in wood products are to be reported for the AWE project but are not included in the quantification of emissions reductions in Equation 6.1. See Section 6.13 for additional information about reconciliation with stacked projects.

6.6 Modeling Wildfire Emissions

Emissions from wildfire that burns the entire project area must be estimated at five-year intervals over the project term. Emissions accounted for under this methodology include non- CO_2 GHGs, as outlined in Table 5.1.

Three types of models are applied to model wildfire emissions:

1. A **forest growth and yield model with a fire component** that determines the impacts of wildfire on the conditions of a given stand. Under this methodology, the Fire and Fuels Extension to the Forest Vegetation Simulator (FFE-FVS) is required to be used by all projects.
2. A **wildfire emissions model** that translates stand-level wildfire characteristics into emissions. The First Order Fire Effect Model, or FOFEM, is required to be used by all projects under this methodology.
3. A **wildfire behavior model** that calculates wildfire spread and the probability of a stand to burn. Models to be used under this methodology must be pre-approved by the Reserve (see the [Climate Forward website](#) for a list of approved models) and must meet the following criteria:
 - i. Peer-reviewed in a process involving experts in modeling and fire ecology/forestry/ecology;

- ii. Used only in scenarios relevant to the scope for which the model was developed and evaluated;
- iii. Parameterized for the specific conditions of the project.

FFE-FVS must be used to produce inputs required by the wildfire behavior model. The SimFire and Compute FVS keywords produce the surface and canopy fuels variables (fire behavior fuel model, canopy cover, canopy base height, etc.) needed by the standard fire behavior models pre-approved by the Reserve for wildfire behavior modeling under this methodology.

The surface fuels data used as inputs for the wildfire behavior model must be retrieved from the Climate Forward website. The wildfire behavior model must be run repeatedly to simulate wildfires at every five-year timestep for baseline conditions as well as for the project conditions. Each model run must use an 8-hour burn time. The goal of the wildfire behavior modeling is to produce a conditional burn probability (CBP) ratio map for each timestep for each project, e.g., CBP_P/CBP_{BSL} in year 0, CBP_P/CBP_{BSL} in year 5, etc., as described further below. These CBP ratio maps represent the extent and magnitude of changes in burn probability outside of fuel treatments due to the effects of the fuel treatments themselves. All paired wildfire behavior model runs must use the same randomly distributed wildfire ignition locations, weather conditions, and fire behavior parameters (see Section 6.1). The CBP rasters have to be saved from each wildfire behavior model run.

Suppression activities can impact wildfire behavior. However, since current wildfire behavior models are limited in their ability to integrate suppression activities, the impact of these activities will not be assessed in this process. The multi-step modeling process involves the following:

1. Use the Fire and Fuels Extension to the Forest Vegetation Simulator (FFE-FVS), at each five-year timestep, to simulate forest dynamics, timber harvest, and track carbon stocks, and to provide inputs for wildfire behavior and emissions models.

To determine fire behavior fuel models by stand, the approach described on the Climate Forward website must be used.

Additionally, certain FVS variants such as the Western Sierra variant lack a forest regeneration model, leaving the user to input this information. This shortcoming can distort forest stand conditions as they are projected into the future based on user inputs which may be inconsistent or subjective. Depending on the understory conditions, projected canopy base height can increase rapidly, thereby greatly reducing the potential for crown fire initiation (Moody et al. 2016). To counter this effect, adjustments and a pulse of mixed-conifer regeneration must be applied at every time step, along with a small-tree growth rate multiplier (Collins et al., 2011), based on the approach described on the Climate Forward website.

Save FFE-FVS fuel load outputs needed for the emissions model FOFEM and save carbon inventory data needed for accounting (Equation 6.1).

2. Format the FFE-FVS outputs for input into FOFEM. The necessary values are stored in the FVS_Fuels and FVS_PotFire tables of the FVS output database. Some FVS output data required for FOFEM runs must be manually crosswalked including (but not restricted to):
 - Fuel load data;

- Duff depth;
- Values for the percentage of rotten versus sound fuel in the greater than 100-hr class;
- Distribution of >100-hr fuels;
- Fuel moisture;
- Estimate of percentage of crown burnt (use P-torch value).

The project proponent must document the crosswalks chosen.

3. Run the emissions model FOFEM for each stand and time step to determine periodic wildfire and prescribed burn emissions across all stands using Equation 6.2 to calculate W_{BSL} and using Equation 6.3 to calculate W_{PR} (see steps 5-9 for additional requirements for project activity wildfire emissions calculations). FOFEM requires an estimate of canopy consumption which can be produced by the wildfire behavior model based on the P-Torch (probability of torching) value as estimated by FFE-FVS for each stand (e.g., Stephens et al. 2012). P-Torch is the probability that torching can occur in a small area of a forest stand and depends in large part on flame length (Rebain et al., 2015).

Equation 6.2. Baseline wildfire and prescribed burn emissions

$$W_{BSL} = \sum_{i=1}^n W_{BSL,stand}$$

Where,

W_{BSL}	= Baseline wildfire and prescribed burn emissions at time t	<u>Units</u> tCO ₂ e
n	= Total number of stands	

And

$$W_{BSL,stand} = \sum_{i=1}^n [CO_{2i} + (CH_{4i} \times GWP_{CH_4}) + (N_2O_i \times (0.16/10^6) \times GWP_{N_2O}) + (CO_i \times GWP_{CO}) + (PM_{2.5i} \times GWP_{PM_{2.5}}) + (NMVOC_i \times GWP_{NMVOC})]$$

Where,

$W_{BSL,stand}$	= Baseline wildfire and prescribed burn emissions for stand i	tCO ₂ e
CO_{2i}	= Carbon dioxide emissions from fire for stand i at time t	tCO ₂ e
CH_{4i}	= Methane emissions from fire for stand i at time t	tCH ₄
GWP_{CH_4}	= Global warming potential for CH ₄ (Table 6.2)	tCO ₂ e/tCH ₄
BB_i	= Oven-dry biomass burnt (from FOFEM) on stand i at time t	kg
0.16	= Nitrous oxide emissions factor for wildfires ¹¹	gN ₂ O/kg fuel
10^6	= Conversion factor for grams to metric tonnes	t/g
GWP_{N_2O}	= Global warming potential for N ₂ O (Table 6.2)	tCO ₂ e/tN ₂ O
CO_i	= Carbon monoxide emissions from fire for stand i at time t	tCO
GWP_{CO}	= Global warming potential for CO (Table 6.2)	tCO ₂ e/tCO
$PM_{2.5i}$	= Particulate matter (2.5) emissions from fire for stand i at time t	tPM _{2.5}
$GWP_{PM_{2.5}}$	= Global warming potential for PM _{2.5} (Table 6.2)	tCO ₂ e/tPM _{2.5}

¹¹ Urbanski, S., 2014. Wildland fire emissions, carbon, and climate: Emission factors. For. Ecol. Manag., Wildland fire emissions, carbon, and climate: Science overview and knowledge needs 317, 51–60. <https://doi.org/10.1016/j.foreco.2013.05.045>

$NMVOC_i$	= NMVOC emissions from fire for stand i at time t	tNMVOC
GWP_{NMVOC}	= Global warming potential for NMVOC (Table 6.2)	tCO ₂ e/tNMVOC

- For the non-CO₂ GHG emissions, the emissions model FOFEM must be used to estimate smoke emissions (in lbs/ac by default) created during the smoldering and flaming phases of combustion for the following species of emissions: particulate matter (PM_{2.5}), CH₄, CO, non-methane volatile organic compounds (NMVOC), and N₂O. The emissions results from FOFEM are then multiplied by the global warming potential (GWP) factors in Table 6.1 to convert to CO₂e. N₂O emissions from wildfire are calculated by multiplying the value for biomass burnt (produced by FOFEM) by a factor of 0.16 g N₂O/kg fuel (oven-dry biomass; Urbanski 2014).

Table 6.2 Non-CO₂ GHG emissions GWPs for conversion to CO₂e

GHG	GWP Factor ¹²
CH ₄	28
N ₂ O	265
CO	1.8
PM _{2.5}	9
NMVOC	5

Procedures identical to those of the previous section for baseline wildfire and prescribed burn emissions are used to calculate unadjusted project wildfire and prescribed burn emissions. However, project wildfire emissions differ from baseline wildfire emissions since fuel treatments change fire severity as well as conditional burn probability (CBP), i.e., the probability of a given point burning assuming a fire occurs. Fuel treatments reduce wildfire emissions within the treated areas themselves (through decreased fire severity) as well as outside of the fuel treatments in fire shadows. A fire shadow is an untreated area that may or may not burn but is indirectly affected by nearby fuel treatments (Box 2). A fire shadow has a reduced CBP and reduced expected fire severity because of neighboring fuel treatments, despite being untreated itself. Two variables are required to fully capture the effect of fuel treatments on fire shadows: fire severity and CBP. Changes in fire severity are captured the same way whether inside or outside of fire shadows — through canopy consumption — and are calculated identically for both baseline and project wildfire emissions.

To account for the change in CBP resulting from fuel treatments, the following additional steps are performed to calculate only the project scenario wildfire and prescribed burn emissions:

- Run the wildfire behavior model for each timestep for both the baseline and project scenario. Save the CBP which are used to calculate project emissions (following section).
- Compute the average CBP within each forest stand for both the baseline and project scenario. This will be used for the project wildfire and prescribed burn emission calculations (see steps 7-9). CBP is the fraction of simulated wildfires that reach each

¹² Values for PM_{2.5} and NMVOC from Buchholz et al. 2019; values for CH₄, N₂O, and CO from IPCC AR5.

pixel of the landscape. CBP values range between 0 and 1.

7. Produce CBP raster map. One raster map of CBPs is produced for the baseline scenario and another for the project scenario. Each CBP raster map has to be produced using a zonal statistics GIS tool to calculate the mean of the CBP values within each forest stand. The resulting two mean zonal rasters can then be divided (CBP_P/CBP_{BSL}); areas where the ratio is 1 have no change in CBP (and are neither a fuel treatment nor a fire shadow) and areas where the ratio is less than 1 is either a fuel treatment or a fire shadow.
8. Correct for CBP ratio anomalies if necessary. The wildfire behavior model should produce identical maps of CBP for identical inputs. As long as the only differences in inputs (including ignition points) are related to fuels treatments, any differences in outputs will solely reflect the effects of those fuels treatments. Nonetheless, a basic check for reasonable outcomes is recommended to ensure that CBP values only differ where expected based on the applied treatments and resulting stand conditions.
9. The ratio of the project and baseline CBPs are then used to account for the fuel treatment impact on burn probability. Project wildfire and prescribed burn emissions, W_{PR} , are calculated according to Equation 6.3.

Equation 6.3. Project scenario wildfire and prescribed burn emissions

$$W_{PR} = \sum_{i=1}^n (W_{PR,stand} \times \frac{CBP_{PR,stand}}{CBP_{BSL,stand}})$$

Where,

W_{PR}	= Project wildfire and prescribed burn emissions at time t	<u>Units</u> tCO ₂ e
$CBP_{PR,stand}$	= Conditional burn probability for a given stand i under project conditions	%
$CBP_{BSL,stand}$	= Conditional burn probability for a given stand i under baseline conditions	%

And

$$W_{PR,stand} = \sum_{i=1}^n [CO_{2i} + (CH_{4i} \times GWP_{CH_4}) + (N_2O_i \times (0.16/10^6) \times GWP_{N_2O}) + (CO_i \times GWP_{CO}) + (PM_{2.5i} \times GWP_{PM_{2.5}}) + (NMVOC_i \times GWP_{NMVOC})]$$

Where,

$W_{PR,stand}$	= Unadjusted project wildfire and prescribed burn emissions for stand i at time t	tCO ₂ e
CO_{2i}	= Carbon dioxide emissions from fire for stand i at time t	tCO ₂ e
CH_{4i}	= Methane emissions from fire for stand i at time t	tCH ₄
GWP_{CH_4}	= Global warming potential for CH ₄ (Table 6.2)	tCO ₂ e/tCH ₄
N_2O_i	= Nitrous oxide emissions from fire for stand i at time t	tN ₂ O
0.16	= Nitrous oxide emissions factor for wildfires ¹³	gN ₂ O/kg fuel

¹³ Urbanski, S., 2014. Wildland fire emissions, carbon, and climate: Emission factors. For. Ecol. Manag., Wildland fire emissions, carbon, and climate: Science overview and knowledge needs 317, 51–60. <https://doi.org/10.1016/j.foreco.2013.05.045>

10^6	= Conversion factor for grams to metric tonnes	t/g
GWP_{N_2O}	= Global warming potential for N_2O (Table 6.2)	tCO ₂ e/tN ₂ O
CO_i	= Carbon monoxide emissions from fire for stand i at time t	tCO
GWP_{CO}	= Global warming potential for CO (Table 6.2)	tCO ₂ e/tCO
$PM_{2.5_i}$	= Particulate matter (2.5) emissions from fire for stand i at time t	tPM _{2.5}
$GWP_{PM_{2.5}}$	= Global warming potential for PM _{2.5} (Table 6.2)	tCO ₂ e/tPM _{2.5}
$NMVOC_i$	= NMVOC emissions from fire for stand i at time t	tNMVOC
GWP_{NMVOC}	= Global warming potential for NMVOC (Table 6.2)	tCO ₂ e/tNMVOC

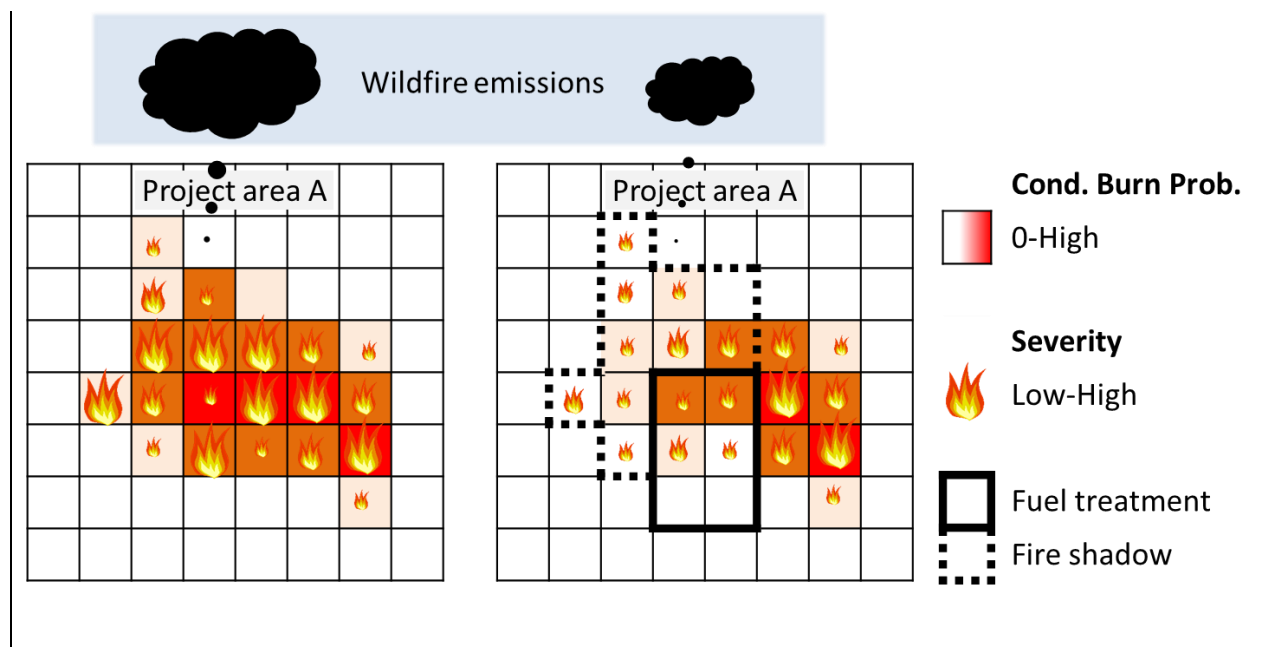
Total wildfire and prescribed burn emissions, $W_{(BSL \text{ or } PR)}$, are amortized using the fire probability for a given time period for application in Equation 6.1.

Box 2: Calculating baseline and project wildfire emissions.

Wildfire emissions reductions occur within the fuel treatment area as well as in the treatment shadow in adjacent untreated areas because of changes in fire severity and reductions in fire size induced by the fuel treatments. Because fire behavior models such as FlamMap-MTT (or alternatively, FconstMTT) are deterministic models and the baseline and project runs utilized must use identical ignition points, any difference in the conditional burn probability (CBP) between the two scenarios is an indication of fuel treatment effectiveness. (The alternative model FlamMap is capable of reusing the same ignition points but it does not handle large landscapes as well.) Changes in expected fire severity due to fuel treatments (whether inside or outside of fuel treatments) are captured by including an estimate of canopy consumption in the emissions modeling. Changes in burn probability are captured by multiplying each stand's expected emissions by the ratio of project CBP to baseline CBP. This term has a value of 1 for stands that are not affected in burn characteristics by the project, which translates to the project having no impact on emissions benefits from fire behavior modifications for those stands. However, in fuel treatments and wildfire shadow areas, the ratio of project CBP to baseline CBP will be typically less than 1 (with some exceptions where fuel treatments can result in increased CBP through opening up the canopy and higher surface wind speed downwind of the treatment area while still retaining a decreased fire severity).

The below figure graphically demonstrates the direct and shadow area wildfire emissions when comparing the baseline and fuel treatment scenarios:

- **Baseline.** For the baseline untreated fireshed on the left, the fire footprint area is shown in red color.
- **Fuel treatment.** For the fuel treatment fireshed shown on the right, fire will be directly limited in severity on the treated stand acres, represented by the orange-colored treatment area. The shadow benefit results from the overall fire size and severity reduction, the difference in the red colored areas.



6.7 Determining Impacts from Delayed Reforestation

In addition to identification of change to forest stocks and wildfire-based emissions under the baseline and project scenarios, project proponents must also quantify the area and emissions associated with project land that is projected to be temporarily or permanently converted from forestland to grass or shrubland following high severity fire over the crediting period.

The contribution of GHG emissions from such delayed reforestation is only accounted for based on the expected annual acreage projected to experience high-severity wildfires. Such emissions are calculated for the variable C_{DR} for application in Equation 6.1 (for both the baseline scenario and the project scenario) and are determined from Equation 6.4 as the product of:

- The change in mean carbon stocks from pre-fire vegetation (e.g., forest) (C_P) to post-fire type converted land (e.g., shrubland) (C_{TC});
- The fraction of the burnt area of the baseline that is projected to have delayed reforestation (P_{DR}). This includes any delayed reforestation that will replace dominant forest vegetation over the crediting period of 40 years and is the product of:
 - Fraction of high severity wildfire area that is landcover type converted (P_{TC})
 - High severity fraction of the wildfire area (P_{HS}).

The fraction of total acreage burnt under high severity conditions (P_{HS}) is taken from the wildfire behavior modeling results where the fire intensity level (FIL) is 5 or 6 (corresponding to flame lengths of greater than 4'). For FILs of 5 and 6, the aboveground dominant vegetation is consumed or dies as a result of stand-replacing wildfire (e.g., Ansley et al., 2000, p. 5).

The fraction of areas affected by high severity wildfire that is likely to experience delayed reforestation (P_{TC}) as well as the mean carbon stocking for forest-replacing vegetation (C_{TC}) are provided on the [Climate Forward website](#). [Look-up table to be produced/provided].

Equation 6.4. Emissions from delayed reforestation.

$$C_{DR,i} = (C_{P,i} - C_{TC,i}) \times P_{DR,i}$$

Where,

$C_{DR,i}$	= Mean carbon stock loss under the baseline or project scenario from delayed reforestation based on the % of burned acres that would have experienced delayed reforestation, time t	<u>Units</u> tCO ₂ e
$C_{P,i}$	= Mean carbon stock for vegetation type in the baseline or project scenario prior to wildfire	tCO ₂ e
$C_{TC,i}$	= Mean carbon stock for vegetation type in the redirected baseline scenario high-severity burn	tCO ₂ e

And

$$P_{DR,i} = P_{TC,i} \times P_{HS,i}$$

Where

$P_{DR,i}$	= Proportion of the burned area where delayed reforestation is likely to occur for the baseline or project scenario	%
$P_{TC,i}$	= Ecological subregion-specific percentage of total acreage burned by high intensity fires that experienced delayed reforestation	%
$P_{HS,i}$	= Percentage of the acreage burned by high intensity fire for the baseline or project scenario (for FIL5 and FIL6)	%

6.8 Estimating Fire Ignition Probability

The expected fire return interval (FRI) for the project area is used to determine the statistical fire probability on an annual basis over the crediting period. Determining the FRI allows the projected wildfire emissions from the project area under both the baseline and project scenarios to be amortized (discounted) by the annual fire ignition probability over each separate five-year interval period of the 40-year crediting period. Project proponents must calculate the average FRI of the project area, based on FRI spatial data provided on the [Climate Forward website](#). The average FRI is then applied in Equation 6.5 to calculate the annual probability of fire occurrence (P_{const}), which is subsequently applied in Equation 6.1. FRI data provided by the Reserve represent contemporary conditions,¹⁴ as opposed to historical pre-suppression conditions. The FRI is assumed to be constant over the 40-year project term.

Equation 6.5. Constant distribution of fire probability for a specific fire return interval.

$$P_{Const} = 1/FRI$$

Where,

P_{Const}	= Constant annual fire probability	<u>Units</u> %
FRI	= Mean fire return interval across the project area	years

¹⁴ FRI data will be updated by the Reserve periodically to reflect changing wildfire trends over time.

6.9 Estimating Performance Decline

Fuel treatments are known to have limited efficacy periods. Figure 6.1 (Collins et al., 2011) illustrates how conditional burn probability (CBP; a measure of fire hazard) for differing fuel treatment intensities (three different tree removal diameter limits) over time more or less converge with the untreated scenario over time. In this example, (1) all fuel treatments provide a considerable (50%) decrease in the initial fire hazard, (2) treatment intensity has little impact on effectiveness or longevity, and (3) effectiveness is completely lost after 20 years for all intensities.

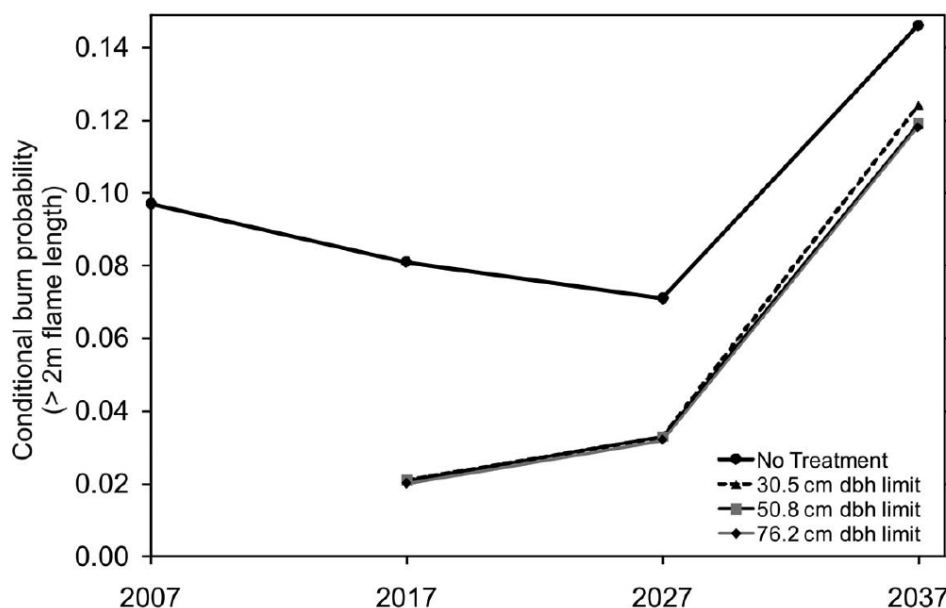


Figure 6.6. Decline in fuel treatment effectiveness over time, from Collins et al., 2011

Nevertheless, decreases in fuel treatment effectiveness, as a reflection of changes in post-treatment stand conditions over time, are captured under this methodology via the modeling process, with stand conditions becoming more similar to baseline stand conditions as time progresses. Thus, although fuel treatments are known to have limited efficacy periods, such limits are accounted for and an AWE project's mitigation performance is not otherwise expected to decline over the crediting period. In other words, the ability of a project to produce the climate benefits projected under this methodology is not dependent on further management activities within the project area.

Although project performance is not expected to decline over the crediting period, a programmatic *ex ante* risk discount of 10% is applied to all projects to ensure conservative accounting and to address the uncertainty associated with estimating the climate benefits from fuel treatments and the probabilistic occurrence of future wildfires in the project vicinity throughout the crediting period. The Reserve will review the overall performance of registered projects periodically to determine if the discount rate needs to be adjusted to ensure programmatic integrity.

6.10 Estimating Abandonment Rates

AWE projects are assumed not to be abandoned in the sense that crediting is largely based on the immediate and time-limited reduction in wildfire risk established when a site is treated. However, there is the possibility that a project area, or portions of it, could be subject to

intentional disturbances (e.g., regeneration timber harvests or land use conversion) during the project's crediting period that alter the wildfire risk profile of the project area in ways that nullify the climate benefits of the project activity from that point in time going forward, relative to the baseline scenario identified at the time of project registration. To account for such risks, the management scenarios that serve as the basis for forest growth modeling must factor in such potential significant non-wildfire disturbances, as described in Section 6.3.

6.11 Ensuring Conservativeness of Quantification

To help ensure the quantification of FMUs for each project represents a reasonable and conservative estimate, this methodology is designed in a way to incorporate a number of aspects that limit credit issuance relative to what otherwise may be claimed. These include:

- Application of programmatic *ex ante* risk deduction;
- Standardized modeling parameters and assumptions that are fixed or restricted and are established on a conservative basis;
- Standardized data required to be used by all projects as the basis for baseline and project modeling;
- Standardized calculation guidance;
- Exclusion of elements that may otherwise increase credit issuance (e.g., bioenergy);
- Limited burn time of 8 hours, though contemporary catastrophic wildfires burn for significantly longer periods;
- Mean fire return intervals applied across the entire project area and across the entire crediting period even though the probability of fire occurrence increases as spatial scale increases and fire return intervals are becoming shorter as a result of climate change;
- Current wildfire behavior models are limited in their ability to adequately capture extreme fire events, leading to likely underestimate of calculated benefits from fuel treatments.

Additionally, modeling parameters appropriate for the project area must be applied in an identical manner for both the project and baseline scenarios. Modeling must be performed with the oversight of a professional forester, with a description of how modeling parameters are reasonable and conservative.

6.12 Permanence Risk Pool

As described in Section 3.8, since the basis for credit quantification under this methodology is derived from the avoidance of high levels of emissions from wildfires and does not rely on future carbon sequestration-based benefits resulting from the project activity, there are no risks to the permanence of the credits. As such, projects registering under this methodology are not required to contribute to the Climate Forward permanence risk pool.

6.13 Reconciliation with Stacked Projects

As described in sections 3.1 and 3.6.3.6, projects may take place on locations where previous AWE projects or other forest carbon projects (e.g., improved forest management projects) have occurred or are currently occurring, with proper updating of vegetation and fuel model data to reflect the conditions present prior to the start of the project as impacted by prior or existing projects. Since the carbon associated materials that are the subject of treatment under AWE projects are conservatively assumed to be immediately emitted into the atmosphere and are not the basis for crediting under this methodology, there is no need for credit quantification for AWE projects to be reconciled with other project types. Nevertheless, project proponents must

disclose if their AWE project is occurring on prior AWE project locations or on locations where relevant carbon projects were or are currently located. The Reserve maintains the right to determine if any reconciliation between an AWE project and another project with which it is stacked is necessary and what the requirements for such reconciliation may be.

7 Project Implementation and Monitoring

The Reserve requires a Project Implementation Report to be established for all monitoring and reporting activities associated with the project. The Project Implementation Report will serve as the basis for the Confirmation Body to confirm that the monitoring and reporting requirements in this methodology have been met. The Project Implementation Report must cover all aspects of monitoring and reporting contained in this methodology and must specify how data for all relevant parameters will be collected and recorded.

At a minimum, the Project Implementation Report shall include the timing of data acquisition, parameter values, a record keeping plan, and the role of individuals performing each specific monitoring activity. The Project Implementation Report must also demonstrate how the project passes the Legal Requirement Test and the Regulatory Compliance Test. Project Proponents are responsible for ensuring that all monitoring and reporting requirements of this methodology have been met.

7.1 Quantification Parameters

Each project must include the prescribed monitoring parameters necessary to calculate baseline and project emissions. These must be shown in a table as shown below in Table 7.1. The project proponent must provide the Reserve robust evidence demonstrating to the Reserve's satisfaction that proposed parameter values are reasonable, and conservative. Confirmation bodies will also review all parameter values to ensure their use in the given project is appropriate.

Table 7.1. Project Monitoring Parameters

Eq. #, Section Reference	Parameter	Description	Data Unit	Applicable	Calculated (c) Measured (m) Reference (r) Operating Records (o)	Comment
Eq. X.X	Parameter identificati on (as referred to in equation)	Provide description of parameter	Unit of measurement	At what scope is this applicable	Where does this value come from?	Explain this parameter in more detail, if necessary.

[Table is intended to capture input, intermediate, and output data involved in project modeling and FMU quantification. To be completed for final methodology.]

Data serving as the basis for modeling and project quantification, as indicated in Table 7.1, are derived from standardized data, as outlined in Section 6. However, those values must be validated by the project proponent to ensure such data accurately reflect actual conditions in the treatment areas both prior to and after fuel treatment activities are performed (i.e., representing baseline and project activity conditions, respectively). Such data, and any updates implemented to reflect actual conditions in the treatment areas, are also reviewed by the confirmation body, as further described in Section 9.4.2. The following guidance indicates monitoring and measurement activities that must be performed at the time a project is undertaken to validate project input data.

7.1.1 Treatment Area Monitoring

Monitoring of forest conditions must be monitored on the ground by the project proponent, both before and after fuel treatments are performed within treatment areas. The primary means of monitoring will be capturing photographic imagery at pre-identified plot locations based on the requirements outlined in Table 7.2.

Table 7.2. Ground-based monitoring plot requirements

Plot attribute	Requirement	
Plot location	Plot locations are georeferenced points located randomly or systematically (grid-based) within the boundaries of a treatment area. If the project incorporates different treatment types, plot locations must be stratified to reflect population variability. Plot locations shall be established prior to treatment and provided to the Reserve.	
Number of plots	The number of plots established in each treatment area shall be based on the size of the treatment area as outlined below, not to exceed 50 total plots per treatment area:	
	Treatment Area Size (acres)	Number of plots (rounded up to nearest integer)
	≤500	Treatment area acres / 25 (minimum of 5 plots)
	501 – 1,000	Treatment area acres / 50
	1,001 – 5,000	Treatment area acres / 100
	5,001 – 10,000	Treatment area acres / 200
	≥10,001	Treatment area acres / 300
Sample timing	Images are to be captured pre- and post-treatment as close to the time of treatment as possible but no more than one year prior and one year after treatment implementation, respectively.	
Imagery Setup	Each plot will be documented both pre- and post-treatment with one clear 360° fisheye camera image looking straight/horizontal and one taken looking up/vertical from the plot center. Camera to be tripod mounted, level and 5' above the ground. If the plot center is obstructed (tree, stump, rock, beehive, etc.), the image shall be taken due north from plot center until operator is at least 10' from obstruction. This action shall be noted in the plot notes.	
Image References	Four Robel type poles to be installed vertically approximately 15' from plot center in each of the four cardinal directions – North, South, East and West. Robel poles to be constructed of 1+” wide by 6' tall material with alternating 1' black and white graduation marks. Poles shall be designed to be inserted into the ground.	
Image Attributes	Plot images are to be tagged with the project name, plot number, project proponent's name, and date. Images (including attribute information) shall be uploaded to the Climate Forward registry at the time of submission for confirmation.	
Image Interpretation	For each plot image (pre- and post-treatment), an interpretation of the following shall be made by the project proponent: <ul style="list-style-type: none"> Determine the dominant overstory (tree) and understory (shrub) vegetation type(s) 	

	<ul style="list-style-type: none"> Correlate each image as closely as possible with one of the 40 <i>Scott and Burgan Standard Fire Behavior Fuel Models</i> (USFS General Technical Report RMRS-GTR-153) based on fuel/vegetation type and tons per acre of fuel loading. Estimate the average canopy base height within +/- 5'. Estimate the average canopy height within +/- 10'. Estimate the overstory canopy closure into one of the following four categories: 0 - 25%, 25 – 50%, 50 – 75%, >75% <p>Image interpretation data shall be uploaded to the Climate Forward registry along with associated imagery at the time of submission for confirmation.</p>
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As an alternative to being performed via plot-based imagery capture, canopy closure may be estimated using GIS analysis and remote sensing imagery for treatments resulting in detectable differences between pre- and post-treatment conditions. If remote sensing data is gathered by drones, imagery must be correlated with (i.e., directly above) field plot locations.

Additionally, project proponents may consider conducting further plot image analysis on an optional basis to support their interpretations by doing the following:

- Utilize the *Natural Fuels Photo Series* from the US Forest Service/University of Washington¹⁵
- Attain drone imagery (directly above and geo-matched to ground plot locations) to further classify pre- and post-treatment images.
- Attain satellite/Differenced Normalized Burn Ratio reflectance imagery to determine species density and height.

7.2 Voluntary Monitoring

Although project proponents have no obligation to monitor and report ongoing project outcomes after it is registered with Climate Forward, some may want to continue monitoring and reporting on the project on a voluntary basis with no bearing on credits issued to the project, especially if wildfires have occurred within the project area. Project proponents may conduct such voluntary monitoring and reporting by submitting relevant documentation to be posted on the project's account page on the Climate Forward registry. Such documents will be listed alongside project documents posted for project registration. Submitted documents will be reviewed by Reserve staff to ensure any claims being made are reasonable; however, they will not be subject to confirmation and will be indicated as such in the registry. Although project proponents reporting in this manner are doing so voluntarily and define how and what to report in their Climate Forward account, the following items are recommended for minimal reporting purposes:

- Reporting date
- Extent and severity of wildfire occurring within the project area
- Extent and severity of wildfire in areas adjacent to the project area
- Current aerial/satellite imagery of the project area and surrounding vicinity

7.3 Voluntary Ongoing Monitoring Incentive

There is no opportunity for projects registered under this methodology to conduct voluntary ongoing monitoring for purposes of having additional FMUs issued based on a project's ability to

¹⁵ Available at: <https://depts.washington.edu/nwfire/dps/>

achieve greater emissions reductions than originally quantified at the time of project confirmation.

7.4 Conversion of FMUs to CRTs

There is no identified pathway at this time for conversion of FMUs issued to projects under this methodology to Climate Reserve Tonnes (CRTs) under the Climate Action Reserve's voluntary offset program. If an offset protocol corresponding to this methodology is developed by the Reserve in the future, projects may then be eligible for the conversion of FMUs to CRTs, as well as potentially the conversion of the project in its entirety to the offset program. If such a protocol is developed, guidance for the transition of credits and projects will be provided by the Reserve at that time.

8 Reporting and Record Keeping

This section provides requirements and guidance on reporting rules and procedures. A priority of Climate Forward is to facilitate consistent and transparent information disclosure among Project Proponents. Project Proponents must submit an emission reduction report as part of the Project Implementation Report to the Reserve.

8.1 Project Submittal and Confirmation Documentation

Project proponents must provide the following documentation for project listing with Climate Forward:

- General Project Submission form
- GIS layer delineating treatment area(s)¹⁶

After the project is listed, the project proponent must then submit the following documentation for confirmation:

- Project Implementation Report
- GIS layer delineating project area
- Signed Attestation of Title form
- Signed Attestation of Legal Additionality form
- Signed Attestation of Regulatory Compliance form
- Signed Attestation of Voluntary Implementation form

As part of the confirmation process, the confirmation body must then submit the following documentation to Climate Forward:

- Confirmation Report
- Confirmation Statement
- Confirmation List of Findings
- Any additional documents as needed

All reports that reference carbon stocks must be submitted with the oversight of a Professional Forester so that professional standards and project quality are maintained. Any Professional Forester preparing a project in an unfamiliar jurisdiction must consult with a Professional Forester practicing forestry in that jurisdiction to understand all laws and regulations that govern

¹⁶ Treatment areas can be tentatively delineated at the time of listing if the treatments are yet to occur, with final treatment boundaries provided at the time of confirmation.

forest practice 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.

All projects shall submit a KML file depicting the project area that matches the maps submitted to depict the project area. The project's reported acres shall be calculated in accordance with the requirements in Section 4. The Reserve will create a file of all forest-related carbon projects (confirmed Climate Forward projects and verified offset projects) on Google Maps for public dissemination.

The above project documentation will be available to the public via the Climate Forward online registry, unless otherwise noted. Further disclosure and other documentation may be made available on a voluntary basis through the Climate Forward registry.¹⁷

8.2 Record Keeping

For purposes of independent confirmation and historical documentation, Project Proponents are required to keep all information outlined in this methodology for a period of seven years after the information is generated. Except for those documents identified in Section 8.1, this information will not be publicly available, but may be requested by the Confirmation Body or the Reserve. Records must be kept in hard copy and/or digital format. For documents that were originally created in hard copy form and for which the original hard copy bears original signatures or other evidence of authenticity (e.g., signed Attestation of Title), hard copies must be retained.

Examples of information the Project Proponent must retain includes:

- All project submittal documentation, as listed in Section 8.1
- All data inputs for the calculation of the project emission reductions, including all required sampled data
- Copies of all permits, formal notices of regulatory violations, and any relevant administrative or legal consent orders dating back at least 3 years prior to the implementation of the first project device
- Executed Attestation of Title, Attestation of Regulatory Compliance, and Attestation of Legal Additionality forms
- Results of emission reduction calculations
- Confirmation records and results
- All evidence relating to Continued Implementation
- Any additional relevant documents

The Reserve also requires that the following project-related records be retained by the Confirmation Body for a minimum of seven years after completing confirmation activities. It must be noted that some records may be subject to fiscal or other legal requirements that are longer than the Reserve's mandated period.

Confirmation bodies shall retain electronic copies, as applicable, of:

- The project's Implementation Report
- The Project proponent's SSR and/or project activity data as well as evidence cited
- The confirmation plan

¹⁷ Climate Forward documents and forms are available at <https://climateforward.org/program/program-and-projectforms/>.

- The sampling plan
- Measurement data from site visit and interpretation data from photo plot interpretation, as well as calculation of SSRs by Confirmation Body
- The Confirmation Report
- The List of Findings
- The Confirmation Statement

Each Confirmation Body must have an easily accessible record-keeping system, preferably electronic, that provides readily available access to project information. Copies of the original activity and source data records shall be maintained within said record-keeping system. Records must be kept in both hard copy and digital format, where possible. For documents that were originally created in hard copy form and for which the original hard copy bears original signatures or other evidence of authenticity (e.g., signed Attestation of Title), hard copies must be retained. The Reserve may at any time request access to the record-keeping system or any supporting documentation for oversight or auditing purposes.

8.3 Reporting and Confirmation Period

For ex ante GHG mitigation projects, the reporting period is equivalent to the crediting period. Project proponents must report forecasted GHG reductions from the project for the entire crediting period.

A confirmation period is the period of time over which forecasted GHG reductions are confirmed. A confirmation period begins with the project start date and ends with the submission of the final Confirmation Report to Climate Forward. The end date of any confirmation period may not extend past the project crediting end date.

Since the implementation of project activities create immediate climate benefits, and there is no ongoing monitoring, confirmation activities may commence directly following the completion of all fuel treatment(s) planned under the project.

9 Confirmation Guidance

This section provides Confirmation Bodies with guidance on confirming GHG emission reductions associated with the project activity. This confirmation guidance supplements the Reserve's Climate Forward Program Manual and describes confirmation activities specifically related to this Methodology.

Confirmation bodies trained to confirm a given methodology type must be familiar with the following documents:

- Climate Action Reserve Climate Forward Program Manual
- Climate Action Reserve Climate Forward Confirmation Program Manual
- Avoided Wildfire Emissions Methodology (this document)

The Reserve's Climate Forward Program Manual, Climate Forward Confirmation Program Manual, and Climate Forward Program methodologies are designed to be compatible with each other and are posted on the Reserve's website at <http://www.climateactionreserve.org/climate-forward/>.

In cases where the Climate Forward Program Manual or Climate Forward Confirmation Manual differs from the guidance in this methodology, this methodology takes precedence. Only

Confirmation Bodies trained and accredited by the Reserve are eligible to confirm project reports. Information about Confirmation Body accreditation and Reserve project confirmation training can be found on the Reserve website at <http://www.climateactionreserve.org/climate-forward/>.

The confirmation of the project must be conducted with the oversight of a Professional Forester so that professional standards and project quality are maintained. Any Professional Forester confirming a project in an unfamiliar jurisdiction must consult with a Professional Forester practicing in that jurisdiction to understand all laws and regulations that govern reforestation activities within the jurisdiction, as well as factors that may influence treatment effectiveness.

9.1 Standard of Confirmation

While there is no requirement for ex-post verification of AWE projects under Climate Forward, there is a requirement for an accredited Confirmation Body to confirm the project has been implemented as described in the forecast methodology and that the estimated emission reductions have been calculated accurately. The confirmation incorporates both a desktop documentation review and a site visit assessment of the mitigation project.

Beyond criteria for the confirmation of mitigation project implementation, the Confirmation Body must also confirm any provisions specified in the forecast methodology that are to be undertaken to ensure the continued implementation of the mitigation project for the duration of its crediting period. The Confirmation Body assesses whether such measures have been appropriately implemented.

9.2 Confirming Project Implementation Report

The Project Implementation Report serves as the basis for Confirmation Bodies to confirm that the monitoring and reporting requirements have been met. Confirmation bodies shall confirm that the Project Implementation Report covers all aspects of monitoring and reporting contained in this methodology and specifies how data for all relevant parameters were collected and recorded.

When assessing the Project Implementation Report, the Confirmation Body shall:

- a) Assess the compliance of the Project Implementation Report with the requirements of the methodology and Climate Forward Program Manual;
- b) Identify the list of parameters required by the methodology and confirm that the Project Implementation Report accounted for all necessary parameters;
- c) Assess the means of implementation of the project data capture, including data management and quality assurance and quality control procedures, and determine whether these are sufficient to ensure the accuracy of forecasted GHG emission reductions to be achieved by the batch/project/program;
- d) Any additional requirements

Where the Project Proponent has applied a sampling approach to determine data and parameters, the Confirmation Body shall assess the proposed sampling plan in accordance with sampling requirements in Section 4.3.3 of ISO 14064-3.

9.3 Core Confirmation Activities

The Climate Forward Program Manual describes the core confirmation activities that shall be performed by Confirmation Bodies for all project confirmations.

Confirmation is a risk assessment and data sampling effort designed to ensure that the risk of reporting error is assessed and addressed through appropriate sampling, testing, and review. The core confirmation activities, which will be discussed in greater detail, are as follows:

1. Reviewing GHG management systems and estimation methodologies
2. Confirming emission reduction estimates
3. Undertaking site visits
4. Confirming evidence of project implementation

9.3.1 Reviewing GHG Management Systems and Estimation Methodologies

The Confirmation Body reviews and assesses the appropriateness of the methodologies and management systems that the Project Proponent uses to gather data and calculate baseline and project emissions. The AWE Methodology relies largely on the use of standardized data, models, and modeling parameters. The Confirmation Body will review the application such data, models and parameters to ensure they have been correctly used to quantify the emissions reductions associated with the project. Furthermore, photo plots taken by the project proponent, as described in Section 7.1.1, will also be reviewed by the Confirmation Body to ensure that the vegetation data serving as the basis for the quantification of credits accurately represents the conditions within the treatment areas.

9.3.2 Confirming Emission Reduction Estimates

The Confirmation Body further investigates areas that have the greatest potential for material misstatements and then confirms whether or not material misstatements have occurred. Include confirmation activities required to confirm emission reduction estimates such as independent recalculation.

9.3.3 Undertaking Site Visits

In addition to undertaking a desk review, Confirmation Bodies shall conduct one or more site visits to undertake confirmation activities. The specific itinerary for a site visit and the activities to be confirmed will be determined by the Confirmation Body, following an assessment of project risk.

During field site visits, at a minimum the Confirmation Body will:

- confirm project area boundaries
- confirm treatment area boundaries
- confirm treatments listed in Project Implementation Report took place on-the-ground

9.3.4 Confirming Implementation of Project Resilience Measures

The Project Proponent will also provide evidence that the project modeling has incorporated background harvesting conditions based on the guidance provided in Section 6.3. The Confirmation Body shall review the Project Implementation Report and supporting project documentation to ensure background harvesting conditions were applied appropriately.

9.4 Confirmation Items

The Confirmation Body needs to address a set of items for each methodology type. This can be displayed in a table that lists the item, references the section in the methodology where requirements are specified, and identifies if professional judgment needs to be applied during the confirmation activity.

Confirmation bodies are expected to use their professional judgment to confirm that methodology requirements have been met in instances where the methodology does not provide sufficiently prescriptive guidance. For more information on the Reserve's confirmation process and professional judgment, please see the Climate Forward Program Manual.

Note: The following tables shall not be viewed as a comprehensive list or plan for confirmation activities, but rather guidance on areas specific to mitigation projects that must be addressed during confirmation.

9.4.1 Project Eligibility and Credit Issuance

To determine that a project is eligible under a given forecast methodology, it must meet a set of criteria that a confirmation body shall confirm during the confirmation process. These requirements determine if a project is eligible to register with the Reserve and/or have credits issued. If any requirement is not met, the project may be determined ineligible.

Use the following table to list the criteria for reasonable assurance with respect to eligibility and credit issuance for a given project.

Table 9.1 Eligibility Confirmation Items

Methodology Section	Eligibility Qualification Item	Apply Professional Judgment?
2.1 Project Definition	<p>a) Project activities consist of mastication, prescribed burning, thinning, pruning, and/or mechanical removal of surface fuels.</p> <p>a. For projects incorporating thinning operations, residual stand conditions within thinning area(s) exhibit:</p> <p>i. an increase in quadratic mean diameter based on a comparison between pre- and post-treatment photo plots</p> <p>ii. greater than 50 square feet in basal area per acre across the thinned stand. Where the confirmation body is unable to make a decision based on professional judgement, satisfying the basal area threshold can be determined based on confirmation body measurements of a minimum of 10 random plots per 1,000 acres treated using a prism, angle gauge or similar tool. If the average basal area after initial sampling is below 50 square feet, the project proponent can request that the confirmation body</p>	<p>Yes, for increase in quadratic mean diameter determination and basal area measurement</p>

	<p>continue sampling (in batches of 10 plots per 1,000 acres treated), in which case the additional sampling results must be added to the original sampling results to calculate the combined stocking.</p> <p>b) If multiple activities are planned, activities occur within a 3-year timeframe.</p>	
3. Location	<p>a) Project is located in the United States on public, private, or tribal lands in areas where required data is available.</p> <p>b) Project area has been under forest cover for at least 20 years.</p> <p>c) The project area is a contiguous spatial unit.</p> <p>d) If projects occur on lands currently or formerly registered as carbon or emissions reductions projects, those projects must be or have ended in good standing.</p>	No
3.2 Project Start Date	The date fuel treatment activities are initiated.	No
3.3.1 Performance Standard Test	Project activities are forecasted to produce GHG reductions in excess of those that would have occurred under “business as usual.”	No
3.3.2 Legal Requirement Test	Proof that a signed Attestation of Legal Additionality form is on file with the Reserve.	No
3.4 Environmental and Social Safeguards	<p>The Project Proponent describes in the Project Implementation Report how the project will not materially undermine progress on environmental and social issues.</p> <p>Evidence provided showing consultation with local fire safety planning groups, including a fuels management plan covering a period of at least 5 years into the future and a signatory form with approval from a majority of signatories.</p>	No
3.5 Attestation of Regulatory Compliance	Proof that a signed Attestation of Regulatory Compliance form is on file with the Reserve. In addition to reviewing this form, the confirmation body must perform a risk-based assessment to confirm the statements made by the project proponent in the attestation of Regulatory Compliance form and the Project Implementation Report with respect to compliance with applicable laws and regulations, as well as the how the potential risk of future regulatory non-compliance has been mitigated.	Yes, with respect to the appropriateness of the reduction or mitigation of future risks
3.6 Double Counting	Via the Attestation of Title, the project proponent attests that the FMUs have not and will not be registered with, reported in, held, transferred or retired via any emissions registry or inventory other than the Climate Forward registry, or registered with Climate Forward under a different project title or location.	No
2.2 Ownership	Project proponent is the entity undertaking (organizing, planning, and/or implementing or overseeing the implementation of) the project activities.	No
3.6	Proof that a signed Attestation of Title form is on file with the Reserve.	No

Attestation of Title		
3.7 - 3.8 Project Resilience and Permanence Measures	Modeling of both the baseline and project scenarios properly incorporates background harvesting activities that impact future fire behavior. See Table 9.2 for further guidance.	No
3.3.3 Enhancement Payments	Project proponents may receive enhancement payments that support fuel treatment activities, unless such payments are specifically quantified on a per tCO ₂ e basis. Such payments must be reported in the Project Implementation Report. The Confirmation Body must seek guidance from the Reserve if payment stacking has occurred and has not previously been approved by the Reserve.	No
6.3 Professional Forester oversight	Modeling in the project quantification must be submitted with the oversight of a Professional Forester.	No

9.4.2 Quantification

Confirmation Bodies shall include quantifications within the confirmation process that include recalculations and risk assessment. These quantification items inform any determination as to whether there are material and/or immaterial misstatements in the project's GHG emission reduction calculations. If there are material misstatements, the calculations must be revised before FMUs are issued.

Use the following table to list the items that Confirmation Bodies shall include in their risk assessment and recalculation of the project's GHG emission reductions.

Table 9.2 Quantification Confirmation Items

Methodology Section	Quantification Item	Apply Professional Judgment?
4 Project Area	Treatment area(s) for the project have been accurately delineated in a GIS layer and depicted in maps in the PIR. Different treatment types comprising an individual project are represented individually in the GIS layer as either single or multi-part polygons. Confirmation Body shall review treatment area boundaries by field reconnaissance of at least 5% of the treatment area boundaries or by the use of earth observation data for cases where treatment boundaries are delineated using such data. Total acreage of treatment areas as calculated by the Confirmation Body must be within 5% of the acreage reported by the project proponent.	No
4 Project Area	A description and maps of the geographic boundaries defining the project area are provided in the PIR and a GIS layer has been submitted to the Reserve along with project documentation.	No
6.1 Project Area Delineation	Project area has been delineated according to the guidance in Section 6.1, including the selection and application of input data and appropriate parameterization of the fire behavior model.	No
6.3 Forest Management Scenarios	Scenarios that are representative of background management conditions have been appropriately determined and incorporated into assumptions for growth and yield modeling under both the baseline and	No

	project activity to simulate changes to forest conditions and carbon stocks from regeneration harvest events over the crediting period, per Sections 6.3. The fuel treatments serving as the basis for the project are accurately characterized, with assumptions used for growth and yield modeling of the project activity appropriately reflecting the treatments performed and forest conditions achieved, as supported by photo plots taken, per Section 7.1.1. Project activity modeling must also incorporate baseline management conditions.	
6.4 Modeling Changes to Forest Carbon Stocks	FFE-FVS is parameterized appropriately for the project location and conditions, with management scenarios run that are representative of the entire crediting period for the project, and input data is correctly selected and appropriate modifications made, as allowed. Carbon stock outputs are reported using the default settings in FFE-FVS. Modeling output is summarized by stratum (if applicable) and converted to annualized carbon stock changes.	No
6.5 Forest Biomass Removals	Standard outputs of harvest/biomass removal volumes from FFE-FVS are reported [plus conversion to HWP C referencing appropriate guidance], with carbon in harvested wood products included in FMU quantification only for projects not being implemented in areas that overlap with other carbon projects with a claim to the climate benefits associated with the carbon in harvested wood products.	No
6.6 Modeling Wildfire Emissions	FFE-FVS, FOFEM, and wildfire behavior model have been applied correctly, per guidance in Section 6.6, including the acquisition and application of standardized input data and required model parameterization. Wildfire behavior model used is one of the pre-approved models listed in Section 6.6 or the project proponent has been granted approval for its use by the Reserve. Wildfire emissions calculations are performed correctly by stratum for each modeling time step for both the baseline and project scenarios, with the CBP ratio applied to project wildfire emissions and all results annualized for reporting purposes.	No
6.7 Delayed Reforestation Impacts	Proportion of project acreage affected by high-severity wildfire is identified from wildfire behavior modeling and applied to delayed reforestation emissions calculation as variable P_{HS} for both the baseline and project scenario. Pre- and post-high severity wildfire vegetation types are correctly identified based on the project conditions and is reflected in the value(s) applied for the variables C_P and C_{TC} in Equation 6.4, and the variable P_{TC} in Error! Reference source not found.	No
6.8 Fire Ignition Probability	Constant probability of fire (P_{const}) is calculated correctly according to the guidance in Section 6.8.	No
6.9 Performance Decline	Programmatic <i>ex ante</i> risk deduction of 10% has been applied.	No
6.13	Project proponent has properly identified project stacking associated with the project and, in cases where projects stacked with a project being submitted under this methodology has a claim to credits based on carbon in harvested wood products, such carbon is not included in FMU quantification under this methodology.	No
7.1.1 Treatment Area Monitoring	The following plot implementation requirements were met by the project proponent: <ul style="list-style-type: none"> Correct number of plots were established for each treatment area, per Table 7.2 	No

	<ul style="list-style-type: none"> Plots were located randomly, with locations provided to the Reserve prior to treatment implementation. Pre- and post-treatment images were captured within one year of treatment implementation for each treatment area. One clear 360° fisheye camera image, following the requirements for 'Imagery Setup', 'Imagery References,' and 'Imagery Attributes' in Table 7.2, was taken representing pre- and post-treatment conditions. 	
7.1.1 Treatment Area Monitoring	<p>The confirmation body will randomly select 20% of the photo plots taken within the project area to relocate and review the project proponent's interpretations of pre- and post-treatment vegetation- and fuel-related metrics. Interpretation by the confirmation body are within the following tolerances for each metric across all plots within a given stratum:</p> <ul style="list-style-type: none"> Dominant over- and understory vegetation species ($\geq 90\%$ match) Standard fire behavior model (pre- and post-treatment) based on Scott and Burgan models¹⁸ ($\geq 90\%$ match) Average canopy base height ($\geq 90\%$ match) Average canopy height ($\geq 90\%$ match) Overstory canopy closure ($\geq 90\%$ match) <p>For overstory canopy closure estimates using remote sensing imagery, the average canopy closure estimate of the confirmation body must be within 10% of the estimate provided by the project proponent.</p>	Yes

In the event a plot or stratum fails confirmation based on the tolerances for either the photo interpretations or treatment area boundaries not being met, the project proponent can choose one of the following options for proceeding:

- Perform on-the-ground adjustments to the treatment area(s) (e.g., treat full area identified in the treatment area polygon, intensify the treatment)
- Adjust modeling inputs to reflect pre-treatment conditions based on improved photo plot interpretations
- Adjust modeling inputs to reflect post-treatment conditions (e.g., diminish treatment polygons, reduce treatment intensity)

9.5 Completing Confirmation

The Climate Forward Program Manual provides detailed information and instructions for Confirmation Bodies to finalize the confirmation process. It describes completing a Confirmation Report, preparing a Confirmation Statement, submitting the necessary documents to the Reserve, and notifying the Reserve of the project's confirmed status.

¹⁸ Scott and Burgan ref

10 Glossary of Terms

Accredited Confirmation Body	A confirmation firm approved by the Climate Action Reserve to provide confirmation services for Project Proponents.
Additionality	Project activities that are above and beyond “business as usual” operation, exceed the baseline characterization, and are not mandated by regulation.
Anthropogenic emissions	GHG emissions resultant from human activity that are considered to be an unnatural component of the Carbon Cycle (i.e. fossil fuel destruction, de-forestation, etc.).
Batch	The implementation of the same activity at multiple sites over a finite period of time.
Biogenic CO ₂ emissions	CO ₂ emissions resulting from the destruction and/or aerobic decomposition of organic matter. Biogenic emissions are considered to be a natural part of the Carbon Cycle, as opposed to anthropogenic emissions.
Carbon dioxide (CO ₂)	The most common of the six primary greenhouse gases, consisting of a single carbon atom and two oxygen atoms.
CO ₂ equivalent (CO ₂ 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.
Confirmation	The process used to ensure that a given participant’s GHG emissions or emission reductions have met the minimum quality standard and complied with the Reserve’s procedures and protocols for calculating and reporting GHG emissions and emission reductions.
Direct emissions	GHG emissions from sources that are owned or controlled by the reporting entity.
Emission factor (EF)	A unique value for determining an amount of a GHG emitted for a given quantity of activity data (e.g. metric tons of carbon dioxide emitted per barrel of fossil fuel burned).
Forest carbon	The carbon found in forestland resulting from photosynthesis in trees and associated vegetation, historically and in the present. Forest Carbon is found in soils, litter and duff, plants and trees, both dead and alive.
Fossil fuel	A fuel, such as coal, oil, and natural gas, produced by the decomposition of ancient (fossilized) plants and animals.
Greenhouse gas (GHG)	Carbon dioxide (CO ₂), methane (CH ₄), nitrous oxide (N ₂ O), sulfur hexafluoride (SF ₆), hydrofluorocarbons (HFCs), or perfluorocarbons (PFCs).
GHG reservoir	A physical unit or component of the biosphere, geosphere, or hydrosphere with the capability to store or accumulate a GHG that

	has been removed from the atmosphere by a GHG sink or a GHG captured from a GHG source.
GHG sink	A physical unit or process that removes GHG from the atmosphere.
GHG source	A physical unit or process that releases GHG into the atmosphere.
Global Warming Potential (GWP)	The ratio of radiative forcing (degree of warming to the atmosphere) that would result from the emission of one unit of a given GHG compared to one unit of CO ₂ .
Indirect emissions	Reductions in GHG emissions that occur at a location other than where the reduction activity is implemented, and/or at sources not owned or controlled by project participants.
Metric tonne (t)	A common international measurement for the quantity of GHG emissions, equivalent to about 2204.6 pounds or 1.1 short tons.
Professional forester	A forester who meets the requirements of professional registrations within jurisdictions where professional or certified foresters exist. For purposes of this methodology, an affiliation with state or national registries or certification by a professional society (e.g., Society of American Foresters) is adequate for the professional to perform the role of a Professional Forester wherever the methodology is used, unless jurisdictional requirements otherwise prohibit this designation, in which case the jurisdiction's laws are assumed. Additionally, foresters with appropriate educational and professional experience (minimum: BA/BS or higher in forestry/natural resources with at least 5 years professional field experience, including experience with fuel treatment activities) may perform the role of Professional Forester under the methodology within jurisdictions where no professional or certified forester requirements exist.
Project baseline	A "business as usual" GHG emission assessment against which GHG emission reductions from a specific GHG reduction activity are measured.
Project Proponent	An entity that undertakes a GHG project, as identified in Section 2.2 of this methodology.
Project Resilience Measures	Activities tailored to the specific project that are undertaken to ensure the continuing implementation of the project for the duration of the crediting period.

11 References

International Organization for Standardization, ISO 14064-2:2006 Greenhouse gases — Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements (2006).

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Appendix A – Local Consultation Signatory Form

[Provided here for public comment draft only. Template to be posted on Climate Forward website]

	Local Resource Conservation District	Local Fire Safe Council	Local Extension Groups that Operate in Fuel Reductions	Local Fire Department	Other (Please Specify)
Contact Information					
Approval – Signatory Page					
Geography of proposed treatments					
Definition of thinning activities (if included)					
Definition of prescriptive fire activities (if included)					
Planned outcome for thinned materials (chip/scatter, pile and burn, remove from site, etc.)					
Project leadership structure					