

# **Biomass Management**

## ***Fuel Removal and Mulching***

### **Overview**

Over time as fuel reduction projects continue in the East Bay hills, it is anticipated that the volume of wood waste (biomass) will greatly increase. A biomass management program needs to be developed that is sustainable. These waste materials and wood products also could be generated during hazard mitigation, native plant restoration, forest management activities, as well as fuel reduction activities. Hills Emergency Forum Members have varying policies for dealing with biomass. The following compendium provides an overview of the various approaches used in the region. Each of the members continues to refine their practices as new equipment or innovative techniques become available and are shown to be effective. This working paper will be updated periodically as new adaptive management strategies are available and adopted by Hills Emergency Forum Members.

### **Options for Biomass Management**

Vegetation debris and wood products have many possible uses, depending upon size, quality, species, and volume of the material. Organic debris can be recycled and reused, and in some instances fair market value can offset the costs of fuel removal. Options for management relate to the size and location of the project. Options that work on large-scale wildland vegetation management will be different from those feasible on small-scale projects that are focused on fuel load reduction for structure protection (in and around the “ignition zone”).

Vegetation debris and woody material of a variety of sizes are produced during fuel reduction projects. There are five typical options on how this material is dealt with in the region:

- Allow to decompose naturally (retain in place).
- Process either on-site or at a central location and returned to site (mulch on site), biotechnical erosion control.
- Process either on-site or at a central location and used elsewhere (mulch for off-site uses), biotechnical erosion control, forest products.
- Remove from the site and dispose of at green waste sites (disposal).

- Remove from site and process for added economic value.

Each of these five options has benefits and costs associated with them as detailed in the next sections.

***Retain in Place- Mowing or Weed Whipping (Leave Cuttings on Site)***

*Description:* Mowing or weed whipping is typically used on grass or other herbaceous plants. The remaining material is left as finely cut matter to blow away or decompose. Used for both large scale wildland vegetation management and small-scale structure protection.

*Regional Retention/ Mulch Policies:* Minimum standing height of dead grasses varies by agency from 4” to 6.” Native bunchgrasses or other perennial materials may be cut higher or later in the season based upon site and species specific issues. The depth of cut grass material is not regulated in the region.

*Associated costs:* Costs typically include labor & equipment. There is no additional distribution, transportation or disposal cost.

*Impact on site-specific fire behavior*

- Ease of ignition and rapid fire spread are the main concerns due to fine size of fuels.
- Cut material reduces flame height and heat output by “laying down” the fuel, as compared to standing tall grasses.
- Cut material responds well to suppression efforts.

*Advantages:*

- More benign fire behavior and improved fire fighter safety over unmowed vegetation.
- Erosion control maintained since root system and plant cover are left in tact.
- Integrated pest management advantage. Minimizes soil disturbance reducing sprouting/ seed propagation of weed seeds.
- Accommodates on site material quarantined due to pest or disease (e.g. light brown apple moth, sudden oak death, eucalyptus borer beetle, pitch pine canker).

*Disadvantages:*

- Potential ignitability of dried cut materials.
- Public dissatisfaction with unfinished appearance of cut materials.

***Retain in Place - Lop and Scatter***

*Description:* Lop and scatter traditionally is used to thin forest fuel loads, but can also reduce amount of fuel in shrubs or be used to remove understory fuels. Trees or shrubs are felled, and branches cut with an ax or chainsaw. The cut materials are then scattered on the ground in open areas, laid flat and left to decompose. This technique creates a microenvironment for grasses and

forbes below the cut material. Used for large scale wildland vegetation management. Usually not appropriate for small-scale structure protection.

*Regional Retention/ Mulch Policies:*

- Branches/ trunks >6” diameter are often cut into shorter 4 to 6 foot lengths (bucked up).
- Small diameter material may be cut into smaller pieces, but is not run through a chipping machine.
- Depth of acceptable slash: 30” (ref. sec. 4551.5 PRC).

*Associated costs:* Costs include labor & equipment, as well as distribution on site. There is no additional transportation or disposal cost.

*Impact on site-specific fire behavior*

- Continuity of fuel, size, depth of material and compaction influence ease of ignition. Widely scattered large materials, or smaller materials that are more compact and “laid down” result in reduced ignitions. Increased slash depth may increase spotting potential, especially when located under trees or near homes, which may contribute to adverse fire behavior.
- Cut material reduces flame height and heat output, as compared to standing shrubs and trees. Scattered materials that break up the continuous fuel bed also reduce heat output.
- Response to suppression efforts depends upon distribution, size and compaction. Widely spread materials easier to suppress.

*Advantages:*

- More benign fire behavior and improved fire fighter safety compared to standing shrub and trees.
- Erosion control maintained since root system and plant cover are left intact. Scattered cut materials provide additional cover to reduce erosion.
- Integrated pest management advantage – Minimizes soil disturbance reducing sprouting/ seed propagation of weed seeds. Can act as nursery for native seedlings.
- Accommodates on site material quarantined due to pest or disease (e.g. light brown apple moth, sudden oak death, eucalyptus borer beetle, pitch pine canker).

*Disadvantages:*

- Potential ignitability.
- Public dissatisfaction with unfinished appearance of scattered materials.

### **Retain in Place - Cutting and Arranging in Fuel Area.**

*Description:* Tree branches, shrubs and other materials are cut into smaller lengths and arranged in windrows or habitat piles. Trunks greater than 12" diameter may be utilized as roadside edging. Habitat piles offer wildlife concealment from predators, as well as nesting sites. Used for large scale wildland vegetation management. Not appropriate for small-scale structure protection.

#### *Regional Retention/ Mulch Policies:*

- Branches/ trunks >6" diameters are often cut into shorter 4 to 6 foot lengths. Stacked in windrows or habitat piles. Located away from trees or buildings.
  - Windrows are rows, ≤4feet high where material dries and decomposes. The shape allows for easy access, stacking and provides air and moisture circulation to aid in decomposition.
  - Habitat piles are usually dispersed; ≤4feet tall, 10 to 15 feet in diameter.
- Small diameter material may be cut into shorter pieces, but is not run through a chipper.

*Associated costs:* Costs include labor & equipment, as well as distribution on site. There is no additional transportation or disposal cost.

#### *Impact on site-specific fire behavior*

- Location of final piles is critical to reduce potential ignition and rapid fire spread. Continuity of fuel, size, depth of material and compaction influence ease of ignition. Cut material reduces flame height and heat output, as compared to standing shrubs and trees. However potential ignition, flame length and heat output need to be considered in location and size of windrows or piles.
- Responses to suppression efforts depend upon distribution, size and compaction. Deep dense windrows may act as mulch piles and require additional suppression and mop-up efforts.

#### *Advantages:*

- Improved fire behavior and fire fighter safety over standing shrub and trees.
- Erosion control maintained since root system and plant cover are left intact. Scattered cut materials provide additional cover to reduce erosion.
- Minimizes soil disturbance reducing sprouting/ seed propagation of weed seeds. Scattered cut materials can act as nursery for native seedlings.
- Accommodates on site material quarantined due to pest or disease (e.g. light brown apple moth, sudden oak death, eucalyptus borer beetle, pitch pine canker).

#### *Disadvantages:*

- Potential ignitability and fire behavior.
- Public dissatisfaction with unfinished appearance of scattered materials.

### **Retain in Place - Grazing**

*Description:* Goats, sheep, horses or cattle are used to remove grass, herbaceous or shrubby plants. No material is left on site. Used for large scale wildland vegetation management. Usually not appropriate for small-scale structure protection.

#### *Regional Policies:*

- Grazing policies differ by land manager.
- Timing, duration, stocking rates, type of grazing animal relate to targeted vegetation. Stubble management practices dictate how long animals remain in a single location.

*Associated costs:* Costs include animals and herders. There is no additional distribution or disposal cost. Other associated costs may include water sources, fencing, transportation and herd control.

#### *Impact on site-specific fire behavior*

- Reduces potential ignition and rapid fire spread by reducing fuel loads and breaking up continuity.
- Reduced flame lengths and heat output.
- Grazed areas respond well to suppression efforts.

#### *Advantages:*

- More benign fire behavior and improved fire fighter safety compared to tall grass and shrubs.
- Reduced ignitability/ slower fire spread.
- More benign fire behavior and improved fire fighter safety.
- Well accepted by many members of the public.
- Accommodates on site material quarantined due to pest or disease (e.g. light brown apple moth, sudden oak death, eucalyptus borer beetle, pitch pine canker).

#### *Disadvantages:*

- Erosion control major management concern.
- Animals can introduce weed seed. Soil disturbance can increase sprouting/ seed propagation of weed seeds.
- Goats non-selective in what they graze. Need to fence off and protect desirable species. Fencing can be major cost.

### ***Retain in Place - Chemical treatment***

*Description:* The agencies in the region may limit chemical usage as a part of their overall Integrated Pest Management (IPM) programs. Post-emergent foliar application is used to kill both woody and herbaceous plants, typically along roadsides. With herbaceous materials the dead matter usually decomposes or blows away. A second more common chemical treatment is direct application to prevent resprout of cut vegetation, such as eucalyptus. Used for large scale wildland vegetation management. May be appropriate for small-scale structure protection to prevent resprout especially of eucalyptus.

*Retention/ mulch policies:* Treated herbaceous material decomposes or is blown away. Standing dead material is usually removed, but may be left in place. For example in broom stands, the plants are sprayed and left to decompose in place in order to eliminate ground disturbance and the resulting seed germination. (This treatment results in an increased short-term fire risk of fire from standing dead material. The dead material has usually completely decomposed within the three seasons.)

*Associated costs:* Costs include material, labor & equipment. Other associated cost may include disposal of standing dead material.

#### *Impact on site-specific fire behavior*

- Short term impacts may include increased ignition potential, rapid fire spread, higher flame lengths and head output as plant materials die back.
- Long term impact includes:
  - Reduces potential ignition and rapid fire spread by reducing fuel loads and subsequent sprouting.
  - Reduced flame lengths and heat output by laying down or removing fuel loads.
  - Treated areas respond well to suppression efforts due to reduced fuel.

#### *Advantages:*

- Reduced ignitability/ slower fire spread due to reduced fuel.
- More benign fire behavior and improved fire fighter safety.
- Limited soil disturbance, does not increase erosion or weed propagation.
- Accommodates on site material quarantined due to pest or disease (e.g. light brown apple moth, sudden oak death, eucalyptus borer beetle, pitch pine canker).

#### *Disadvantages:*

- Additional erosion control may be needed.
- Need to protect desired species from chemical drift.
- Public acceptance low (in some instances there is strong support for specific treatment such as for eucalyptus to prevent stump sprout).
- Foliar treatments can appear unsightly and unnatural for a period of time. (If timed appropriately treatment may mimic the natural deciduous late summer/ fall die-back).

### ***Mulched On Site - Chipping:***

*Description:* Typical chippers handle cut stems and branches up to 4 inches in diameter and 6' long (6" diameter with large chippers) that are chipped into fine material and are either scattered, piled or removed. Larger machinery (track chipper) can handle mature trees up to 28" diameter and 160' length. Used for both large-scale wildland vegetation management and small-scale structure protection.

This technique can also be used on un-cut shrubs and trees, if a machine such as brush hog, mowing machinery or masticator is utilized.

#### *Retention/ mulch policies:*

- Material left on site can vary from 2" to 6" in size or finer depending upon machine. Material is left to decompose.
- Depth of mulch varies by agency from 4" to 2'. Temporary piles may exceed this height before they are spread.

*Associated costs:* Costs include labor & equipment for chipping. Preparation for processing, spreading, or transportation and disposal costs vary depending upon technique used and final disposition of chips.

#### *Impact on site-specific fire behavior*

- Natural compaction of chips reduces likelihood of ignition and fire spread.
- Burning chips typically smolder without high flame height. Wood chips in deep piles (25 feet plus) at sawmills have been known to spontaneously combust if internal temperatures reach combustion stage due to decomposition.
- Difficult to suppress fire once started in chips, especially where placed in deep layers.

#### *Advantages:*

- Reduced ignitability/ slower fire spread.
- More benign fire behavior, lower heat output and improved fire fighter safety.
- Erosion control.
- Weed suppression, reduce sprouting/ seed propagation (this is an accepted IPM method for seed suppression of some species).
- Public acceptance high for finished appearance. Noise and dust complaints common during chipping operations.
- Chips increase soil moisture levels by reducing evapo-transpiration; helping re-establishment of tree and shrub seedlings.
- Accommodates on site material quarantined due to pest or disease (e.g. light brown apple moth, sudden oak death, eucalyptus borer beetle, pitch pine canker).

#### *Disadvantages:*

- Additional suppression actions (potential additional cost for mop up).
- Limited locations for retention/ disposal.
- Deep mulch may limit propagation of desirable native species.

### ***Mulched for Off Site Use***

*Description:* Whole material removed from site to centralized location where it is chipped. Used for small-scale structure protection. Additional expense limits use for large scale wildland vegetation management.

*Associated costs:* Costs include labor & equipment for chipping. Transportation, processing and disposal costs vary depending upon chipping site and final disposition of chips.

#### *Impact on site-specific fire behavior*

- Fuel removal reduces likelihood of ignition and fire spread.
- Reduced flame height/ heat output.
- Suppression response reduced due to reduced fuel.

#### *Advantages:*

- Reduced ignitability and slower fire spread.
- More benign fire behavior, lower heat output and improved fire fighter safety.
- Limits noise and dust complaints common during chipping operations.
- Public acceptance of finished appearance depends on how natural site looks.

#### *Disadvantages:*

- Cost for transport and processing.
- Limited locations for retention/ disposal.
- May need additional erosion control.
- May need additional weed suppression, reduce sprouting/ seed propagation.
- Traffic issues related to transport of unprocessed materials off site.
- Public acceptance of finished appearance depends on how natural site looks.
- Quarantines due to pest or disease (e.g. light brown apple moth, sudden oak death, eucalyptus borer beetle, pitch pine canker) may restrict ability to transport chips off site or out of quarantine area.

### ***Removed from Site and Disposed at Green-waste Site***

*Description:* Whole material removed from site to centralized disposal or green waste site. Also called “rake and take.” Used for small-scale structure protection. Additional expense, erosion and weed control limit use for large scale wildland vegetation management.

*Associated costs:* Costs include labor & equipment for cutting/ removal. Transportation, processing and disposal costs vary depending upon final disposition of material.

#### *Impact on site-specific fire behavior*

- Fuel removal reduces likelihood of ignition and fire spread.
- Reduced flame height/ heat output.
- Suppression response reduced due to reduced fuel.

#### *Advantages:*

- Reduced ignitability and slower fire spread.
- More benign fire behavior, lower heat output and improved fire fighter safety.



- Limits noise and dust complaints common during chipping operations.
- Public acceptance of finished appearance depends on how natural site looks.

*Disadvantages:*

- Cost for transport and processing.
- Limited locations for retention/ disposal.
- May need additional erosion control.
- May need additional weed suppression, reduce sprouting/ seed propagation.
- Traffic issues related to transport of unprocessed materials off site.
- Public acceptance of finished appearance depends on how natural site looks.
- Quarantines due to pest or disease (e.g. light brown apple moth, sudden oak death, eucalyptus borer beetle, pitch pine canker) may restrict ability to remove material from site or transport to green-waste site or out of quarantine area.

***Removed from Site and Processed for Added Economic Value***

*Description:* Whole material removed from site to centralized location where it is processed for added economic value. This could include:

- Fire wood
- Dust Free horse bedding
- Feed (acacia and eucalyptus to zoo animals)
- Lumber or whole boles
- Pulp
- Biofuels

Used for large scale wildland vegetation management. Costs often limit is viability for small-scale structure protection. Revenue may offset project costs.

*Associated costs:* Costs include labor & equipment for removal. Transportation, processing and disposal costs vary depending upon processing site and final disposition of materials.

*Impact on site-specific fire behavior*

- Fuel removal reduces likelihood of ignition and fire spread.
- Reduced flame height/ heat output.
- Suppression response increased due to reduced fuel.

*Advantages:*

- Reduced ignitability and slower fire spread.
- More benign fire behavior, lower heat output and improved fire fighter safety.
- Limits noise and dust complaints common during chipping operations.
- Public acceptance of finished appearance depends on how natural site looks.
- Generates revenue.

*Disadvantages:*

- Cost for transport and processing.
- Limited locations for retention/ disposal.
- May need additional erosion control.

- May need additional weed suppression, reduce sprouting/ seed propagation.
- Traffic issues related to transport of unprocessed materials off site.
- Public acceptance of finished appearance depends on how natural site looks.
- Quarantines due to pest or disease (e.g. light brown apple moth, sudden oak death, eucalyptus borer beetle, pitch pine canker) may restrict ability to remove material from site or transport out of quarantine area.