

# Ecological Evaluation of Fire Fighting Efforts Associated with the Twin Butte/Moonshiner and Highway 20 Wildland Fires

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## 1.0 Purpose

The INEEL Wildland Fire Management Environmental Assessment Finding of No Significant Impact (DOE 2003) requires certain site restoration activities following each fire to determine the potential impacts from suppression activities.

*The INEEL will implement site restoration activities, as identified in Section 2.1.3, as necessary to determine impacts to cultural resources and ensure the establishment of a native plant community in areas disturbed by suppression activities. Until such time as a native plant community is established, the INEEL will control non-native weeds, including noxious weeds and invasive species, on those areas. (DOE/EA-1372 2003)*

The purpose of this report is to review information gathered to determine the potential for impacts to ecological resources resulting from suppression activities associated with the Twin Buttes, Moonshiner, and Highway 20 Fires and to make recommendations for mitigating any impacts.

On July 19, 2007, the Twin Buttes Fire consumed over eight thousand acres on and around East Butte with the majority of the acreage burned located on INL property. A containment line approximately seven miles long was created around the Twin Butte Fire in July 2007. The fire encompassed 8,715 acres in Bingham County and was on the south side of Highway 20 from approximately mile marker 270 to 277 to approximately two miles south of East Butte. A containment line was not created along the east border of the fire where the INL meets a private property fence, nor where the fire met Highway 20. Portions of T-4, T-6, and T-19 intersected the containment line.

On August 17, 2007, the Moonshiner Fire burned adjacent to the south and eastern edges of the Twin Butte Fire. This fire consumed 2,676 total acres, of which 1,541 acres were on INL property.

The Highway 20 Fire burned over 1400 acres (560 ha) north and east of Highway 20 on July 9, 2008 with the ignition point between mile markers 268 and 269. All acreage burned was located on INL property. A containment line approximately eleven miles (18 km) long was created around the fire. The fire burned parallel to the highway and north to the East Powerline Loop Road. Containment lines surround approximately 95 percent of the burned area.

## 2.0 Introduction

Fires in the summer at the INL are not uncommon. However, methods of fighting them and the subsequent clean-up are an ever changing practice. Fuel removal via containment lines can be an effective way to stop a spreading wildfire. Containment lines are usually created using a bulldozer to remove vegetation and topsoil in front of an advancing wildfire. Containment line construction is of ecological concern due to its disruption to the natural environment. Soil disturbance along with loss of the perennial vegetation is one of the main factors leading to weed infestation. The removal of topsoil and its seed bank also leaves the containment line swathe

less receptive to native plant revegetation. Ricks (piles of soil and debris flanking the containment line on either side) left to remain on the side of a containment line may suggest the appearance of a road, which if driven can further impede natural recovery and promote weed invasion. Previous data collected on the INL site suggests that native perennial vegetation is able to recover (with the exception of *Artemisia tridentata*) in approximately three years if rangeland health was previously good (Blew 2000) and the soil has not been disturbed.

Blew et al (2002) studied the recovery of vegetation on containment lines up to eight years old. They reported that density and frequency of cheatgrass were higher on containment lines and ricks than in the burned area near the containment line. They also reported that perennial grass density on containment lines was less than one-half of that found on nearby burned areas. Perennial grass cover was also higher on the burned area than on containment lines. They further recommended that those areas of containment line found to not be recovering well should be restored. Based on this guidance, our review of the suppression efforts on the Twin Buttes, Moonshiner and Highway 20 Fires focused primarily on the containment lines.

Our surveys on these fires addressed two primary issues. The first was to assess the potential for the containment line to recover naturally to native perennial vegetation rather than to cheatgrass or other weedy species.

The second was to determine the potential for direct impacts to wildlife under consideration for protection under the Endangered Species Act. We surveyed for pygmy rabbit burrow systems adjacent to the containment line in unburned habitat. We also conducted surveys for sage grouse in the vicinity of the containment line with adjacent sagebrush habitat.

We then use the information gathered in these surveys to provide recommendations for mitigating potential impacts to ecological resources.

## **3.0 Methods**

### **3.1 Containment Line and Vegetation Condition**

To gauge the potential for vegetation recovery and risk for weed invasion on the Twin Buttes Fire, our surveys consisted of establishing a set of plots approximately every 1600 ft (500 m) along the containment line (Figure 1). At each set, we established three transects 33 ft (10 m) long: one in the center of the containment line, one 50 ft (15 m) inside the burn, and one 50 ft (15 m) inside the unburned. Each transect was evaluated as a belt transect 6.5 ft (2 m) wide. Within the belt transects we recorded a species list and assigned each species an abundance rank: 1 for dominant/co-dominant, 2 for abundant, 3 for common, and 4 for rare. Also, on each containment line transect we measured containment line width once at each end of the transect and once in the center.

Because natural vegetation recovery had not begun on the Highway 20 Fire, we did not collect vegetation data, but measured only the containment line width as described above (Figure 2). Field crews were not able to locate containment lines associated with the Moonshiner Fire except where contiguous with the Twin Buttes Fire. Therefore, no containment line surveys unique to the Moonshiner Fire were conducted.

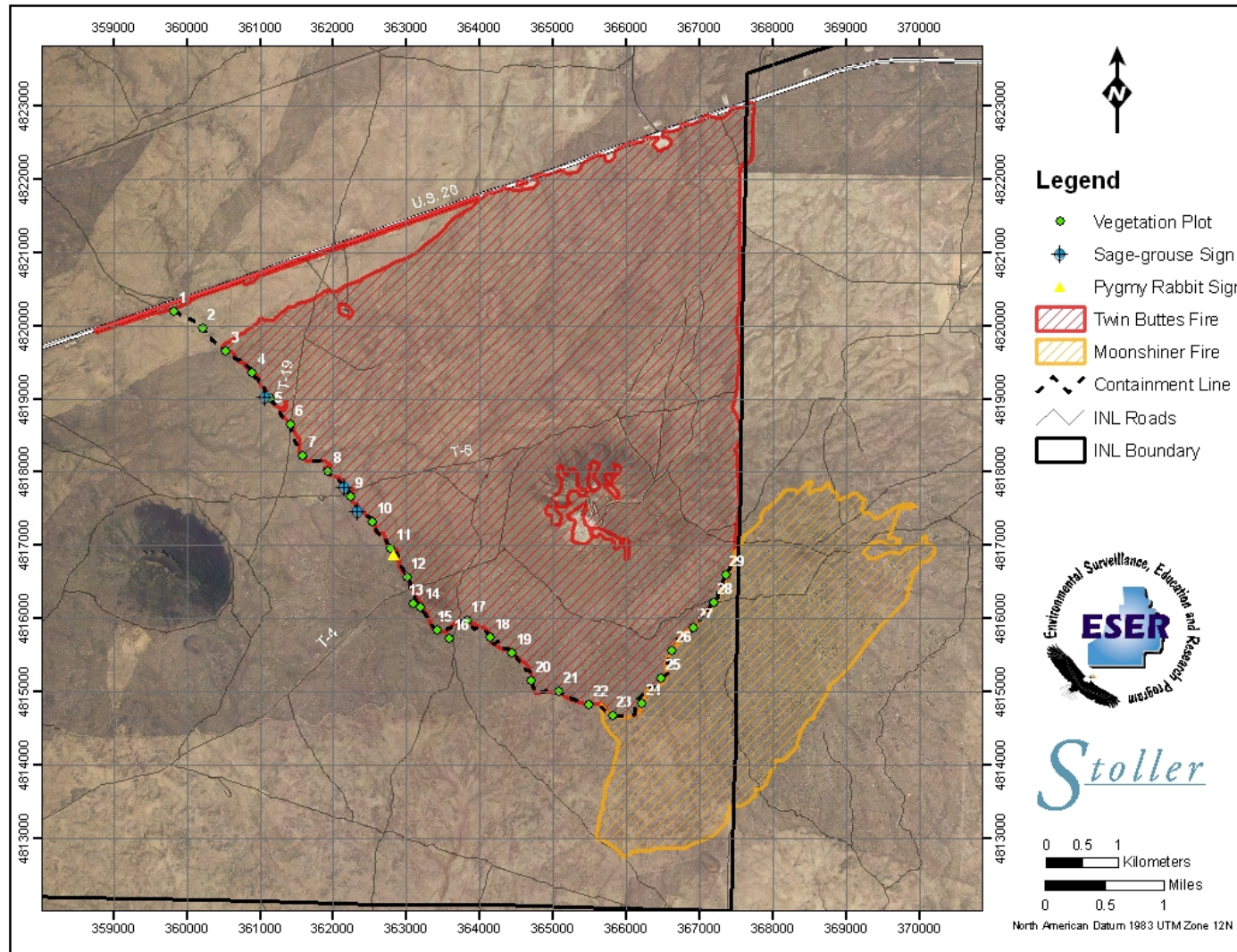


Figure 1. Map of Twin Buttes and Moonshiner Fires, survey locations and wildlife sign sightings.

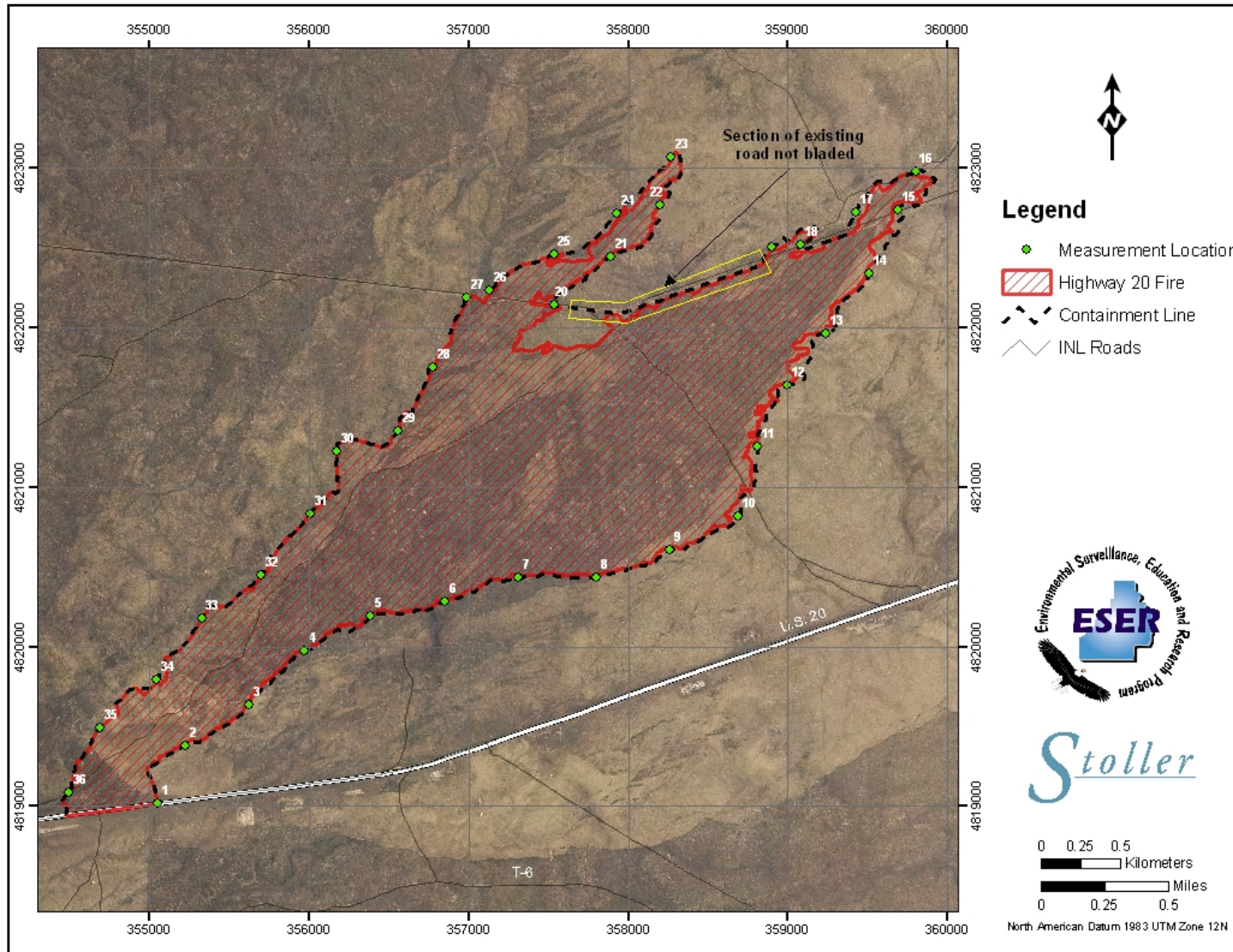


Figure 2. Map of Highway 20 Fire showing containment line and survey locations.

### 3.2 Wildlife Surveys

On the Twin Buttes Fire we estimated there to be about 5 miles (8 km) of containment line with sagebrush habitat remaining on the unburned side. These areas were surveyed for pygmy rabbit and sage grouse sign out from the containment line to a distance of about 50 ft (15 m).

On the Highway 20 Fire similar surveys for pygmy rabbits and sage grouse were conducted on the about 12 miles (19 km) of containment line. The length of containment line with adjacent unburned sagebrush habitat was limited due to past fires in this area.

Because no containment lines were found associated with the Moonshiner Fire, no wildlife surveys were conducted in association with this burned area.

## 4.0 Results

### 4.1 Containment Line Widths

The Twin Buttes Fire containment line width measurements varied from 10.8 ft (3.3 m) to 36.4 ft (11.1 m) (Table 1). However, in certain locations, the containment line was up to four disconnected dozer widths. The widest sections were found running south from T-19 to the end of INL property to the east.

Table 1. Width of containment lines at Twin Buttes and Highway 20 Fires.

| Dominated or Co-dominated by: | Width in feet (meters) |                |               |
|-------------------------------|------------------------|----------------|---------------|
|                               | Minimum                | Maximum        | Average       |
| Twin Butte Fire               | 10.8<br>(3.3)          | 36.4<br>(11.1) | 20.7<br>(6.3) |
| Highway 20 Fire               | 10.2<br>(3.1)          | 26.9<br>(8.2)  | 13.8<br>(4.2) |



Numerous containment line offshoots were present (Figure 3). Some of these offshoots formed “spurs” while others reconnected to the main containment line and created islands of uncut vegetation. The purpose of these offshoots was not clear.

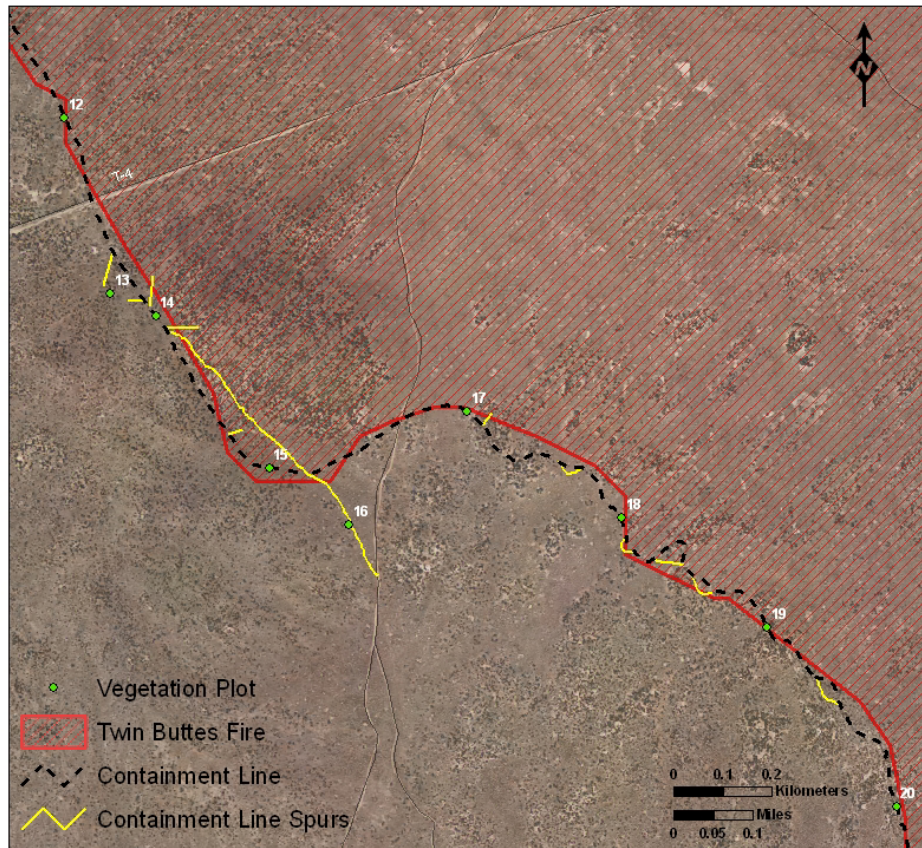


Figure 3. Portion of Twin Buttes containment line showing "spurs."

Bulldozer activity appeared excessive, in one location creating an area approximately 65 ft X 130 ft (20 m X 40 m) entirely cleared of vegetation and topsoil. There were frequent portions of the line where the bulldozer had driven beside the double-bladed containment line with its blade up, but still removed larger shrubs and crushed smaller shrubs and grasses. In sections where the bulldozer drove off the containment line without blading, a blanket of cheatgrass made the section stand out from surrounding native community types.

The containment line around the Highway 20 fire is extremely variable and measurements ranged from 10.2 ft (3.1 m) to 26.9 ft (8.2 m). Some sections are well over 30 ft (10 m) wide while others are only one blade width (about 10 ft or 3 m).

The lines vary in depth as well. In some places, it appears as though the lines have filled in with wind blown material or were never very deep to begin with. In some of these locations, the

damage was light enough that the shrubs have popped back up after being run over and are beginning to recover. In other locations the ricks are over 2 feet (0.6 m) high with no vegetation in the center of the dozer lines (Figure 4). In addition to the containment line around the majority of the burn, there is also a road, and sometimes two roads, that parallel the containment line (Figure 5).



Figure 4. Containment line on Highway 20 Fire with large rick and bladed deep enough to remove all vegetation.



Figure 5. Containment line on Highway 20 Fire showing road paralleling containment line.

## 4.2 Vegetation Condition

Vegetation surveys associated with the Twin Buttes Fire containment line indicate that the unburned side of the line is in good condition with all plots dominated by native perennial species (Table 2).

Table 2. Percentage of plots on the Twin Buttes Fire containment line that were either dominated or co-dominated by annuals, cheatgrass, native perennials and bare ground.

| Dominated or Co-dominated by: | % of Plots |          |                  |
|-------------------------------|------------|----------|------------------|
|                               | Burned     | Unburned | Containment Line |
| Annual Species                | 14         | 0        | 69               |
| Cheatgrass                    | 11         | 0        | 44               |
| Native Perennial Species      | 94         | 100      | 41               |
| Bare Ground                   | 0          | 0        | 6                |

Native vegetation is recovering on the Twin Buttes Fire burned area. In most cases weeds have not spread extensively out to 50 ft (15 m) inside the burn. Weed presence in the burned area is higher where the containment line also has weeds. Plant abundance and species diversity is low but appears promising for natural recovery. Ninety-four percent of the plots in areas that had burned were dominated or co-dominated by native perennial species suggesting that the burned area is recovering well. However, 11 percent of the plots were dominated or co-dominated by cheatgrass (*Bromus tectorum*) and 14 percent were dominated or co-dominated by annual species.

Vegetation on the containment line appeared to have been substantially impacted by blading. Only 41 percent of the plots on the containment line were dominated or co-dominated by native perennial species. Forty-four percent of the plots were dominated or co-dominated by cheatgrass and 69 percent were dominated or co-dominated by annual species (Figure 6). It should be noted that some of these plots are co-dominated by green rabbitbrush (*Chrysothamnus viscidiflorus*), a native shrub that re-sprouts after fire and can withstand some soil disturbance. Also, some of the annual species noted as co-dominants are native species. These species usually are present in healthy sagebrush communities as ephemerals and growing primarily in years with normal or greater precipitation. However, when these native annual species show up as a large component of the plant community it is generally considered a sign of substantial loss of the native perennials species.



Figure 6. Containment line on Twin Buttes Fire covered by cheatgrass with native vegetation on either side.

Overall, there is minimal weed presence at 50 ft (15 m) from the containment line within the burned and unburned areas. However, in sections with abundant weeds on the containment line, weeds are present at 50 ft (15 m), and occasionally are continuous up to and beyond 50 ft (15 m).

One of the factors noted by the field crews as contributing substantially to the degradation of vegetation on the containment line was vehicle traffic (Figure 7). All of the containment line has been driven repeatedly, and it has the appearance of a road, including the presence of ruts from driving in wet weather (Figure 8). Where the containment line intersects T-4, T-6, and T-19, there is nothing to prevent vehicles from inadvertently driving on the line. It is possible that the containment line traffic is coming from drivers unaware they are on INL property. The driven blade line soil is very compacted, with little to no vegetation growing in the tire tracks.



Figure 7. Containment line on Twin Buttes Fire showing extensive damage to vegetation by vehicle use.



Figure 8. Containment line on Twin Buttes Fire showing ruts created by vehicles during wet weather.

The driven sections of the containment line are dominated by weedy annuals such as cheatgrass (*Bromus tectorum*), tansymustard (*Descurainia pinnata*), tumble mustard (*Sisymbrium altissimum*), and halogeton (*Halogeton glomeratus*). Perennial grass presence was limited and mostly consisted of Sandberg's bluegrass (*Poa secunda*) and bluebunch wheatgrass (*Pseudoroegneria spicata*). There were a few seedlings of three-tip sagebrush (*Artemisia tripartite*) and horsebrush (*Tetradymia canescens*). The species lists for the containment line plots were longer than expected, although the actual number of individual plants was low. The majority of the plants present in the containment line were growing between the tire tracks where the soil had not been packed down and made susceptible to repeated driving stress. Where the containment line is double-bladed, the blade width not being driven has improved regeneration. The species present in the non-driven section are similar to those in the driven section, but plants are healthier and more abundant.

The northwest portion of the containment line (north of T-6) was narrower (one bulldozer blade width) and had less evidence of vehicle traffic than on the southern parts of the containment line. Revegetation of perennial species is occurring with few weeds present.

On the Highway 20 Fire, much of the burned area and associated containment lines are devoid of vegetation. There has been no vegetation re-establishment as of this time (except where native vegetation was not completely removed by blading). Hence, no conclusions regarding vegetation condition can be drawn from this survey. As noted above, there is also a road, and sometimes two roads, that parallel the containment line. These roads are an added disturbance to the soil and are likely to recover similar to that reported here for the Twin Buttes Fire containment line. Considering what has been documented on the Twin Buttes Fire, it is feasible to predict that higher levels of cheatgrass and other weedy species will appear on these road ways next spring if use of the roads continues.

## 4.2 Wildlife

Sage grouse rely on sagebrush for both food and cover. Loss of sagebrush habitat is a substantial threat to the survival of this species. The INL in general provides an important stronghold for sage grouse in this region. Breeding, nesting and wintering habitats for sage grouse are known to occur in the vicinity of the areas burned. Studies are currently underway to determine the distribution of habitat use by sage grouse on the INL.

Some evidence of sage grouse use of the area along the Twin Buttes Fire containment line was noted (Figure 1). No sage grouse sign was noted in the Highway 20 Fire survey. However, very little sagebrush habitat remains in the vicinity of that fire.

Pygmy rabbits are sagebrush steppe obligate species and have recently been petitioned for protection under the Endangered Species Act. Pygmy rabbits depend on sagebrush for cover and forage. Once sagebrush is removed from an area pygmy rabbits disappear. Populations of pygmy rabbits on the INL may be relatively stable because much of the site remains undisturbed; however, little is currently known about the status of pygmy rabbit populations on the INL.

Pygmy rabbit sign was noted in only one location during the survey (Figure 1). This sighting was of a burrow system that appeared to have not been used recently. Pygmy rabbit occurrence was assessed based on the presence of pygmy rabbit sign (i.e., sightings of rabbits, burrows, and/or scat) and the presence of suitable sagebrush habitats. Suitable sagebrush habitats were identified by the presence or absence of sagebrush. Unfortunately, our surveys were not conducted under conditions conducive to observing pygmy rabbit sign. If a more accurate assessment of pygmy rabbit occurrence is desired, surveys should be conducted during the winter when there is adequate snow cover to allow for the identification of tracks.

## 5.0 Discussion

Because many of the plant species in the sagebrush steppe are able to recover from fire, often the disturbance caused by fire suppression activities is greater than that of the fire itself.

Containment lines are often constructed during a fire to separate fuel from the fire to stop its spread. In sagebrush steppe, containment lines are usually created by removing vegetation and a small amount of soil with a bulldozer forming a line around the fire. Ideally, some of the vegetation will re-sprout, but often the blade causes greater soil disturbance, the loss of most or all of the native vegetation, and increases the risk of weed invasion.

In this survey we found that weed presence and density appeared to be related to containment line width and level of soil disturbance. In areas where the containment line continued to be driven (specifically, south of T-6) and was also wider (over a bulldozer blade wide), cheatgrass and other weedy annuals were present in greater density and frequently blanketed the containment line and ricks. Patches of cheatgrass were visible on the burned side of the line but were much smaller and less frequent than on the line itself. There was low density to no cheatgrass approximately 10 ft past the containment line rick on the unburned side. Where both sides of the containment line burned, there are weeds present on both sides of the line. Cheatgrass density and proliferation is likely to fuel fires in the future as well as weaken the natural vegetation structure.

Containment line width and vehicle traffic are the two major factors affecting re-establishment of native perennial plants. The wider and more driven the containment line, the greater the subsequent weed density, versus a normal progression of native vegetation on the narrower, single blade-width section of line. The ricks contain topsoil and a potential seed bank of native vegetation.

Weed density could be decreased by keeping ground disturbance to a minimum via single blade-width lines, no creation of “spurs”, and immediate disuse of the containment line as a road. Removing the ricks by replacing the disturbed top soil and seed base will aid in the restoration of native vegetation, as well as return the landscape to a more natural topography. Installation of barriers to traffic at road/line intersections would discourage continued travel on the containment line.

In the case of the Highway 20 Fire, where the fire has burned this season, it is imperative to fix the ricks and finish the clean up. If the rick is visible and pulling it back will not destroy good

condition sagebrush along the side, we recommend that it be pulled back across the dozer line. Ricks that have disappeared and lines that have filled in from the wind should be left alone.



Figure 9. Containment line on Highway 20 Fire showing light blading and sagebrush that "popped up" after the blade passed. This area will likely need little restoration action.

In areas where the native vegetation has "popped up" and recovery has begun since the fire, lines should be left alone (Figure 9). Vehicles should be kept to previously disturbed areas to avoid additional disturbance to the already fragile state of the soil. Again, signs should be placed at all T road and containment line intersections to discourage off road travel.

There is only one location on the Hwy 20 Fire where a vehicle has driven onto the containment line. It is on the north end of the fire and the line was accessed via the East Powerline Loop Road.



In general, it is very important to return to a burned area and begin the post-fire recovery activities soon after the fire. At that time, it is much easier to improve the damage left from the fire suppression activities. If this work is done soon after the burn, there should be fewer weedy species, less erosion, and better recovery from the native plants in the area.

The introduction of cheatgrass and other non-native annual plant species has altered the effects of fire in the sagebrush steppe ecosystem. Wildfire in areas where the understory is dominated by cheatgrass results in the conversion of native sagebrush steppe to annual grasslands. Dense stands of cured cheatgrass are highly flammable and can result in an increased fire frequency of three to five years. The increased fire frequency greatly limits the ability of native species to recover.

The Idaho National Engineering and Environmental Laboratory Wildland Fire Management Environmental Assessment FONSI states that the INL will incorporate minimum impact suppression tactics (MIST) whenever conditions allow. MIST emphasizes suppression of wildland fires with the least impact on the land (DOE 2003). Some of the containment lines do not fall within the definition of a MIST as they were up to four passes wide by a dozer. A bladed width up to 24 ft is considered to be the maximum for containment lines unless the on scene commander determines that larger containment lines are necessary (DOE 2003).

Containment lines 2 to 3 ft (0.6 to 0.9 m) wide are recommended by Teie (2001) in grass fuels, and up to 9 ft (2.7 m) in heavy brush. The vegetation community type surrounding East Butte varies from juniper woodland to grassland with some shrub steppe in the interim. This area has dense sagebrush stands but usually no taller than 3-4 ft (1-1.5 m). Other containment line recommendations include avoiding heavy fuel concentrations and keeping the lines as straight as possible (Teie 2001). Interestingly, large patches of juniper were dozed into piles and pushed into the containment line ricks or just piled next to the line. Also, tight corners were made through juniper stands and around lava outcrops. Most of this was found on the south side of the fire. The fire moved in a northerly direction. Standard fire management practices (in both Teie 2001 and DOE 2003) call for mop-up and site restoration. No clean up was done following these fires in 2007.

In a study of vegetation recovery on containment lines from 2002, Blew et.al, found that cheatgrass density and frequency was generally higher on containment lines and ricks than on the undisturbed burned area. The Twin Butte/Moonshiner Fires is no exception. We found an extensive length of containment line dominated by cheatgrass that was noticeably denser than both the unburned, native side of the line and the undisturbed, burned side of the line (Figure 10). While there was evidence of cheatgrass establishment in the unburned areas, it was infrequent and intermixed into the native plant populations. It had a much greater presence in the burned areas but the native grasses were also showing a level of recovery which supports the idea that if a range is in good condition before it burns, it is likely to recover in the same manner (Ratzlaff and Anderson 1995). However, with a true soil disturbance (dozer lines) we see an obvious increase in non-native species in the year(s) following the fire.



Figure 10. Containment line on Twin Buttes Fire with dense cover of cheatgrass.

## 6.0 Summary

Surveys of the Twin Buttes Fire containment line show substantial deterioration compared to the adjacent burned and unburned areas. A large portion of the containment line is dominated or co-dominated by cheatgrass. These portions of the containment line are now more prone to fire and increase the risk of fire in the surrounding area. A substantial contributing factor to this deterioration is the continued use of the containment line as a road.

Surveys of the Highway 20 Fire containment line show great variability in containment line width and depth. Some of the containment line is bladed deep enough that there is a great risk that these portions will not have natural recovery by native perennial species. There appears to be new road adjacent to the containment line in the burned area. Based on our findings at the Twin Buttes Fire, these two factors suggest the containment line and adjacent road are at risk to invasion by non-native species.

We found no evidence that the containment line directly impacted wildlife species of concern. However, the potential increased risk of invasion by non-native plants, especially cheatgrass, likely puts adjacent habitat at greater risk to fire in the future.

## 7.0 Recommendations

We recommend that a site restoration plan be developed for the Twin Buttes Fire containment line in order to meet the requirements of DOE/EA-1372 (2003) in section 2.1.3. The plan should address:

- filling in the deeper parts of the containment line pulling the ricks back over the containment line
- re-distributing larger size brush or trees cut during containment line construction
- controlling non-native weeds, including noxious weeds
- revegetating the containment line with locally collected plant materials
- establishing physical barriers to vehicle access to the containment line
- using GIS to map all areas receiving restoration treatments
- monitoring until restoration has been completed.

Similarly for the Highway 20 Fire we recommend developing a restoration plan for the containment lines that includes:

- filling in the deeper parts of the containment line pulling the ricks back over the containment line
- controlling non-native weeds, including noxious weeds
- establishing physical barriers to vehicle access to the containment line
- using GIS to map all areas receiving restoration treatments
- monitoring until restoration has been completed.

For future fires we recommend that restoration efforts begin immediately following the fire. These actions should include re-contouring the ricks and containment line, scattering larger brush and trees and installing barriers to vehicle access to the containment line.

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## Appendix A

### GPS Locations Associated with the Twin Butte/Moonshiner Fires

|              | <u>Easting</u> | <u>Northing</u> | <u>Comment</u>   |
|--------------|----------------|-----------------|--|
| <b>start</b> | 362888         | 4816774         | cheatgrass infestation   |
| <b>end</b>   | 363056         | 4816394         |  |
|              | 363011         | 4816543         | very large pile of containment line debris composed of juniper, forbs, grasses, and dirt; 15 x 7 x4 ft |
| <b>start</b> | 363163         | 4816190         | offshoot   |
| <b>end</b>   | at T-4         | at T-4          |  |
| <b>start</b> | 363232         | 4816089         |  |
| <b>end</b>   | 363643         | 4815621         | cheatgrass patch   |
|              | 364470         | 4815494         | beginning of scattered musk thistle  |
|              | 364762         | 4814995         | musk thistle- 2 plants   |
|              | 364821         | 4814985         | musk thistle   |
|              | 364870         | 4815022         | musk thistle- 6+ plants  |
|              | 345181         | 4814944         | musk thistle and Halogeton- many individuals   |
| <b>start</b> | 365337         | 4814871         | cheatgrass patch   |
| <b>end</b>   | 365571         | 4814850         |  |
|              | 365400         | 4814825         | musk thistle- 2 plants   |
|              | 365554         | 4814828         | musk thistle- 6+ plants  |
|              | 365779         | 4814672         | musk thistle patches next 500 m  |
|              | 366175         | 4814719         | musk thistle   |
|              | 366207         | 4814818         | Split in containment line, SE corner lines going everywhere, numerous offshoots, musk thistle          |
|              | 366570         | 4815323         | cheatgrass, musk thistle, dense patch of tumbled mustard   |
|              | 366891         | 4815831         | musk thistle   |
|              | 366995         | 4815929         | musk thistle   |
|              | 367182         | 4816217         | musk thistle   |
|              | 367384         | 4816653         | musk thistle   |

**Appendix B**  
**Containment Line and Vegetation Condition**  
**Survey Data**

Table 1. Dominant/Co-dominant species, total species richness and non-native species richness on each plot at Twin Buttes Fire.

| Plot # | Class            | Dominated or Co-dominated by:                  | Species Richness | Non-native Richness |
|--------|------------------|--|------------------|---------------------|
| 1      | containment line | Green rabbitbrush                              | 7                | 3                   |
| 1      | burned           | Green rabbitbrush                              | 9                | 3                   |
| 1      | burned           | Green rabbitbrush                              | 10               | 3                   |
| 2      | containment line | Green rabbitbrush                              | 6                | 0                   |
| 2      | burned           | Green rabbitbrush                              | 10               | 1                   |
| 2      | burned           | Western wheatgrass                             | 12               | 1                   |
| 3      | containment line | Bare ground                                    | 16               | 2                   |
| 3      | burned           | Sandberg's bluegrass                           | 11               | 3                   |
| 3      | not burned       | Green rabbitbrush, Sandberg's bluegrass        | 13               | 2                   |
| 4      | containment line | Green rabbitbrush                              | 9                | 0                   |
| 4      | not burned       | Wyoming big sagebrush                          | 8                | 1                   |
| 4      | partial burned   | Bluebunch wheatgrass                           | 10               | 1                   |
| 5      | containment line | Green rabbitbrush                              | 12               | 1                   |
| 5      | burned           | Sandberg's bluegrass, Bluebunch wheatgrass     | 9                | 0                   |
| 5      | not burned       | Three-tip sagebrush, Green rabbitbrush         | 11               | 1                   |
| 6      | containment line | Green rabbitbrush                              | 17               | 3                   |
| 6      | burned           | Sandberg's bluegrass, Bluebunch wheatgrass     | 10               | 1                   |
| 6      | not burned       | Green rabbitbrush, Bluebunch wheatgrass        | 9                | 1                   |
| 7      | containment line | Cheatgrass, Green rabbitbrush                  | 10               | 2                   |
| 7      | burned           | Western wheatgrass                             | 5                | 1                   |
| 7      | not burned       | Three-tip sagebrush, Green rabbitbrush         | 9                | 1                   |
| 8      | containment line | Bare ground                                    | 14               | 1                   |
| 8      | burned           | Sandberg's bluegrass, Bluebunch wheatgrass     | 15               | 1                   |
| 8      | not burned       | Three-tip sagebrush, Green rabbitbrush         | 17               | 2                   |
| 9      | containment line | Green rabbitbrush                              | 12               | 3                   |
| 9      | not burned       | Three-tip sagebrush, Bluebunch wheatgrass      | 15               | 1                   |
| 9      | partial burned   | Bluebunch wheatgrass                           | 18               | 2                   |
| 10     | containment line | Slimleaf goosefoot                             | 10               | 2                   |
| 10     | containment line | Green rabbitbrush, Bluebunch wheatgrass        | 20               | 1                   |
| 10     | burned           | Sandberg's bluegrass, Bluebunch wheatgrass     | 10               | 1                   |
| 10     | not burned       | Three-tip sagebrush, Bluebunch wheatgrass      | 13               | 1                   |
| 11     | containment line | Slimleaf goosefoot                             | 8                | 1                   |
| 11     | not burned       | Three-tip sagebrush                            | 15               | 2                   |
| 11     | partial burned   | Three-tip sagebrush, Bluebunch wheatgrass      | 20               | 2                   |
| 12     | containment line | Maiden blue-eyed Mary                          | 16               | 0                   |
| 12     | burned           | Bluebunch wheatgrass                           | 7                | 0                   |
| 12     | not burned       | Black sagebrush, Bluebunch wheatgrass          | 13               | 1                   |
| 13     | containment line | Sandberg's bluegrass, Unidentified annual forb | 18               | 2                   |
| 13     | not burned       | Three-tip sagebrush, Bluebunch wheatgrass      | 15               | 1                   |
| 13     | not burned       | Bluebunch wheatgrass                           | 18               | 1                   |
| 14     | containment line | Slimleaf goosefoot, Green rabbitbrush          | 15               | 2                   |
| 14     | containment line | Slimleaf goosefoot, Maiden blue-eyed Mary      | 23               | 2                   |
| 14     | burned           | Sandberg's bluegrass, Bluebunch wheatgrass     | 15               | 1                   |
| 14     | not burned       | Black sagebrush, Three-tip sagebrush           | 20               | 1                   |
| 15     | containment line | Cheatgrass                                     | 12               | 2                   |
| 15     | burned           | Bluebunch wheatgrass                           | 20               | 1                   |



Ecological Evaluation of Fire Fighting Efforts Associated with the Twin Butte/Moonshiner  
and Highway 20 Wildland Fires

November 26, 2008

STOLLER-ESER-115

| Plot # | Class            | Dominated or Co-dominated by:                  | Species Richness | Non-native Richness |
|--------|------------------|--|------------------|---------------------|
| 15     | not burned       | Wyoming big sagebrush, Bluebunch wheatgrass    | 23               | 3                   |
| 16     | containment line | Cheatgrass                                     | 15               | 1                   |
| 16     | not burned       | Three-tip sagebrush, Sandberg's bluegrass      | 17               | 1                   |
| 16     | not burned       | Wyoming big sagebrush, Bluebunch wheatgrass    | 20               | 2                   |
| 17     | containment line | Cheatgrass                                     | 6                | 1                   |
| 17     | burned           | Bluebunch wheatgrass                           | 17               | 1                   |
| 17     | not burned       | Three-tip sagebrush                            | 21               | 3                   |
| 18     | containment line | Cheatgrass                                     | 10               | 2                   |
| 18     | burned           | Bluebunch wheatgrass                           | 13               | 3                   |
| 18     | not burned       | Black sagebrush, Sandberg's bluegrass          | 13               | 2                   |
| 19     | containment line | Cheatgrass, Western tansymustard               | 13               | 1                   |
| 19     | not burned       | Black sagebrush, Bluebunch wheatgrass          | 13               | 0                   |
| 19     | partial burned   | Bluebunch wheatgrass                           | 21               | 3                   |
| 20     | containment line | Bluebunch wheatgrass                           | 7                | 1                   |
| 20     | burned           | Sandberg's bluegrass                           | 9                | 2                   |
| 20     | not burned       | Utah juniper, Bluebunch wheatgrass             | 12               | 1                   |
| 21     | containment line | Cheatgrass, Green rabbitbrush                  | 16               | 9                   |
| 21     | burned           | Green rabbitbrush, Bluebunch wheatgrass        | 9                | 1                   |
| 21     | burned           | Green rabbitbrush, Bluebunch wheatgrass        | 13               | 2                   |
| 22     | containment line | Cheatgrass, Sandberg's bluegrass               | 12               | 4                   |
| 22     | burned           | Cheatgrass                                     | 12               | 4                   |
| 22     | burned           | Sandberg's bluegrass, Bluebunch wheatgrass     | 14               | 4                   |
| 23     | containment line | Cheatgrass                                     | 9                | 6                   |
| 23     | burned           | Cheatgrass, Bluebunch wheatgrass               | 6                | 5                   |
| 23     | burned           | Bottlebrush squirreltail, Bluebunch wheatgrass | 15               | 5                   |
| 24.1   | containment line | Cheatgrass, Western tansymustard               | 10               | 3                   |
| 24.1   | burned           | Sandberg's bluegrass, Bluebunch wheatgrass     | 13               | 2                   |
| 24.1   | burned           | Bluebunch wheatgrass                           | 12               | 2                   |
| 24.2   | containment line | Western tansymustard                           | 6                | 3                   |
| 24.2   | burned           | Cheatgrass, Bluebunch wheatgrass               | 11               | 2                   |
| 24.2   | burned           | Bluebunch wheatgrass                           | 10               | 1                   |
| 25     | containment line | Cheatgrass                                     | 18               | 5                   |
| 25     | burned           | Sandberg's bluegrass, Bluebunch wheatgrass     | 11               | 1                   |
| 25     | burned           | Sandberg's bluegrass, Bluebunch wheatgrass     | 22               | 4                   |
| 26     | containment line | Cheatgrass, Rosy gilia                         | 8                | 1                   |
| 26     | burned           | Cheatgrass, Western tansymustard               | 19               | 4                   |
| 26     | burned           | Western tansymustard, Bluebunch wheatgrass     | 17               | 2                   |
| 27     | containment line | Flatspine stickseed                            | 11               | 1                   |
| 27     | burned           | Sandberg's bluegrass, Bluebunch wheatgrass     | 18               | 2                   |
| 27     | burned           | Sandberg's bluegrass, Bluebunch wheatgrass     | 18               | 4                   |
| 28     | containment line | Cheatgrass, Maiden blue-eyed Mary              | 22               | 3                   |
| 28     | burned           | Sandberg's bluegrass, Bluebunch wheatgrass     | 23               | 3                   |
| 28     | burned           | Sandberg's bluegrass, Bluebunch wheatgrass     | 12               | 1                   |
| 29     | containment line | Cheatgrass                                     | 11               | 2                   |
| 29     | burned           | Sandberg's bluegrass, Bluebunch wheatgrass     | 12               | 2                   |
| 29     | burned           | Sandberg's bluegrass, Bluebunch wheatgrass     | 19               | 2                   |

Table 2. Average containment line width on Twin Buttes Fire.

| Plot # | Width |        |
|--------|-------|--------|
|        | Feet  | Meters |
| 1      | 12.0  | 3.7    |
| 2      | 10.7  | 3.3    |
| 3      | 12.1  | 3.7    |
| 4      | 16.7  | 5.1    |
| 5      | 11.3  | 3.4    |
| 6      | 12.0  | 3.7    |
| 7      | 10.9  | 3.3    |
| 8      | 11.7  | 3.6    |
| 9      | 10.9  | 3.3    |
| 10.1   | 23.1  | 7.0    |
| 10.2   | 23.1  | 7.0    |
| 11     | 21.8  | 6.6    |
| 12     | 21.8  | 6.6    |
| 13     | 13.2  | 4.0    |
| 14.1   | 35.0  | 10.7   |
| 14.2   | 35.0  | 10.7   |
| 15     | 16.5  | 5.0    |
| 16     | 25.5  | 7.8    |
| 17     | 26.0  | 7.9    |
| 18     | 28.3  | 8.6    |
| 19     | 27.9  | 8.5    |
| 20     | 36.3  | 11.1   |
| 21     | 25.8  | 7.9    |
| 22     | 28.1  | 8.6    |
| 23     | 23.5  | 7.2    |
| 24.1   | 27.7  | 8.4    |
| 24.2   | 13.1  | 4.0    |
| 25     | 29.4  | 9.0    |
| 26     | 23.0  | 7.0    |
| 27     | 21.4  | 6.5    |
| 28     | 19.5  | 5.9    |
| 29     | 17.9  | 5.5    |

Table 3. Average containment line width on Highway 20 Fire.

| Plot # | Width |        |
|--------|-------|--------|
|        | Feet  | Meters |
| 1      | 12.0  | 3.7    |
| 2      | 10.8  | 3.3    |
| 3      | 11.3  | 3.4    |
| 4      | 10.9  | 3.3    |
| 5      | 16.8  | 5.1    |
| 6      | 12.1  | 3.7    |
| 7      | 10.6  | 3.2    |
| 8      | 11.6  | 3.5    |
| 9      | 10.5  | 3.2    |
| 10     | 10.7  | 3.3    |
| 11     | 11.0  | 3.3    |
| 12     | 10.8  | 3.3    |
| 13     | 10.0  | 3.1    |
| 14     | 10.8  | 3.3    |
| 15     | 10.2  | 3.1    |
| 16     | 11.5  | 3.5    |
| 17     | 11.0  | 3.3    |
| 18     | 10.4  | 3.2    |
| 19     | 10.1  | 3.1    |
| 20     | 11.5  | 3.5    |
| 21     | 12.3  | 3.7    |
| 22     | 12.7  | 3.9    |
| 23     | 12.6  | 3.8    |
| 24     | 12.5  | 3.8    |
| 25     | 12.0  | 3.6    |
| 26     | 12.6  | 3.9    |
| 27     | 13.2  | 4.0    |
| 28     | 14.3  | 4.4    |
| 29     | 11.8  | 3.6    |
| 30     | 18.1  | 5.5    |
| 31     | 21.5  | 6.6    |
| 32     | 25.4  | 7.7    |
| 33     | 21.4  | 6.5    |
| 34     | 24.7  | 7.5    |
| 35     | 19.7  | 6.0    |
| 36     | 27.2  | 8.3    |

## **Appendix C**

### **Additional Photos of Containment Lines**



**Cheatgrass on Twin Buttes Fir containment line and evidence of continued use as a road.**



**Cheatgrass, bareground and road use on Twin Buttes Fire containment line.**



**Very wide containment line with no obvious rick on the Highway 20 Fire.**



**Very steep side hill that has extensive damage from dozer.**





**Close-up of damage on steep side hill. These ricks should be pulled in on both sides and re-contoured to match surrounding terrain.**