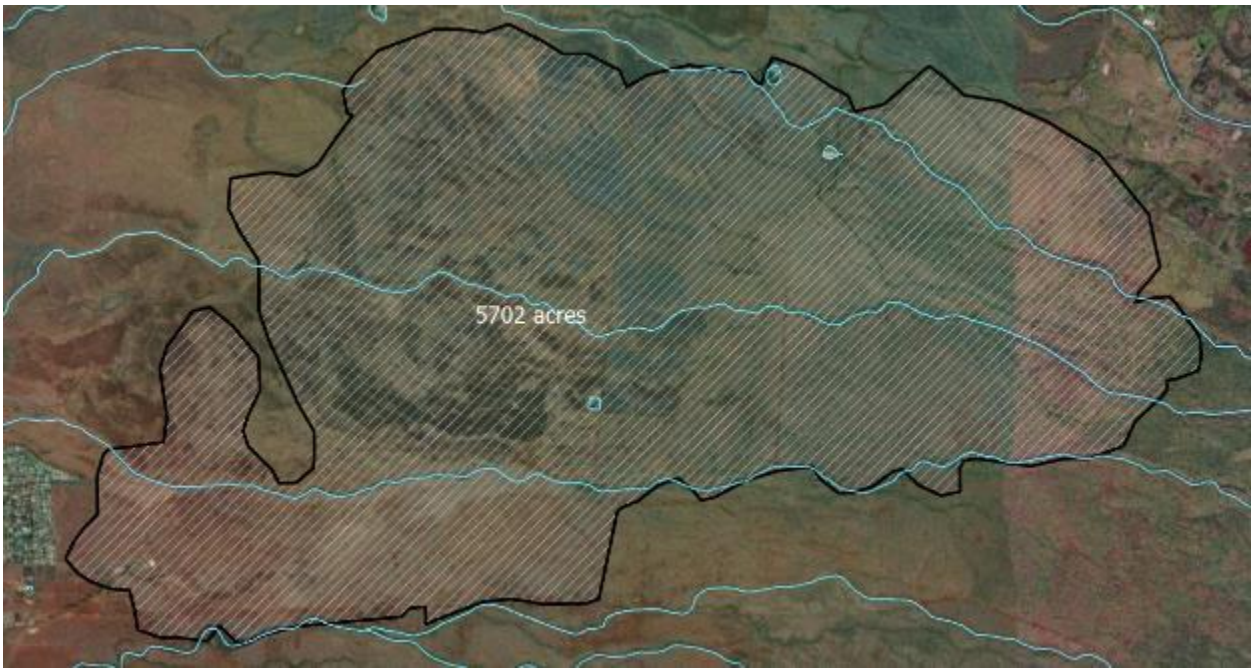
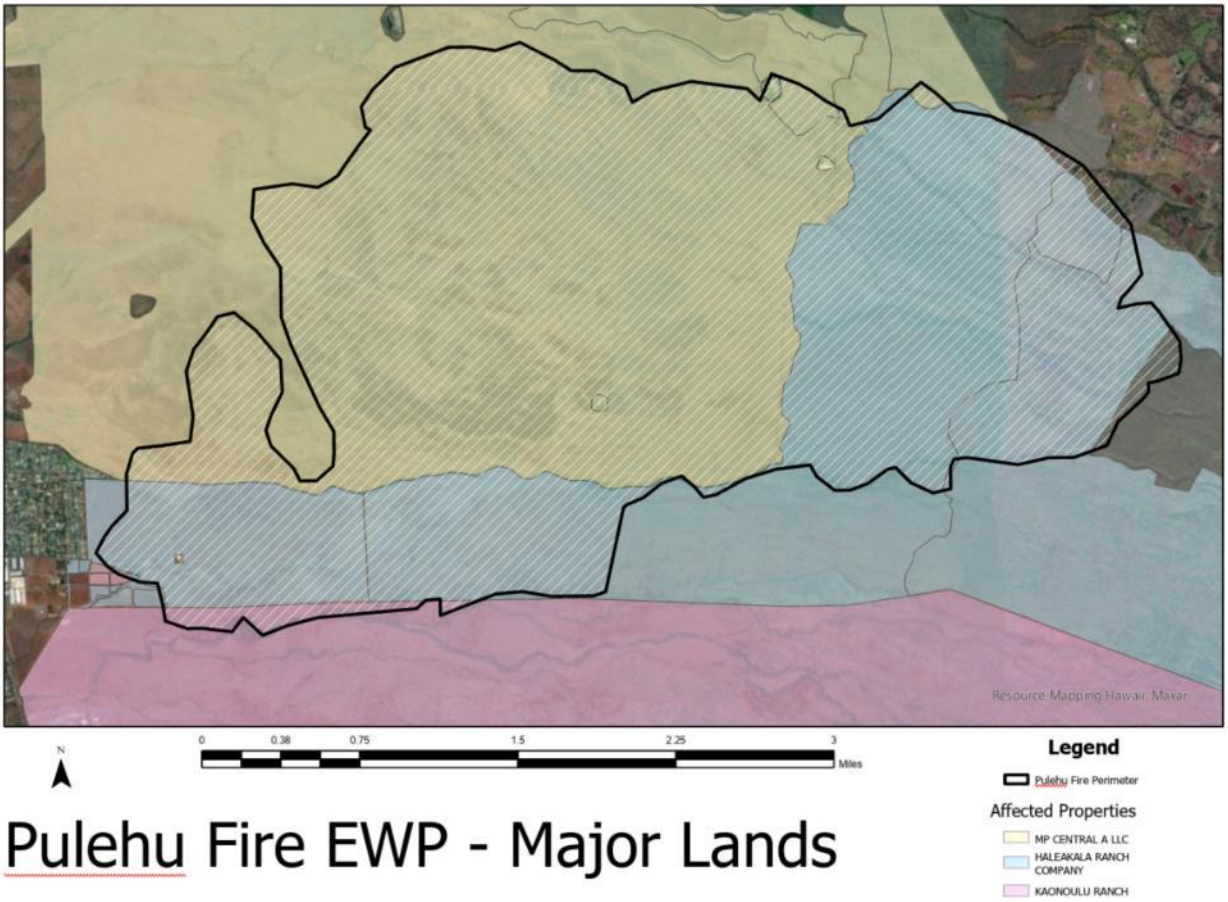
Emergency Watershed Protection
Maui, Hawaii – Pulehu Fire:

OVERVIEW

The Pulehu Fire burned approximately 5,700 acres. These lands are owned by Mahi Pono (3,000 acres), Haleakala Ranch (2,500 acres) and Kaonoulu Ranch (200 acres). As working agricultural and grazed lands, landowner interests and objectives are key considerations in fire mitigation recommendations. The burn extent and ownership of these lands is shown on the images below. The terrain is steep, with mineral surface soils containing very little organic matter. Interspersed through the watershed are volcanic rocks, some of which have been pushed into piles and mounded up along the gulches. Some of the burned land had previously been cultivated with sugar cane. The cultivated land was manipulated and graded to keep irrigation water from entering adjacent gulches. Currently, none of the burned lands are irrigated.



Approximate Pulehu Fire burn extent



Landownership under Pulehu Fire burn area

REVEGETATION

It is recommended that the entire burn area be reseeded, with the areas along the gulches given the highest priority for treatment.

Grasses are the most effective plants for large scale, landscape level soil stabilization. After considering many factors, buffelgrass (5 lbs/acre Pure Live Seed) is the principal recommended species, as it is well-adapted to the site, is an excellent soil stabilizer and existed in a near monoculture on this landscape prior to the fire and is readily available commercially. Buffelgrass has deep roots that anchor the soil and forms a quick canopy and abundant litter that protects the soil surface from raindrop impact and sheet, rill, and wind erosion. Buffelgrass also provides valuable livestock forage, which is important to all three landowners affected by this fire. Other non-native plant options that could be mixed with buffelgrass include common groundcover species, with proven short-term restoration values that are not weed risks such as annual rye grass (*Lolium multiflorum*) or perennial rye grass (*Lolium perenne*). Such species could be added to prescribed quantities of buffelgrass, however NRCS must approve all species and seeding rates prior to application.

Native species such as pili grass *(Heteropogon contortus)* could be incorporated into the reseeding plan based on availability and appropriateness to the site in areas not actively grazed by livestock. If seed, sprigs and/or seedlings of native grasses, shrubs and trees can be successfully sourced in a timely manner, NRCS recommends that:

- Proposed species must be approved in advance by NRCS to ensure adaptation to the extreme environmental conditions of this site and for provision of important technical management guidance.
- In the event available quantities are limited, smaller targeted areas for native species installations can be identified along gulches and in locations that have limited grazing activity. Landowners should be aware that such sites will require higher management inputs for controlling competing vegetation, preparing sites for planting, and maintenance once established.
- Such installations must be supported by the landowner.
- Such installations could provide beneficial insights into the feasibility of similar plantings in the future if plant establishment is successful.

Aerial broadcast seeding is the preferred method for the entire burned area, with hydroseeding as an option for the more severely burned areas depending on location and access. Temporary irrigation water would help germinate the seeds along the gulches more rapidly. This would provide for controlled application of water at a rate that will be enough to stimulate growth but not transport the seeds versus rainfall where rates and amounts are variable and unpredictable.

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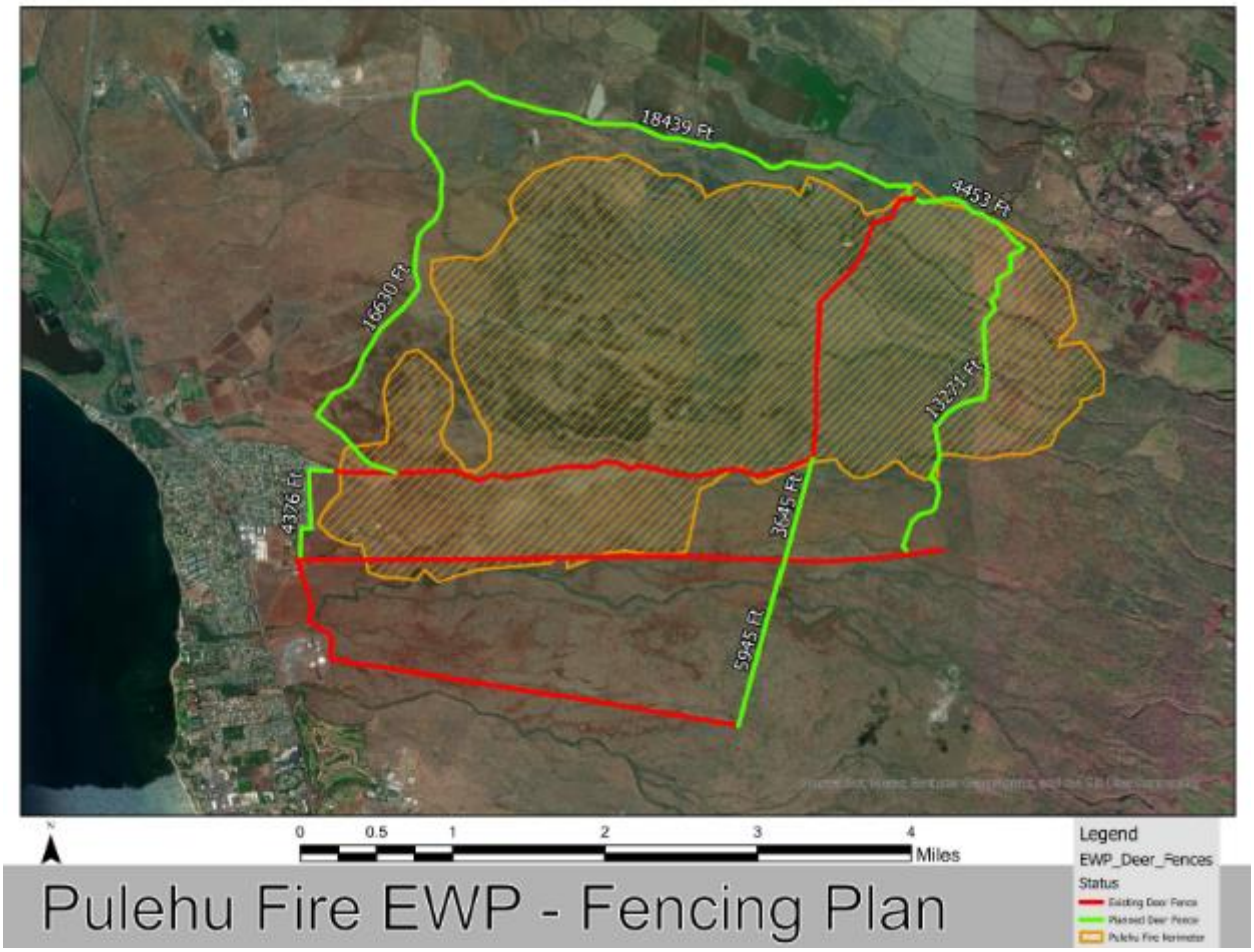
FENCING

Fencing the burned area is the highest priority and critical to create a favorable environment for the existing grasses to resprout and recover and for newly broadcast seed to germinate and establish without being subject to intense grazing pressure from axis deer. Fences must be woven wire with one barbed wire strand placed along the bottom and be at least 6 feet tall. The fencing alignment will be coordinated with the existing landowners and their business operations. The estimated length of fencing need is approximately 14 miles. Proposed fences (shown in green) are laid out along the most advantageous routes to tie into existing deer fences (shown in red) and create manageable units.



Proposed NRCS deer fences are shown in green. Existing deer fences are shown in red.

FIREBREAKS

Re-establishment of buffelgrass is expected to effectively anchor and protect the soil from erosion. However, a healthy, productive buffelgrass community also presents a renewed threat of wildfire in subsequent dry/dormant seasons and underscores the importance of fuel management. Revegetation and reestablishment of the burned grass is of critical importance to protecting the soil and preserving water quality, and the installation of accompanying firebreaks is a crucial supporting practice for mitigating the associated wildfire risk with a healthy grass-dominated plant community in a dry, windy area. This is true for both native and non-native grasses.

The preferred strategy is to install a network of interconnected firebreaks. The "network" approach consists of installing a series of multiple, parallel and perpendicular firebreaks, which creates the effect of compartmentalizing and containing fires when they start, preventing them from growing to an unmanageable size. The network of firebreaks also provides responders with direct access to potential fires, reducing response time and improving vehicle and resource access. The intent is to facilitate fire suppression efforts such that future fires would be fought at a manageable scale with local resources.

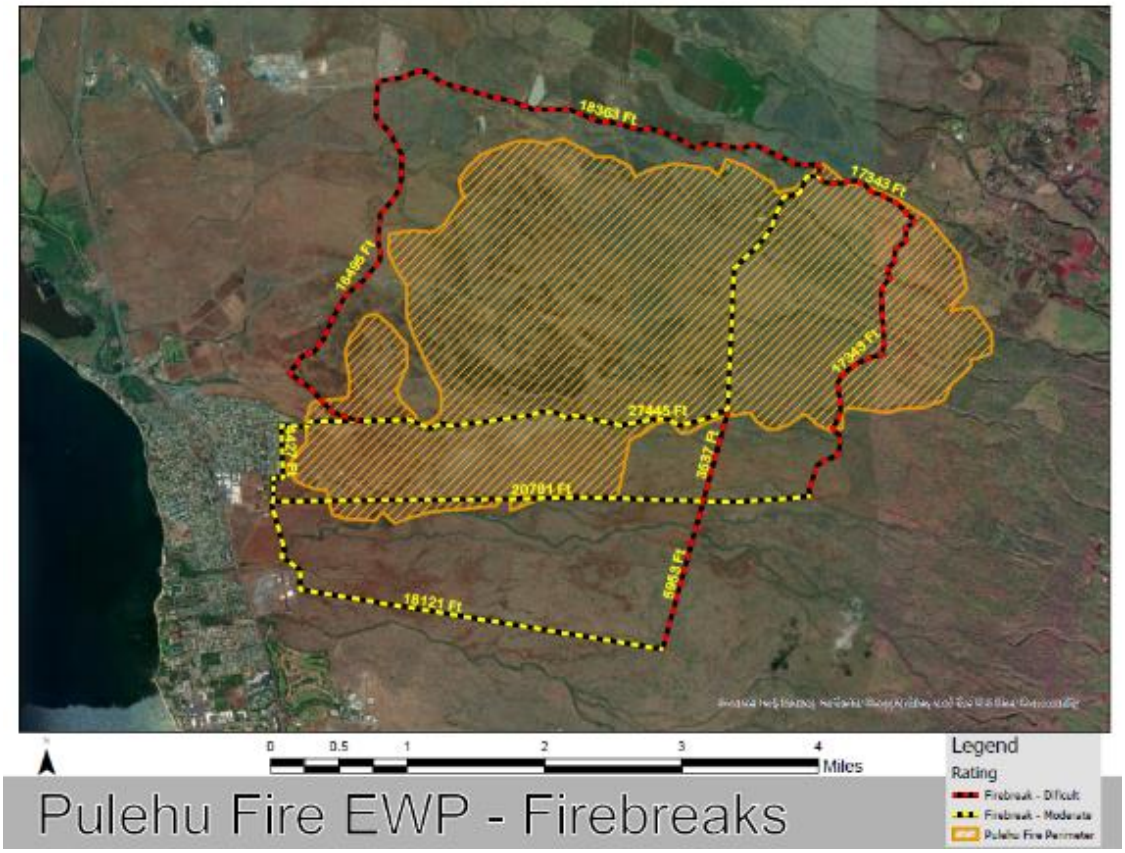
Firebreak dimensions were designed to handle the expected flame lengths and fire behavior based on the fuel sampling and estimation study results. Maximum fuel heights were measured at 30 inches (2.5 feet), which corresponds to a *minimum* firebreak width of 25 feet. Since this requires multiple passes with a bulldozer, both "moderate" (47% of total length) and "difficult" (53% of total length) installation cost rates were employed based on terrain. A 10% correction factor was added to the total length of the firebreaks to account for slope and difficult terrain. The total length of all planned firebreaks was estimated at 145,730 feet. The proposed alignments for these firebreaks that are depicted in the figure below are idealized to a degree. NRCS recognizes each landowner will dictate whether these recommendations will be followed in full, in part or at all. However, the objective is to encourage cooperation across ownerships to support a firebreak network that protects the entire landscape.

Firebreaks are typically installed as control lines bladed to bare soil where all fuels have been removed. However, firebreaks can also incorporate non-combustible materials such as rows of plants with high moisture content (such as banana, with irrigation) or coarse mulch. In the specific case of organic mulches, use of NRCS EWPP funding is only permissible for purchase, production or spreading of organic mulches sourced from the island of Maui.

Existing natural features that limit fire movement such as streams, rocky outcrops, and bare areas and man-made structures like roads, concrete drainage ditches and natural drainages can be used to augment firebreaks. Bladed firebreaks should incorporate erosion prevention structures such as rolling dips or water bars with wing ditches to prevent erosion.

Once installed, firebreaks may result in air quality issues due to emissions of wind-borne dust. NRCS can provide technical assistance for mitigating this potential issue through technical assistance outside of the EWP program, and for eligible landowners, financial assistance through other programs.

Refer to Appendix B - Firebreaks and Fuel Management - Lahaina and Pulehu Fires for further background and discussion on firebreak recommendations.

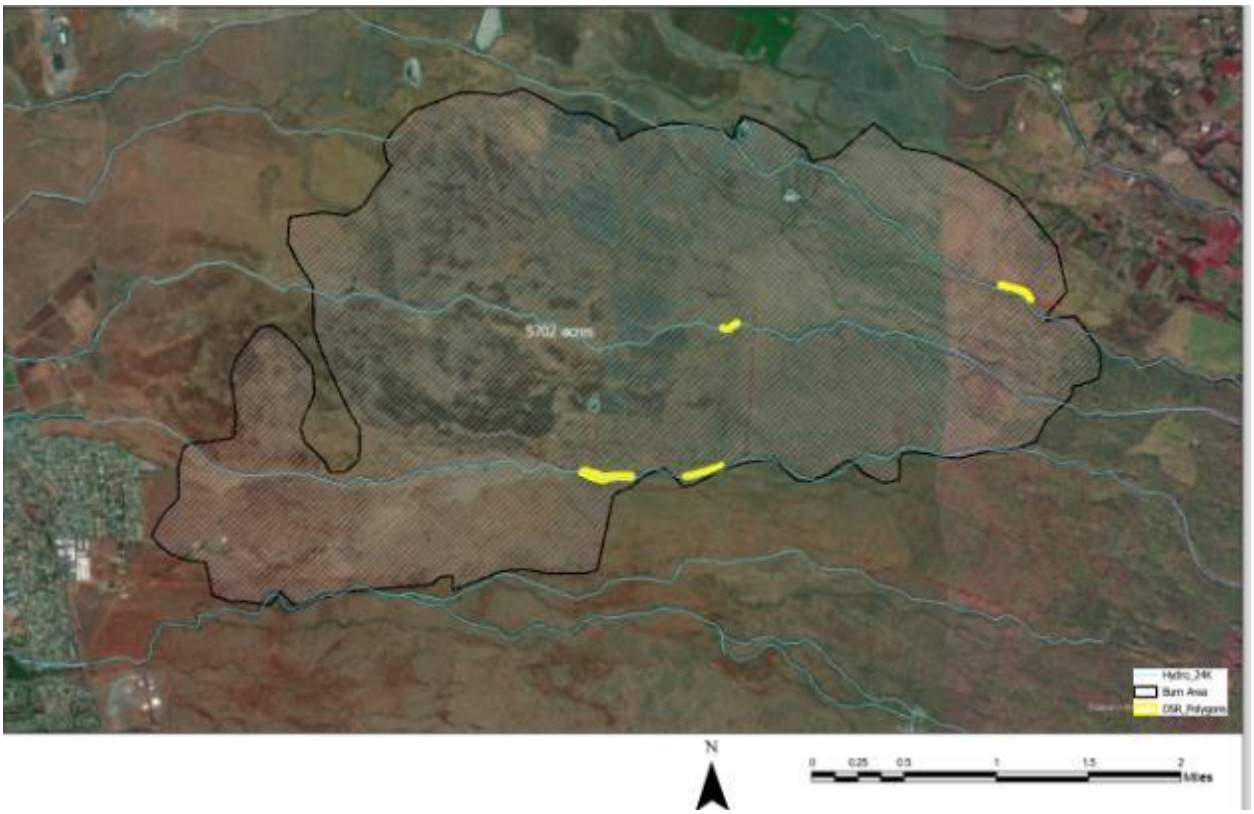


Moderate installation firebreaks are represented by yellow/black lines. Difficult installation firebreaks are represented by red/black lines.

GULCHES & TREE REMOVAL

In general, the bottom of gulches within the Pulehu fire unit were not burned, and the vegetation appears to be intact. Furthermore, prior land management, particularly in the Mahi Pono section, often included piling of rocks and soil along the top edges of gulches. For these reasons, mulching as a soil stabilization measure is not considered a high priority practice in the Pulehu burn unit.

There are a few areas where the gulches were burned and trees and debris now present should be removed. Typically, the fire burned the base of the tree and continued burning up the tree to about 2-4 feet above the base, causing many trees to fall over. The tops of the trees did not burn, indicating that tree didn't fall until after the fire had passed. NRCS recommends burned trees that have fallen into the gulches be removed and has identified the areas where tree removal will be needed. This includes 3,000 feet along the gulches as shown in the image below. The trees could be chipped/mulched and spread along the top banks of the gulch. These are the locations where the fires burned hot and the mulch may assist in reestablishing vegetation and stabilizing exposed soils. NRCS recommends that a forester evaluate any standing trees that need to be removed. Again, in the specific case of organic mulches, use of NRCS EWPP funding is only permissible for purchase, production or spreading of organic mulches sourced from the island of Maui.



Tree Removal and Mulching Locations

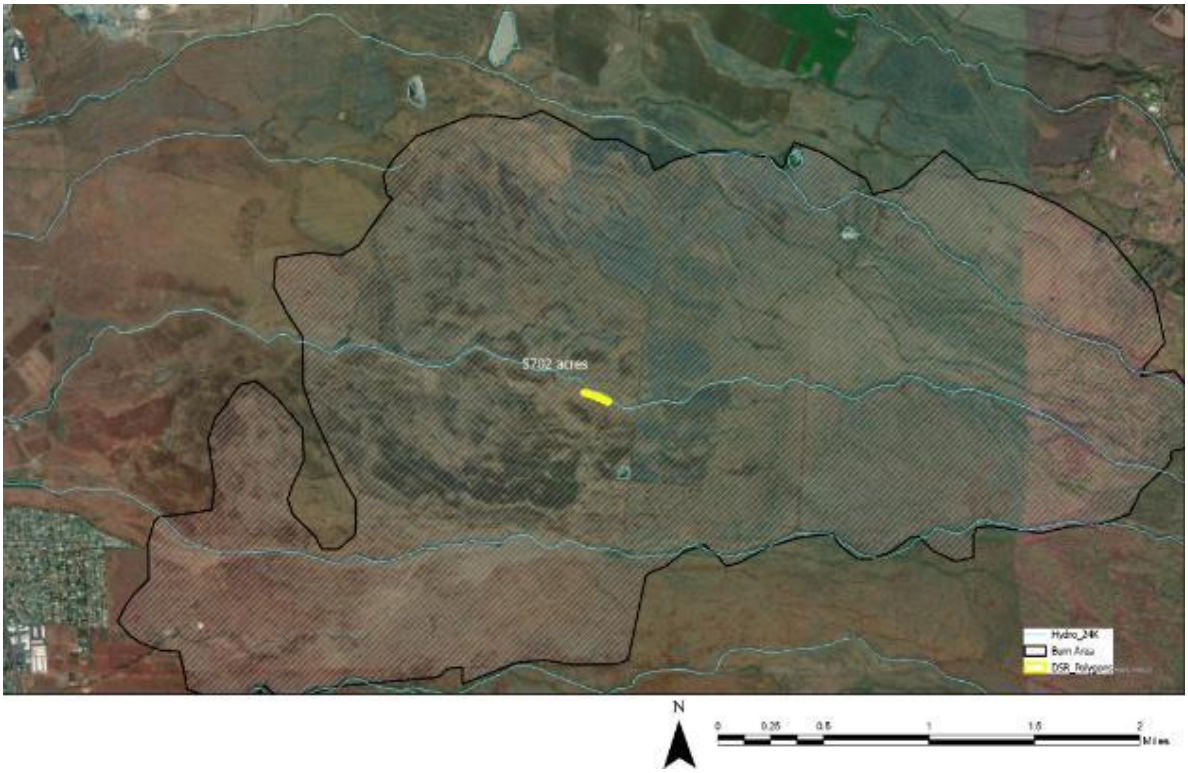
Sketch of Tree Removal and Mulching

Example of tree debris at head of gulch

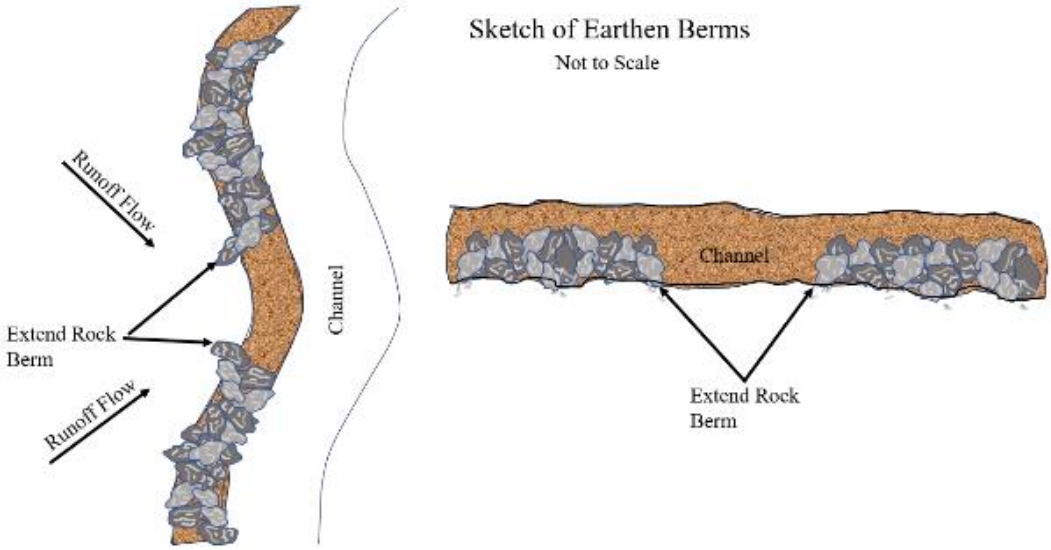
ALL TASKS HEREAFTER WILL REQUIRE ACE PERMITTING

NATURAL DRAINAGES (GULCHES) – BERM REPAIR

During a site visit, a network of previously established earth berms were observed at the top banks of principal natural drainages i.e. gulches. These were probably created as rocks and soil for land smoothing were removed from cultivated fields. In some locations, small sections of the earth embankments have been removed. NRCS recommends that in these locations totaling approximately 650 linear feet that the berms be restored to control storm surface water flow into gulches.



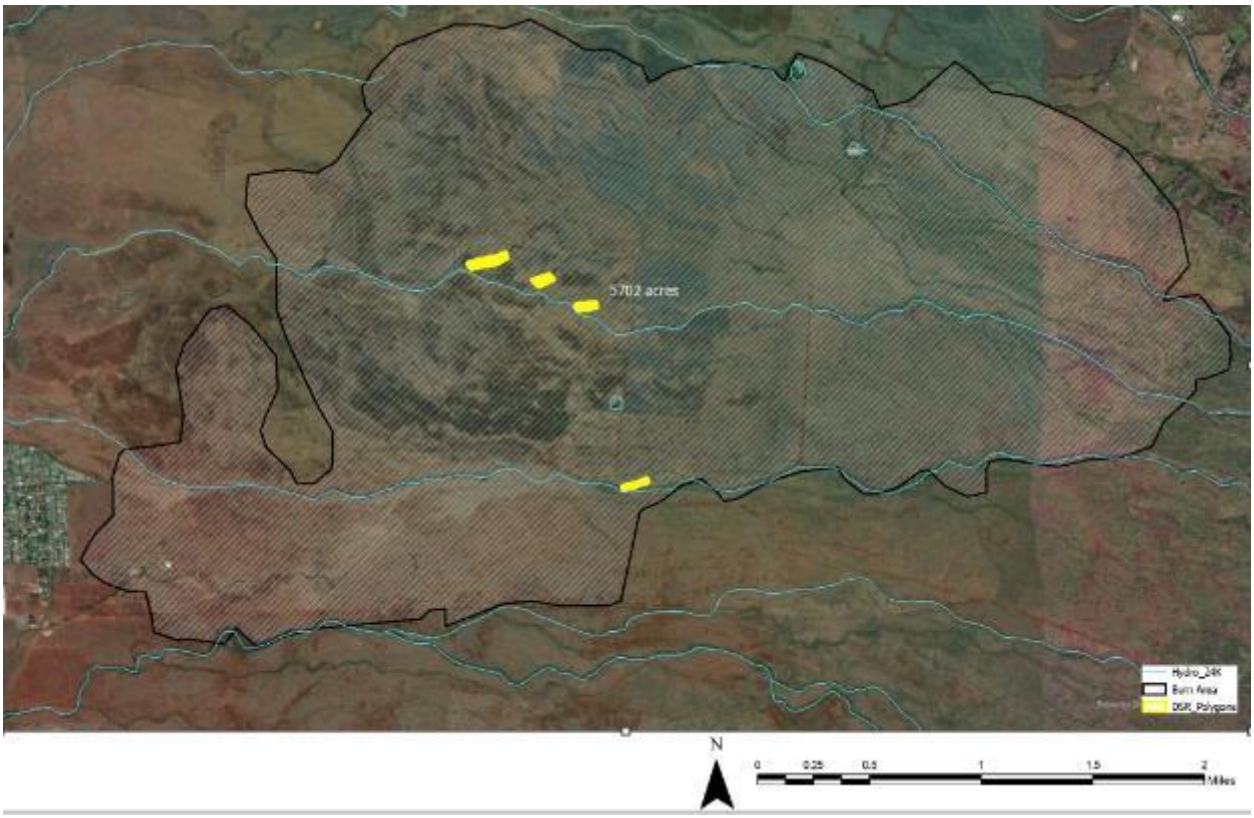
Earth berm location at the top bank of the gulch.



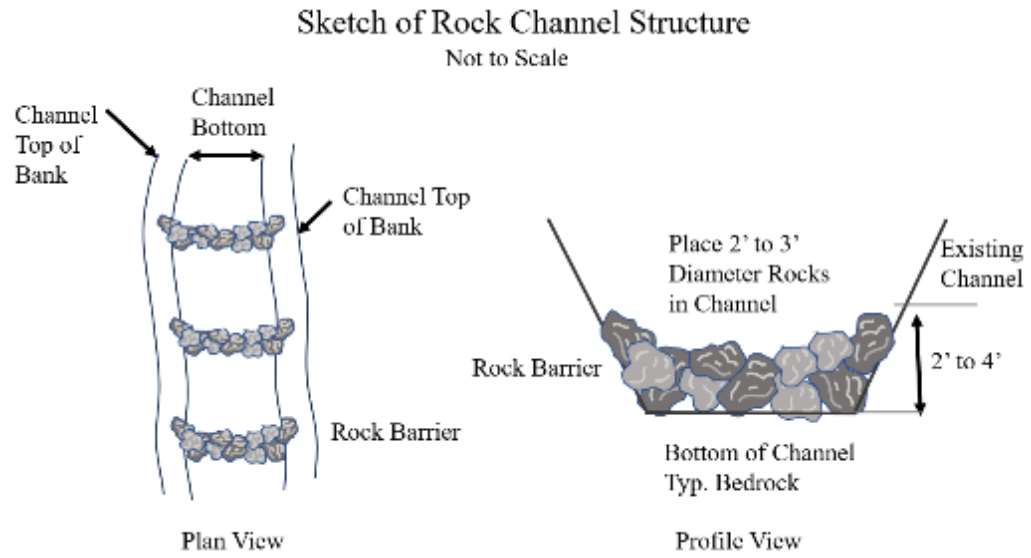
Sketch showing construction of earth berm along the top bank of the gulches

NATURAL DRAINAGES (GULCHES) – ROCK BARRIERS

There are several tributaries identified that NRCS recommends placing temporary rock barriers at the bottom channel to catch sediment and debris. The concept here is to provide short-term sediment trapping infrastructure to capture a portion of storm water sediments that are likely to be associated with initial post-fire rainstorm events. As revegetation efforts progress and surface soils within the burn unit are better protected, these barriers along with trapped sediments can be removed as an option. Additionally, the landowners can periodically remove sediment and debris from behind the check dams to extend their lifespan and functionality if desired. Rock barriers should be constructed with 2-3-feet diameter rocks and placed no higher than 2-4 feet above the channel bottom. There following 4 tributaries identified, with a total of 25 rock barriers suggested.



Rock Sediment Detainment Structures on Tributaries

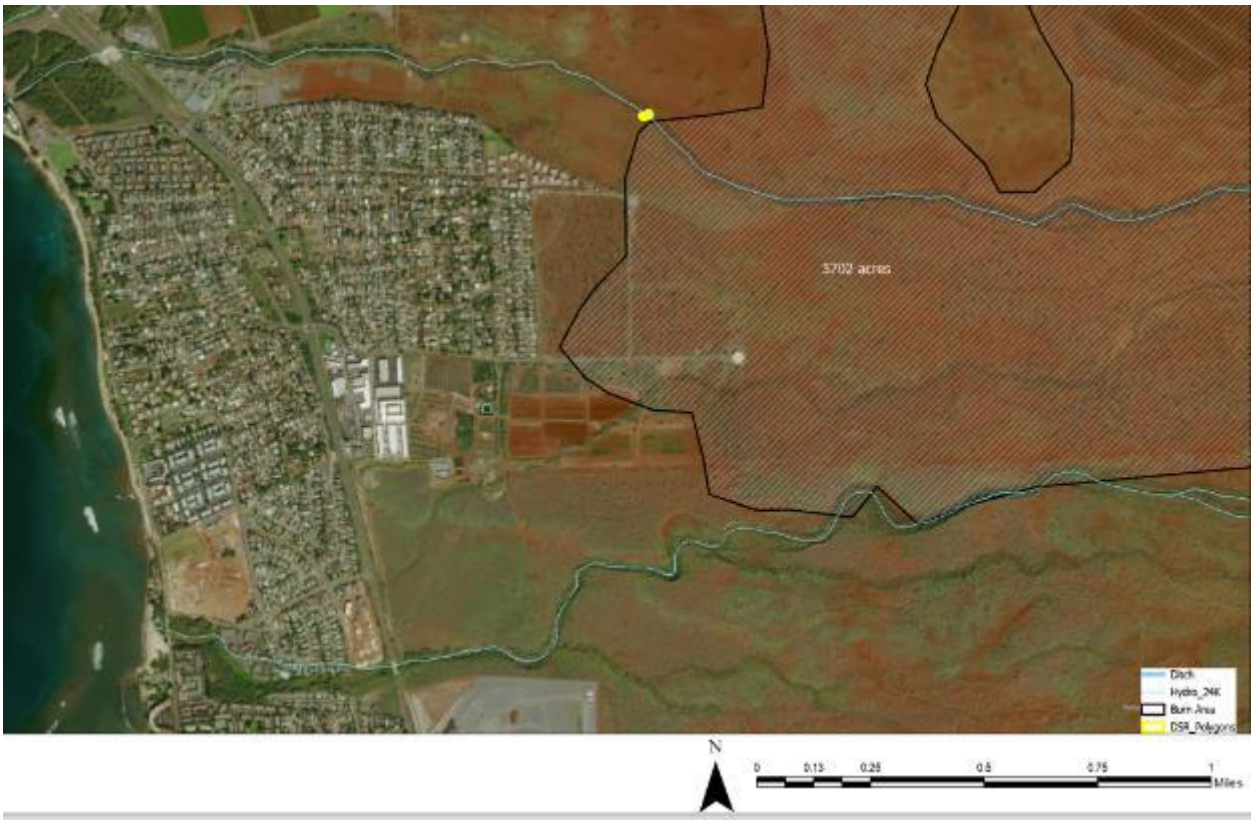


Sketch of Rock Channel Structure

SEDIMENT REMOVAL

The rainfall in this area of the watershed does not appear to contribute much to the flow in associated gulches. Rainfall in the area generally falls during the rainy season from October through March with typically higher amounts of rainfall in December and January. During a significant storm event this area may receive from 2 to 5 inches of rain, but higher amounts are possible. The gulches appear to flow due to the rainfall that occurs in the upper watershed and the sediment in the gulches reflects this observation as the sediment is "gray/black color rather than the "red" mineral soil in the burned area. In discussion with the landowner, flow in the channel tends to run between 1 and 3 days depending on the storm event and the length of rainfall. Flow depths on his ranch in the gulch ranges between 3 and 6 feet.

During the fire, several dozers were used to cut firebreaks. In the process of establishing the firebreaks, the dozers crossed Keahaiwi Gulch and pushed earthfill into the channel. NRCS recommends that this earthfill be removed from the channel and the channel restored to match the existing channel cross section.



Remove earthfill in the channel caused during active fire response efforts to establish a firebreak.

In other areas, storm events prior to the Pulehu Fire incident resulted in sediment laden runoff that deposited significant quantities of sediment in gulches and urban drainage channels, and also led to water and sediment inundation in developed areas of Kihei. As drainage channels pass through lower elevations and approach the ocean, water runoff velocity will slow and sediment will be deposited. This is particularly noticeable where primary road bridges cross drainages near Kihei, and where the channels are considerably wider both upstream and downstream of the bridges. NRCS recommends that existing sediment at the bridge locations identified below be removed. This work will restore hydraulic function and capacity of the drainages and help buffer sediment delivery risk from eroded landscapes to ocean and near-shore reef systems during future storm events. Additionally, both South Kihei Rd and Piilani Highway are at risk of flooding due to inadequate gulch capacity to convey stormwater. This becomes especially problematic at the confluence of N. Kihei Rd, S. Kihei Rd, and Piilani Highway just Northwest of the Waiakoa Gulch, as this is the only access into and out of the Kihei and Wailea communities.

Sediment removal under bridge at Piilani Hwy./Waiakoa Gulch and sediment at Kulanihakoi Gulch)

Proposed sediment removal underneath the bridge at Piilani Highway and Kulanihakoi Gulch. Note that sedimentation accumulation in primary drainages near Kihei town have attained depths up to 17 feet over many years, but in some places at least four feet in just the last two years prior to August, 2023. This extreme loss of fertile surface soils in adjacent watershed areas such as the Pulehu burn unit underscore the importance of post-burn vegetation restoration and soil stabilization needs.