UNIVERSITY OF CALIFORNIA
Agriculture and Natural Resources
Forest Stewardship

Post-Fire Mechanical Treatments for Reforestation

Managing Fuel loads and competing vegetation

Effective post-fire reforestation relies on investing in management practices that promote resilient forests capable of withstanding shifting climate patterns and future wildfires (Noble and York, 2024). Land managers must contend with hazardous fuel accumulations from dead trees while simultaneously managing aggressive shrub competition that threatens both seedling survival and contributes to future fire risk. Among available treatments, **mechanical site preparation methods**—including salvage logging, mastication, and piling—form the critical foundation for preparing sites where seedlings can successfully establish and thrive.

After high-severity fires, significant tree mortality rates create large areas populated by standing dead trees, commonly known as snags (*See Image 1)*. These snags may present immediate hazards to safety within forested areas, as they can fall unpredictably. As time progresses, these dead trees decay and drop, thereby adding to the overall fuel load and heightening the risk from future wildfires (Knapp, 2015). In addition, competing vegetation, particularly vigorously resprouting shrub species, can impede reforestation efforts by: (1) outcompeting vulnerable planted seedlings for essential resources like soil moisture (Davis et al., 2023) and (2) contributing to fuel loads, whether as live vegetation or dead, that increase the risk of reburning at high severity (Coppeletta et al., 2016).

Mechanical site preparation refers to equipment-based treatments that physically alter post-fire sites by systematically removing or modifying dead fuels and resprouting vegetation prior to planting seedlings. Mitigating fire spread and severity via treatments involves strategically targeting and reducing fuel loads across different fuel strata: fine surface fuels that carry fire horizontally, ladder fuels that create vertical continuity allowing fire to reach tree crowns, and heavy woody debris, like large-diameter logs, that contribute to fire intensity and duration. Post-fire treatments that reduce standing, fallen, or remaining woody debris enable reforested stands to develop with a lower risk of mortality from future wildfires (Lyons-Tinsley and Peterson, 2012).

Image 1: Depicts border between untreated USFS land (on left) and salvaged logged, chipped, sprayed, and reforested private land post- 2021 Dixie Fire in Greenville (on right). Vegetation on right includes resprouting black oaks [Photo: Nic Dutch, 2024]

Mechanical site preparation lays the groundwork for newly planted seedlings to grow into a resilient forest stand by:

(1) Reducing the amount and continuity of post-fire fuel loads before planting

(2) Treating competing vegetation during the most critical part of a seedling's growth period (0-5 years)

Complementary treatments, including herbicide application for vegetation control or prescribed burning of hand-piled fuels, can be integrated and leveraged with mechanical methods to achieve comprehensive site preparation and long-term reforestation success. Mechanical site preparation provides the essential starting point, first addressing post-fire fuel loads and safety hazards before other treatments can be effectively implemented.

Method 1: Salvage Logging

Salvage logging involves harvesting fire-killed trees that still retain commercial value before they deteriorate, typically focusing on larger-diameter snags that can be processed into lumber or other wood products. When economically viable, salvage logging facilitates the recovery of merchantable timber while reducing fuel loads and providing income for landowners to fund future treatments. However, post-fire logging may not be possible if trees are too small to be merchantable, if the site is too remote or steep, or if there is no sawmill available or willing to purchase the timber. In order to sell timber products, a registered professional forester (RPF) is required to develop an exemption permit that satisfies the California Forest Practices Act. While salvage logging removes large diameter woody material, it's operation often leaves behind small and accessible fuel, known as slash. The equipment used for tree harvesting can also pile resulting slash, making the combination of salvage harvesting, piling, and burning a highly effective strategy for fuel reduction.

Method 2: Chipping

Chipping can effectively process fallen trees and debris into small, uniform wood chips, which is typically deposited near the chipper's operational site. Chipped material can be spread on site and serve as mulch, helping to retain soil moisture, improve soil structure, and somewhat suppress the growth of competing shrubs (McDonald and Henderson, 1990). In some locations, the resulting chips can be marketed as woody biomass for energy production or other uses, providing an economic incentive (*See* Forest biomass diversion in the Sierra Nevada). However, in many locations chipping does not produce revenue and the costs must be covered by the landowner or with grant funded chipping program (*Check with local Fire Safe Council*).

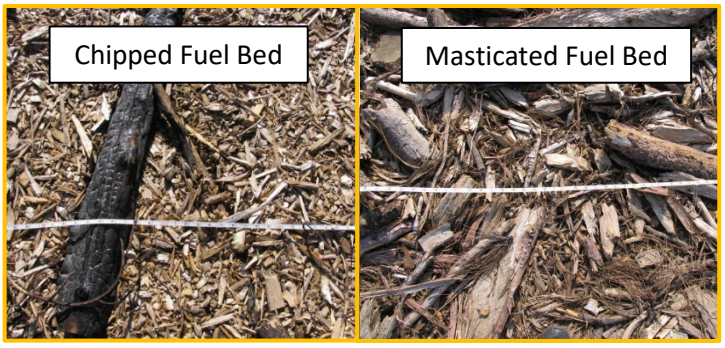

Image 2: Comparison of chipped and masticated fuels. [Photo: Daylin Wade]

Image 3: Comparison of post-fire reforestation treatments [Photos: Daylin Wade, Susie Kocher, 2014]

Method 3: Mastication

Mastication involves shredding or chopping live and dead fuels—including small trees, shrubs, downed woody debris, and other materials—using a masticator head mounted on an excavator tractor. What is left is a compacted fuel bed made up of dead surface fuel. When retained on-site, mastication, like chipping, reduces vertical continuity of fuels (ladder fuels), while increasing the amount of smaller surface fuels (Image 2). Initially, these fuels can increase surface fuel loading and wildfire intensity; however they also decompose faster than larger fuels and result in lower wildfire intensity compared to doing nothing (Image 3). A heavy and thick masticated fuel layer can suppress competing vegetation, providing and potentially reducing the need for herbicides (Kocher and Wade, 2023; see USFS Erosion Control Factsheet). Compared to other mechanical treatments, mastication operations limit soil compaction (Moghaddas and Stephens, 2008).

Mechanical Methods to Manage Fuels and Competing Vegetation				
Method	**Overview**	**Advantages**	**Challenges**	**Timeline**
Salvage Logging	Removes dead trees to recover timber value and reduce fuel loads	- Reduces large fuel load - Removes hazard trees - May generate revenue	- Soil disturbance risk - Safety hazards - Dependable on log market availability	Immediately to 1-year post-fire
Chipping	Processes small wood and slash into chips for mulch or biomass	- Conserves soil moisture - May suppress shrub growth - May improve soil health - May generate income	- Distribution challenges - Soil compaction risk - Biomass production depends on operational availability	1 to 2 years post-fire, before planting
Mastication	Mechanical grinding of brush and trees into smaller pieces left on site.	- Reduces standing fuel levels - Speeds up decomposition - May limit shrub competition	- Initial increase in fuel load - During a fire, potential increase in fire intensity	1 to 3 years post-fire, before planting
Piling	Gathering slash into piles for burning or removal.	- Can clear area rapidly - Reduces fire risk - Able to treat riparian areas	- High-cost manual labor - Concentrated in areas, may result in lack of fuel connectivity for broadcast burns	1 to 3 years, before planting or after if away from seedlings
Deep Ripping	Tilling of soil using shanks to alleviate compaction and prepare for planting	- Improves soil structure - Aids water infiltration in post-fire hydrophobic soils	- Requires contour lining to avoid erosion - Unable in steep slopes	1 to 2 years post-fire, before planting

Method 4: Piling and Burning

Piling involves gathering woody debris by hand or by using a brush rake mounted on a bulldozer and then placing it into piles for later burning. Piles can also be constructed with an excavator equipped with a grapple attachment. Hand piling is an accessible way to dispose of brush and woody vegetation at smaller scales that do not require heavier equipment. However, considerations for permitting and fire behavior must be accounted for (See Guide to Pile Burning.)

Method 5: Deep Ripping

Deep ripping or tilling involves using specialized equipment to break up compacted post-fire hydrophobic soil layers, which reduce fire-related erosion. It also breaks up woody debris and incorporates it into the soil, facilitating faster decomposition of the combustible material (Page-Dumroese et al. 2021). Deep ripping may also open up the underlying soil seed bed, stimulating the resurgence of shrub growth and requiring further treatment of competing vegetation.

Management Considerations

Post-fire reforestation success depends on safeguarding the growth of regenerating young stands, where both the timing and sequence of treatments—each intervention must occur within specific windows to effectively address fuel loads and vegetation competition. Mechanical site preparation methods can be strategically phased with other treatment methods, with timing driven by ecological, operational, and economic factors (*See table above*).

For example, a possible treatment sequence:

Year 0-1: Salvage logging captures timber value before decay; mastication or chipping immediately processes slash while equipment remains on-site, pre-emergent herbicide applied before resprouts germinate
Year 1-2: Planting conifers
Year 3-5: Follow-up direct spray application targets resprouting shrubs
Years 5-10+: Prescribed fire reintroduction once trees reach fire-resistant size

While mechanical site preparation requires an upfront investment, this foundational treatment—when properly timed and sequenced—pays dividends through improved seedling survival, reduced high-severity reburn risk, and long-term forest resilience.

Further Reading & Resources

For full work cited, please refer to:
https://ucdavis.box.com/v/post-fire-mechanical-citations

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