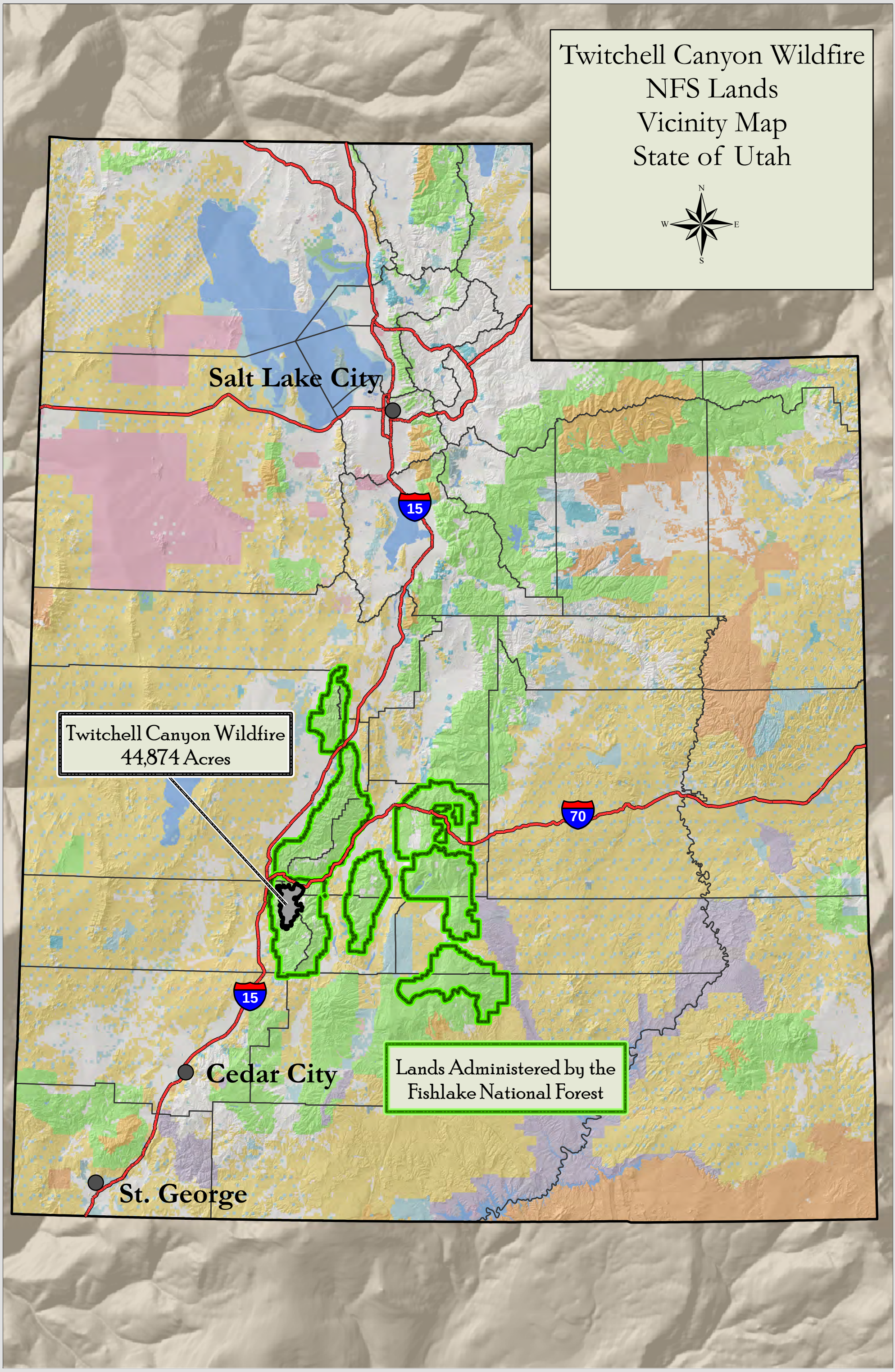
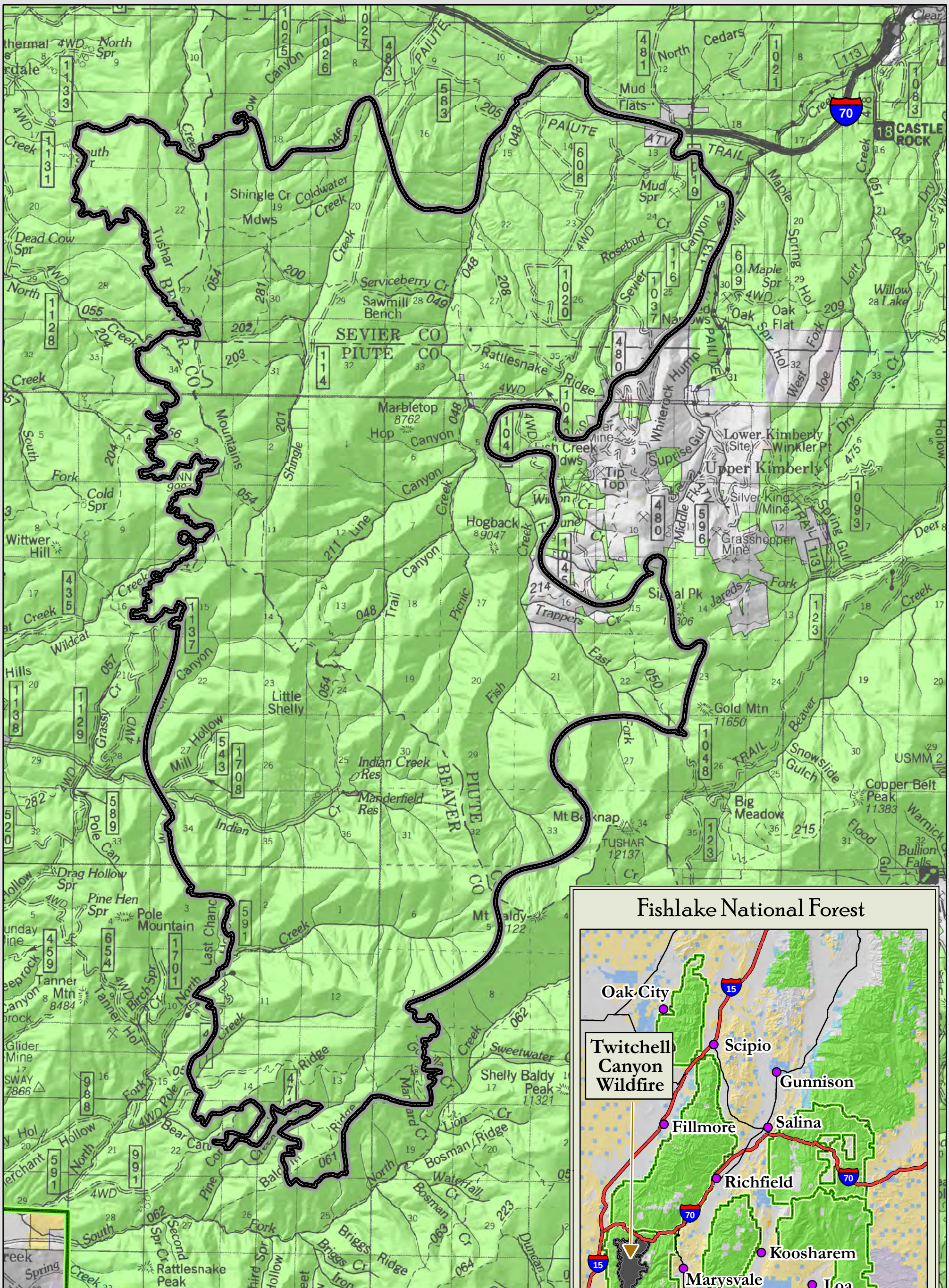
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q … Initial BAER Report

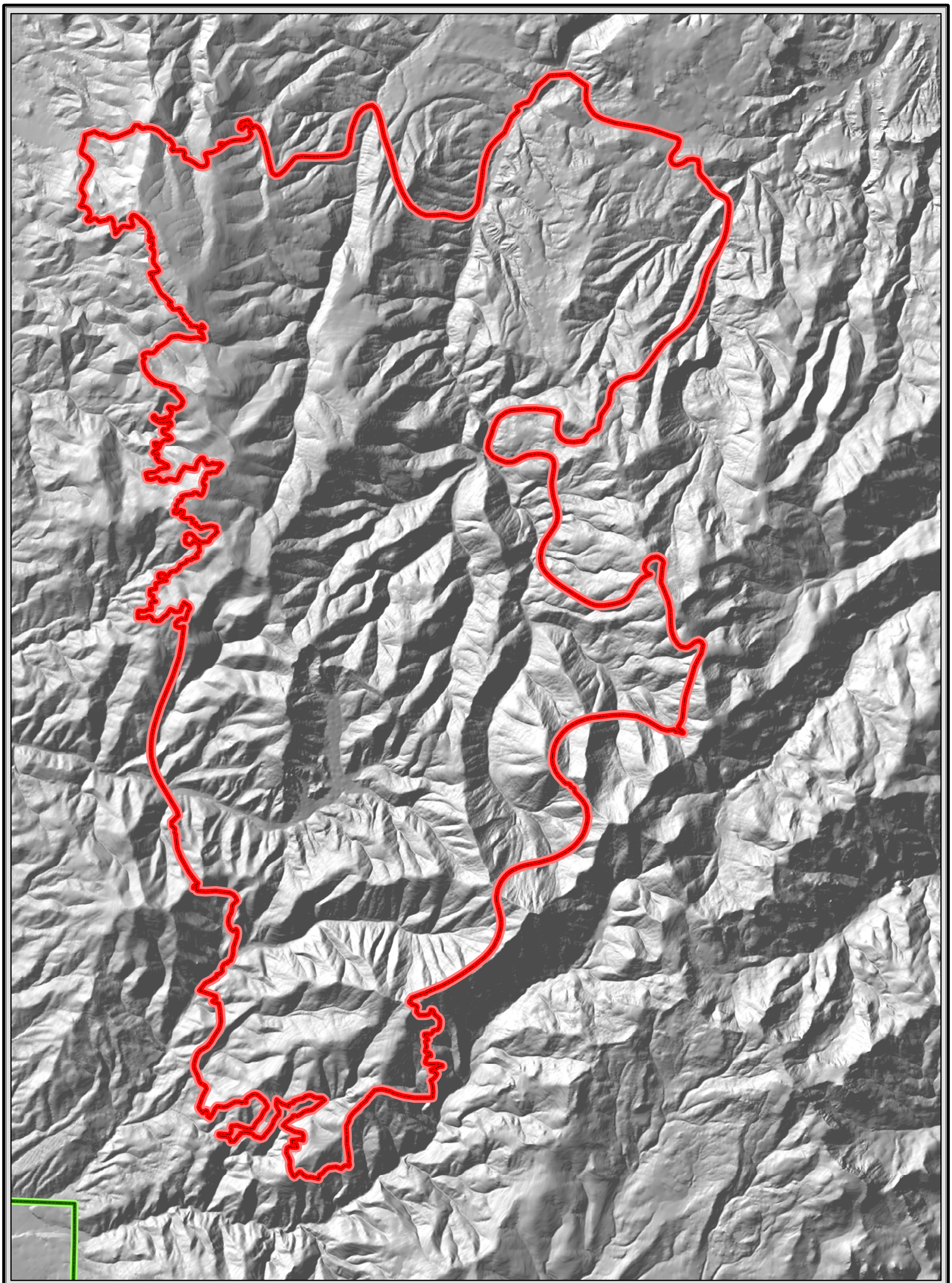
Burned - Area Emergency Response

Region … R4 / Intermountain	NFS Lands Affected … 44,376 Acres
Forest … 0408 / Fishlake NF	Severe Burns on NFS Lands … 33 %
District … D3 / Beaver RD	Date Fire Started … 07/20/2010
Incident Size … 44,874 Acres	Date Fire Contained … 10/xx/2010


Twitchell Canyon Wildfire
NFS Lands
Vicinity Map
State of Utah
N
W
E
S
Salt Lake City
15
Twitchell Canyon Wildfire
44,874 Acres
70
15
Cedar City
Lands Administered by the
Fishlake National Forest
St. George



Twitchell Canyon Wildfire
44,874 Acres
Fishlake National Forest
Vicinity Map



Twitchell Canyon Wildfire
Fishlake National Forest
Shaded Relief

0 1 2 4 Miles

1:75,000 Scale

N
W E
S

Shaded Relief

- Twitchell Canyon Wildfire ~ 44,874 Acres
- Forest Boundary

Date of Report: 10-18-2010

BURNED - AREA REPORT

(Reference FSH 2509.13)

PART I - TYPE OF REQUEST

A. Type of Report:

[X] 1. Funding … Request for Emergency Stabilization Funds

[ ] 2. Accomplishment Report

[ ] 3. No Treatment Recommendation

B. Type of Action:

[X] 1. Initial Request (best estimate of funds needed to complete eligible stabilization measures)

[ ] 2. Interim Report

[ ] Updating the initial funding request based on more accurate site data or design analysis

[ ] Status of accomplishments to date

[ ] 3. Final Report (following completion of work)

PART II - BURNED-AREA DESCRIPTION

A. Fire Name: Twitchell Canyon Wildfire

B. Fire Number: UT - FIF - 000089

C. State: Utah

D. Counties: Beaver, Piute and Sevier

E. Region: Intermountain - 04

F. Forest: Fishlake NF - 0408

G. District: Beaver - D3

H. Fire / Incident Job Code: P4FL8Q

I. Date Fire Started: 07-20-2010 at 1120 – Lightning Strike

J. Date Fire Contained: 10-16-2010 (95 %)

K. Suppression Cost: $ 21,080,000 … estimated from the Incident Status Summary / ICS – 209 from 10-04-2010

L. Fire Suppression Damages Repaired with Suppression Funds

According to the GIS / Support Groups assigned to the Type 2 / Incident Command Teams of Ourada, Whalen and Gage … the following disturbances were caused by fire suppression related activities:

1. Dozer Line – 1.2 miles / Saw Line – 2.1 miles / Hand Line – 15.9 miles and Masticator Line – 13.6 miles … these disturbances were waterbarred when the lines were constructed on steep to very steep terrain – and, re-seeded on an as-needed basis. Some of the mountain and high mountain locations will re-sprout new grasses and shrubs once the site receives adequate moisture ….

2. Other (identify) … Spike Camps – 10 / Helibase – 2 / Helispots – 11 / Drop Points – 10 / Water Sources – 6 / Main Fire Camps – 2 and Lookouts – 1

(note) … several of our Resource Advisor's have commented and documented with photographs - just how, light-on-the-land the various crews were during the construction of the field camps and containment lines …….

M. Watershed Numbers: (This information was provided by the Fishlake NF / GIS Staff – Jenneka Knight)

Subwatersheds … 6th Field HUCs and Drainage Names	
160300030101 – Fish Creek	160300070103 – Mud Spring Hollow / Wildcat Creek
160300030102 – Headwaters of Clear Creek	160300070203 – South Fork of Pine Creek
160300030104 – Mill Creek	160300070208 – North Creek
160300030208 – Deer Creek / Sevier River	160300070501 – Sulphur Creek
160300070101 – Upper Indian Creek	160300070502 – Bear Canyon

N. Total Acres Burned: (Summary of the Acres Burned by Land Ownership / 10-09-2010)

44,376	**USDA - FS**	-0-	**USDI - BLM**	-0-	**State of Utah**	498	**Private**

O. Vegetation Types:	Much of the burn had consisted of Spruce / Fir, Seral Aspen and Stable Aspen (67 %) type plant communities located on moderately steep to steep mountainsides occurring throughout the higher elevations; Mixed Conifers (Ponderosa Pine, Douglas Fir and White Fir) with Mountain Brush (16 %) was observed in the canyons and along the very steep ridgetops at the mid-elevation areas; Gambel Oak, PJ & Mountain Big Sagebrush (15 %) was found on the lower elevation foothills and structural benches; the remaining areas were either Riparian Zones, Subalpine Meadows with Perennial Grasses or Rock Outcrops / Talus Slopes / Cirquelands (2 %) associated with the high peaks of the Tushar Mountains.
P. Dominant Soils	The High Mountain areas had Pachic Argicryolls, Typic Argicryolls, Alfic Argicryolls, Mollic Haplocryalfs, Typic Haplocryalfs, Typic Cryochrepts, Typic Cryorthents and Lithic Cryorthents under the Spruce / Fir, Seral Aspen and Stable Aspen type plant communities; the Mountain sites had Inceptic Haplocryalfs and Ustic Haplocryalfs under the Mixed Conifers with Ustic Argicryolls and Lithic Argicryolls under the Mountain Brush while … Typic Argiustolls, Typic Haplustolls, Aridic Argiustolls and Lithic Argiustolls were mapped under the PJ and upland shrub plant communities.
Q. Geologic Types:	Much of the area consists of loamy and clayey soils derived from intermediate and basic igneous rocks … such as latite, andesite and basalt (62 %); distinct areas near Fish Creek, Shingle Creek and Indian Creek had sandy soils formed from acid igneous rocks called volcanic tuff and rhyolite (29 %) while the remaining areas were developed in mixed sediments of alluvium and colluvium or glacial deposits (9 %) (note) … severely burned soils formed from latite, andesite or basalt are subject to flooding hazards and debris flows; severely burned soils formed in volcanic tuff or rhyolite are subject to flooding hazards and mudslides.

R. Miles of Streams:

→ **Perennial:** 56 miles

→ **Intermittent:** 86 miles

S. Existing Transportation Systems (2)

Trails:	USDA / Forest Service	3 miles (motorized)
	USDA / Forest Service	54 miles (non-motorized)
	Private Ownership	0.5 miles
Roads:	USDA / Forest Service	37 miles
	Private Ownership	2 miles

USDA – Forest Service … 94 miles

Private Ownership … 2.5 miles

Total … 96.5 miles

PART III - WATERSHED CONDITION

A. Burn Severity Classes … based upon BARC 256 / Burn Severity Classes taken from Landsat 5 / Imagery acquired from the EROS / Data Center on 09-21-2010 and SPOT 4 / Imagery secured by Jess Clark at RSAC on 09-30-2010 … combined with several reconnaissance flights – and, on-the-ground sampling observations made by the BAER Team:

Burn Severity Classes	# of acres	% of the Incident
Unburned	5,723	13 %
Low	9,304	20 %
Moderate	15,206	34 %
High	14,641	33 %
Total …	**44,874**	**100 %**

B. Estimate of Water-Repellent Soils: 24,680 acres (55 % of the burned-area)

C. Soil Erosion Hazard: 20,363 acres (45 % of the burned-area is in a High Hazard Zone)

D. Erosion Potential: 13.82 tons / acre (ERMiT Model – Year 1 / Forest)
9.09 tons / acre (ERMiT Model – Year 1 / Chaparral)
5.13 tons / acre (ERMiT Model – Year 1 / Range)

11.76 tons / acre (ERMiT Model – Year 1 / Average)

E. Sediment Potential: 6,021 cubic yards / square mile (ERMiT Model / Average)

PART IV - HYDROLOGIC DESIGN FACTORS

(Information for the Fish Creek Subwatershed / 160300030101)

A. Estimated Vegetative Recovery Period	**2 – 5 years**
B. Design Chance of Success	**70 %**
C. Equivalent Design Recurrence Interval	**10 years**
D. Design Storm Duration	**30 minutes**
E. Design Strom Magnitude	**0.6 inches**
F. Design Flow	**19 cfs / mi^2**
G. Estimated Reduction in Infiltration	**60 %**
H. Adjusted Design Flow	**30.4 cfs / mi^2**

PART V - SUMMARY OF THE ANALYSIS

A. Describe the Critical Values-at-Risk / Resource Concerns and Immediate Threats …

TWITCHELL CANYON WILDFIRE

BAER / CRITICAL VALUES-AT-RISK … SUMMARY TABLE

HUMAN LIFE AND SAFETY

Human Life and Safety on or in close proximity to burned NFS lands.

Private / State Property – Flooding to transportation surfaces, (i.e. Clear Creek Highway) structures and overall safety of the general public along the Clear Creek drainage – Possible / Minor … **LOW**

Roads – Flooding hazards to Indian Creek Road, Sevier Canyon, North Fork of North Creek, Mud Springs and Shingle Creek areas – Very Likely / Moderate … **VERY HIGH**

After an incident of wildfire, damaged transportation systems often behave as conduits by accelerating the flow of surface water across unprotected landscapes during periods of spring snowmelt or summer thunderstorm events. In most cases, the drainage design of a given road or trail system will NOT be sufficient to handle the increased magnitude of flows that will be produced as a direct result of the burning disturbance.

Much of the burned-area is currently prone to extreme flooding hazards; specifically, Mill Hollow, Twitchell Canyon, Line Canyon, Hop Canyon, Sevier Canyon, Shingle Creek, lower Fish Creek, upper Fish Creek and most of North Creek can all be expected to flood, have mudslides or showcase a large debris flow. If flooding occurs … human life and safety could be compromised by surface water flowing across the landscape.

Mine Adits – Burned out barriers allowing public entry – Likely / Major … **VERY HIGH**

Several abandoned mine sites located within Sevier Canyon and on Mud Springs were affected by the Twitchell

Canyon Wildfire; the wooden barricades blocking their adits were consumed by the burn … allowing the general public to have access back into these hazardous locations.

Hazard Trees – At trailhead, recreation sites, trail and roads – Possible / Major … **HIGH**

Approximately 25 % of the aspen and conifer trees surrounding the Manderfield Reservoir Site were killed by the recent fire event. The public uses this area for dispersed camping, fishing and the storage of irrigation water. Many of these trees will be subject to severe windthrow hazards during periods of strong winds.

PROPERTY

Buildings, water systems, utility systems, road and trail prisms, dams, wells or other significant investments on or in close proximity to the burned NFS lands.

Forest Roads – Very Likely / Moderate … **VERY HIGH**

According to our Fishlake National Forest / GIS Staff, there are over 90 miles of transportation surfaces (roads & trails) occurring on NFS Lands located inside the perimeter of the Twitchell Canyon Fire. Any (or all) of these surfaces will be subject to accelerated rates of soil erosion for the next 2 to 4 years during inclement weather conditions. Most of our roads and drainage structures require normal maintenance, cleaning or repairs to function properly once again. Some of our roads occupy the same location in the channel as our intermittent streams … these transportation surfaces need to be re-located using CMLG, CMRG or NFN3 funds. Still … most of our existing roads and trails are considered to be at-risk from flooding hazards, debris flows and mudslides due to the size and severity of the recent wildfire event.

State Highway – Unlikely / Moderate … **LOW**

The Clear Creek Highway may be at risk to flooding overtopping the highway through The Narrows.

Forest Trails / Trailheads – Likely / Moderate … **HIGH**

Much the same description as our Property / Forest Roads … these recreation sites and trail surfaces could be compromised by soil erosion during upcoming storm events. Some of our trailheads need to have their signs, post and pole fencing and culverts replaced to protect our soil resources on NFS lands.

Forest roads and trail infrastructure is at risk of failure as a result of increased runoff, flooding and debris flows – especially, in Sevier Canyon, North Fork of North Creek and Indian Creek

Downstream Diversions – Unlikely / Minor … **VERY LOW**

Agricultural/Livestock Water Systems – Possible / Moderate … **INTERMEDIATE**

Downstream Improvements / Fish Barriers – Possible / Moderate … **INTERMEDIATE**

There are 2 downstream improvements in Shingle Creek that were constructed to act as fish barriers to protect introduced populations of Bonneville cutthroat trout. These barriers are threatened by sediment and debris deposits resulting from the increased flows from the burned-area. The lowest culvert on North Fork North Creek is designed to function as a fish barrier as well.

Geothermal Plant – Unlikely / Moderate … **LOW**

Manderfield Reservoir – Possible / Moderate … **INTERMEDIATE**

The Manderfield Reservoir in upper Indian Creek may be at risk to debris flows initiated in the burned headwaters

NATURAL RESOURCES

Water used for municipal, domestic, hydropower, or agricultural supply or waters with special state or federal designations on or in close proximity to the burned NFS lands.

Eligible Fish Creek Wild and Scenic River – Unlikely / Minor … **VERY LOW**

North Fork North Creek Irrigation Companies – Likely / Minor … **LOW**

Clear Creek Irrigation Companies – Possible / Minor … **LOW**

Sulphurdale Geothermal Plant – Unlikely / Moderate … **LOW**

Soil productivity and hydrologic function on burned NFS lands.

Loss of Topsoil and Long Term Soil Productivity supporting ecological function for:

- exposure of aspen root system
- other re-sprouting species (i.e. oak, manzanita, willows)
- loss of native seed bank

Protect soils from highly erosive ground conditions after the removal of effective ground cover and coarse woody debris.

Very Likely / Major … **VERY HIGH**

Our most recent BARC 256 Image indicates about 70 % of this incident was subjected to Moderate and High Severity Burns. The steep mountainsides and very steep ridgetop areas located within this burn will be prone to flooding hazards and mudslides during spring / summer / fall thunderstorm events. The sandy soils located near Mill Hollow and Twitchell Canyon will eventually become moist, wet – then, saturated … mudslides will occur damaging soils and the surrounding terrain.

Currently, the Twitchell Canyon Wildfire has over 14,641 acres of High / Severity Burn Zones… much of this fire-damaged terrain is located along Indian Creek, Fish Creek, Shingle Creek and North Creek, in Sevier Canyon, Hop Canyon and Line Canyon, on Rattlesnake Ridge and surrounding Manderfield Reservoir. All of these locations will be subject to extreme flooding hazards … some areas, could be impacted by large debris flow events.

Many of the burned landscapes were located in areas of Seral Aspen; if the topsoil is truncated from these fragile sites by accelerated rates of erosion … it's possible we will lose our opportunity for aspen regeneration – getting, perennial grasses instead of trees.

Very Likely / Moderate … **VERY HIGH**

Since CY 2000, we have experienced several large debris flows on this Forest. Recently, assorted debris was transported into lower Limekiln Canyon during 2006 and 2007 as a direct result of the Devil's Den Wildfire. During 2000 and 2001, two large debris flows affected Maple Hollow and Johnson Canyon in connection with the Swains Wildfire. **It should be noted, all of the necessary conditions are in place once again for another grand episode of debris flows here on the Twitchell Canyon Wildfire**. Many areas experienced very hot fires with long residence times resulting in strongly hydrophobic ground conditions to a depth of 3 to 5 inches. These fire-damaged areas commonly occur on steep to very steep terrain having long slopes. Much of the geology is a mixture of intermediate and basic igneous rocks – meaning, the soils are skeletal containing > 35 % rock fragments. These rocks have the potential to get transported during flash flood events … large flows of water can easily move cobble-sized rocks (3 to

19 inch size) downslope and into the surrounding drainages for continued movement. Often times, the rocks accumulate as obstructions within the channel. In some instances, the obstructions need to be cleared using a trackhoe to protect facilities, private property – or, allow for proper function of the drainage. **Make no mistake about it … flash floods, debris flows & mudslides all have the potential to injure or kill anyone positioned in close proximity to the event**. These occurrences are common on the larger burns; they frequently result in substantial property damage and harm to critical natural resources and cultural sites on NFS lands.

An adverse change to hydrologic function is expected due to the large contiguous areas burned at moderate and high severity. These areas are very steep and contain large percentages of hydrophobic soils. Many of the tributary drainages contain accumulated channel sediments that have a high probability of being mobilized in high intensity, short duration rainfall events. This will result in the following changes:

- Increased flow and sedimentation (increasing threat for whirling disease)
- Channel down-cutting and lateral migration
- Loss of riparian areas and access to flood plains
- Degradation of aquatic and terrestrial wildlife habitat (i.e. BCT)

Channel down-cutting and lateral migration that may result in a loss of riparian areas and access to floodplains.

Unless protective ground cover is re-established on the steep to very steep canyons surrounding North Creek … accelerated rates of soil erosion will result in a loss of long-term soil productivity, a loss of ecological integrity and the potential destruction of sensitive fish habitat

Critical habitat or suitable occupied habitat for federally listed threatened or endangered terrestrial, aquatic animal or plant species on or in close proximity to the burned NFS lands.

Unlikely / Minor … **VERY LOW**

Bonneville Cutthroat Trout are considered a USDA – Forest Service / Intermountain Region and State of Utah sensitive species. They have been petitioned for listing as a threatened species several times. To help prevent the need for that listing, a Conservation Agreement and Strategy was developed to guide their management, including protection of populations and habitat from threats, habitat improvements and the active restoration of new populations. The USDA – Forest Service / Intermountain Region is a signnatory to this document. Bonneville cutthroat trout currently occupy about 11 % of their historic range in the southern Geographical Management Unit (GMU) which includes the Fishlake National Forest.

Native or naturalized communities on NFS lands where invasive species or noxious weeds are absent or present in only minor amounts.

Protection of native plant communities (e.g. curlleaf mountain mahogany, manzanita and aspen communities) from invasive cheat grass and noxious weed infestations.

Lower Elevation (14 - 22 inch precipitation zone) = Likely / Moderate … **HIGH**

The Fishlake National Forest is a supporting member of the Early Detection / Rapid Response Program when it comes to identifying and eradicating noxious weeds. According to our GIS Database … the unwanted weeds growing in close proximity to the Twitchell Canyon Fire were 1) Musk Thistle, 2) Hoary Cress, 3) Leafy Spurge, 4) Scotch Thistle and 5) Russian Knapweed. In addition, both Bull Thistle and Houndstongue were identified near the burn by several District employees **We do not want any of these weeds spreading into the fire disturbance**; simply stated, these undesired plants were NOT present in the Tushar Mountains before the wildfire.

Higher Elevation (22 + inch precipitation zone) = Possible / Moderate … **INTERMEDIATE**

CULTURAL AND HERITAGE RESOURCES
Cultural resources on NFS lands which are listed on or potentially eligible for the National Register of Historic Places. Unlikely / Minor … **VERY LOW**

B. Emergency Treatment Objectives:

The goal of burned-area emergency rehabilitation is to:

- Reduce threats to personal injury and/or human life of homeowners in the North Creek area by completing seeding in moderate and high severity burn areas.

- Reduce threats to personal injury and/or human life of Forest visitors surrounding the burn, homeowners in the North Creek area by installing warning signs, and storm patrols. In some instances area closure gates will aid in protecting people.

- Warn users of Forest roads, trailheads, and trails of hazards present in the burned area.

- Protect the public by closing mine adits with longterm closure structures in cooperation with the State that also continue to provide for bat use.

- Mulch and vegetation treatments are intended to mitigate soil loss.

- Elevated soil erosion, sedimentation, runoff, and stream flows are expected to occur at decreasing rates over two to five years after the fire, until vegetation has sufficiently recovered to restore the surface soil-hydrologic function and processes of the watersheds that burned at moderate and high severity. These treatments will allow grasses / shrubs to recover to a point where they will out compete with invasive species such as cheatgrass and other noxious weeds.

- Broadcast Seeding will be used to stabilize existing ground conditions on severely burned terrain. Seeding would maintaining long-term soil productivity, uphold the ecological intergrity of our high mountain aspen sites, shielding the existing transportation system from surface runoff, and limit the amount of sediment available for tranport into water bodies.

- Vegetative recovery and early detection of invasive and noxious weed species (monitoring) are needed to determine if soil productivity objectives are being achieved.

- Control expected invasion of noxious weeds within the area, especially along and adjacent to Forest roads, dozer lines, helispots, spike camps and private land boundaries used by fire equipment and in existing populations within the Twitchell Canyon Fire boundary.

- Minimize damage to system roads and trails within the Twitchell Canyon fire boundary by cleaning existing or installing new drainage structures.

- Maintain stream hydrologic function in streams by constructing cross vanes in strategic locations. These structures will aid with high BCT protection as well. Armored crossings would additionally aid in maintence of stream function and would provide for travel corridor protection where constructed.

- Protect the function and water quality for fisheries and downstream uses of Manderfield Reservoir by protecing the shoreline with straw wattles used in strategic locations to limit sedimentation. We will maintain the dam and spillway.

- Identify appropriate monitoring activities that estimate the effectiveness of emergency stabilization treatments and identify necessary maintenance and continuation of other approved BAER activities.

C. Probability of Completing Emergency Stabilization Treatments Prior to a Storm Damaging Event:

Land	**60 - 90 %**	**Channel**	**90 %**	**Roads / Trails**	**75 %**	**Protection / Safety**	**90 %**

D. Probability of Treatment Success: (on NFS lands)

Treatment Types:	**← Years After Treatment →**		
	1	**3**	**5**
Land Treatments (seeding)	**60 %**	**70 %**	**75 %**
Land Treatments (mulching)	**75 %**	**80 %**	**80 %**
Channel Treatments (cross vanes)	**90 %**	**80 %**	**70 %**
Road / Trail Treatments (drainage)	**90 %**	**90 %**	**90 %**
Protection / Safety Treatments (signs)	**90 %**	**90 %**	**90 %**

E. The Cost of Taking No - Action: $ 18,810,000

The values at risk directly lost through No-Action includes: damage to water quality, loss of soil productivity (as impacted by noxious weed potential and erosion), homes, recreational opportunities, roads, trails, utilities, and human life due to changed hydrologic and hillslope conditions.

Values-At-Risk	**Estimated Costs**
Impairment to Water Quality	$4,000,000
Loss of Long-term Soil Productivity and Ecosystem Integrity from an increase in invasive species and erosion.	$10,000,000
Loss of Homes and Structures	$2,500,000
Loss of Recreational Opportunities	$550,000
Loss of Forest Roads	$1,090,000
Loss of Trail System	$370,000
Bonneville Cutthroat Habitat, and Bats	$300,000
Total	**$18,810,000**

F. The Cost of the Selected Alternative: $ 14,021,923 (including loss)

Values-At-Risk	Estimated Costs
Loss of Long-term Soil Productivity and Ecosystem Integrity from an increase in invasive species and erosion. Damage to Water Quality, Loss of Homes, Loss of Recreational Opportunities and Loss of Irrigation and Water System. • The mulching and seeding treatments are estimated to be 60% effective in reducing the frequency of runoff and slowing erosional processes for 1-2 year storm events. • 40% failure rate of $18,810,000 plus $5,542,887 of the cost of the aerial mulching and seeding treatments.	$13,066,887
Loss of Forest Roads • The road treatments are estimated to be 90% effective in protecting the forest roads. • 10% failure rate of $1,090,000 plus $766,304 of the cost of the road treatments.	$875,304
Loss of Trail System • The road treatments are estimated to be 80% effective in protecting the forest trails. • 10% failure rate of $370,000 plus $42,732 of the cost of the trail treatments.	$79,732
Total	**$14,021,923**

G. Skills Represented on the Initial / Burned - Area Emergency Response Team:

X	**Hydrology (4)**	X	**Soils (2)**	X	**Geology**	X	**Range**		**BLM**
	Forestry		**Wildlife**	X	**Fire Mgt.**	X	**Engineering (2)**		**NRCS**
X	**R4 / Contracting**	X	**Ecology**	X	**Botany (2)**	X	**Archeology (2)**	X	**Helitack**
X	**Fisheries**	X	**Research**		**Visuals**	X	**GIS**	X	**District Staff**

Co-Team Leaders: Doug Robison / NEPA Specialist - Monitoring and Adam Solt / Hydrology

BAER Team Mentor: Michael D. Smith / Soil Scientist – Technical Specialist (THSP)

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H. Treatment Narratives: DESCRIBE THE EMERGENCY TREATMENTS, WHERE AND HOW THEY WILL BE APPLIED – AND, WHAT THEY ARE INTENDED TO DO. THIS INFORMATION HELPS TO DETERMINE QUALIFYING TREATMENTS FOR THE APPROPRIATE FUNDING AUTHORITIES. FOR SEEDING TREATMENTS … INCLUDE SPECIES, APPLICATION RATES AND SPECIES SELECTION RATIONALE

(Please see our 11 x 17 " GIS displays for noxious weed monitoring and recommended BAER Treatments at this time)

LAND TREATMENTS

AERIAL MULCHING

Purpose of Treatment … Apply agricultural straw mulch to the ground surface to achieve a continuous cover of uniform thickness, as specified below, to replace ground cover consumed by the fire. Ground cover is needed to maintain soil moisture, accelerate recovery of native vegetation, to protect any seed remaining onsite, and to improve success of stabilization seeding treatment. In addition, the organic mulch will protect soil from solar heating and drying, thereby improving the ability of seeds to germinate.

Location or General Description of Suitable Sites for Treatment … The treatment unit totals 4,158 acres. The location of this treatment is upslope of road and trail infrastructure, reaches of habitat important to Bonneville cutthroat trout, and fish barriers important to the protection of the species. The mulch will be applied in the watersheds of North Fork, Mill Hollow, Twitchell Canyon, Shingle Creek, Fish Creek and Sevier Creek. Refer to BAER Treatment Map for the exact locations.

Design Specifications:

- Treat areas in designated units with " High " and " Moderate " soil burn severity. Do not treat areas that have needles in trees, exposed rock outcrops, or slopes greater than 60 %.
- Straw application rate: Apply mulch to achieve a continuous cover of uniform thickness over 70 % of treatment area at a depth of less than 2.0 inches. Application rate will be approximately 1 ton / acre (2,000 pounds). This is about 0.25 inches or 3 straw shafts deep. Aerial application may not achieve desired ground cover, therefore ground crews will likely be needed to spread straw clumps by hand in select locations in each treatment unit. Discussion with Pete Robichaud on October 14, 2010 regarding a rate of 0.5 tons/acre identified that patching or stripping has not proved to be successful in the past. It was determined that the energy created between patches or strips of treated area overwhelms the next treated area and/or undercuts with rilling.
- Straw must conform to State Department of Agriculture (SDA), Certified Noxious Weed Free Standards for Noxious Weed Free Forage and Straw (NWFFS). All straw provided must have been planted and harvested during the 2010 growing season. Straw shaft length will not exceed 12 inches. Suitable straw includes barley, rice, and wheat grasses.
- The straw must be applied dry (less than 12 percent internal moisture content) to ensure proper dispersal during aerial applications. The Forest Service may randomly test bales using a moisture probe.

This treatment is intended to achieve three sequential objectives:

- Improve conditions to protect soil productivity by replacing ground cover burned in the fire. Replacing ground cover will: a) decrease erosion by interrupting raindrop impact and surface soil detachment; and b) increase hillslope obstructions to decrease slope lengths which mitigate accelerated overland flow, thereby decreasing sediment delivery. Mulching also helps to protect the native seedbed and retain moisture on the burned slopes to facilitate vegetative recovery of the treatment areas.

- Decrease overland flow and erosion from high soil burn severity areas upslope of trails or roads, which can intercept surface runoff and result in damage and/or loss of infrastructure.
- Decrease sedimentation from burned-areas and trails upslope of streams that provide important spawning and rearing habitat for Bonneville cutthroat trout, a federally sensitive aquatic species.

The mulching treatments are predicted to lower the estimated soil erosion and subsequent sediment delivery to the streams by up to about half. Mulching will also reduce downstream peak flows by absorbing and slowly releasing overland runoff which is likely to be increased due to reduced soil cover and hydrophobic soil conditions. Mulching treatments in the headwaters of the streams can protect a much larger downstream area from cumulative runoff and sedimentation.

The purpose of the mulching treatment is to reduce the delivery of sediment from severely burned hillslopes to avoid sediment bulking of flows entering sensitive fish habitat and road or trail infrastructure.

The mulching treatments were determined to be the minimum necessary to protect critical values, as defined in FSM 2523.1. The probability of damage or loss to the following critical values is very likely. The critical values are soil productivity, hydrologic function, human safety, road and trail infrastructure, and native / naturalized communities where invasive species and noxious weeds are absent. These values are threatened by the post-fire response to short duration, high intensity precipitation events. The magnitude of consequences is moderate especially to road infrastructure, soil productivity, natural resources, and human safety. Overall, the assessed risk is high for natural resources and human safety.

Effectiveness Monitoring

Visually inspect randomly selected mulch treatment units for proper application rate and uniform thickness during / immediately after treatment. In each unit, measure percent ground cover using a 100 ft pace transect method once after treatment, and again in the spring of 2011.b

STRAW WATTLES

Purpose of Treatment: To trap sediment and mitigate negative effects to reservoir in terms of water quality.

General Description: Install 9 ” diameter straw wattles along hillslopes above Manderfield Reservoir below areas of high to moderate severity burn.

Location (Suitable) Sites: Hillslopes above Manderfield Reservoir that burned at a moderate to high severity

BROADCAST SEEDING

Purpose of Treatment: To seed with grasses in high and moderate severity burn to aid in preventing soil productivity loss, erosion, and debris flows that severely impact soil productivity and hydrologic function. At lower elevations (14 - 22 inch precipitation) a primary purpose of this seed treatment is to minimize the spread of minor amounts of adjacent cheatgrass and noxious weeds.

General Description: Aerially seed with grasses in conjunction with mulch treatments on 14,799 acres of other areas to increase the likelihood of success for soil stabilization, establish vegetation in high and moderate severity burn and to prevent additional soil productivity loss. The seeding applications are most effective beyond the first growing season. However, some success has been achieved within the first year using sterile Triticale in the mix.

Location (Suitable) Sites: Moderate to high severity burn areas of the Twitchell Canyon Fire.

Design Specifications:

The following seed mixes were developed specifically for **EMERGENCY STABILIZATION TREATMENTS** within the context of Forest Service Manual (2523.2 p. 22; effective 5/26/2004) … " Mulching, seeding or planting of grass, forbs, shrubs or trees when needed to prevent unacceptable erosion, to stabilize critical or significant natural or cultural resources, to prevent permanent impairment to critical habitat for Federal and State listed, proposed, or candidate threatened or endangered species – or, to prevent detrimental invasion by non-native plants. Use only planted materials that should be effective within two growing seasons." We feel these are seed mixes "of species known to be effective for erosion control, adapted to the target area and compatible with future management objectives" (FSH 2509.13,20 p. 13). Our seed mixes will help to restore ecosystem function and protect against the rapid increase of cheatgrass. The mixes contain a strong component of native species as well as some introduced species. In light of Executive Order 13112 (2/3/1999) on invasive species, we considered and determined that the introduced species in these mixes will not be "likely to cause economic or environmental harm or harm to human health."

The seed purchased will be certified to the variety claimed. Also, the mixes will be certified that NO noxious weed seeds are present. Pure live seed (PLS) equals the percent of purity times the percent total germination (PLS = % P x % TG).

Price estimates were obtained from Granite Seed Company in Lehi, UT. Actual costs may vary depending on availability at time of purchase from the successful bidder. The following table shows the pounds / acre of seed (PLS) that would be used in each mix. Cost for aerial application is estimated at $35 per acre.

Native or Introduced	**Species to be Seeded (Planting Guide for Utah)**	**Seed Mix # 1 (MAP … 14 to 22 inches)**	**Seed Mix # 2 (MAP … 22 + inches)**
N	Big bluegrass "Sherman"	0.25	-
N	Bluebunch wheatgrass "Anatone"	1.5	-
N	Snake River wheatgrass "Secar"	1.5	-
N	Canby bluegrass	0.5	1
N	Sandberg bluegrass (not Canby)	0.25	-
N	Slender wheatgrass "Pryor"	3	-
N	Slender wheatgrass "San Luis"	-	3
N	Mountain brome "Bromar" or "Garnet"	3	4
N	Thickspike wheatgrass "Bannock"	1	2
I	Crested wheatgrass "Fairway"	2	-
I	Crested wheatgrass "Hycrest"	2	-
Pounds / Acre (PLS)	Total Pounds / Acre	15	10
	Total Seeds / Ft^2 1 /	71	43
	Estimated Seed Cost / Acre	$ 44.00	$ 25.25
	Estimated Cost of the Seed Mix / Pound	$ 2.93	$ 2.53

1 / Recommended rates for broadcast seeding mixes are about 50 – 100 seeds per square foot.

Where the sterile triticale hybrid is used (20 lbs / acre @ $ 1.60 / lb), it will cost an extra $ 32 / acre) – so, the adjusted seed cost / acre becomes $ 76.00 when adding triticale to the seed mix #1 – and, the estimated treatment cost becomes $ 111.00 / acre when considering the aerial application.

These seed mixes include the recommendations of District and Forest Specialists. We referred to seed mixes previously used on the Forest and the Intermountain Planting Guide, from Utah State University Cooperative Extension Service, while designing these seed mixes to achieve the FSM objectives listed above.

BAER Team / Recommendation

Five seed treatments are proposed (see Aerial Seeding Treatment map):

1) Use Seed Mix # 1 for lower areas that will be mulched – 844 acres
2) Use Seed Mix # 1 plus 20 lbs/ac of sterile hybrid for lower areas that will not be mulched – 1,439 acres
3) Use Seed Mix # 2 for higher areas that will be mulched – 4,239 acres
4) Use Seed Mix # 2 plus 20 lbs/ac of sterile hybrid for higher areas that will not be mulched – 7,043 acres
5) Use sterile hybrid triticale at 40 lbs/ac – 1,234 acres

Most of the seed will be applied in areas that receive about 14 to 30 + inches of precipitation annually. Some of the species in these mixes each have the ability to dominate a stand depending on the location. The value of multiple species in the seed mix provides the flexibility for different species in the seed mix to thrive in a microsite that is best suited for that certain species.

Specific ecological attributes valued for some of the species include the following:

Big bluegrass— "when properly managed, will compete with cheatgrass"

Bluebunch and Snake River wheatgrass— "long-lived, drought tolerant, widespread"

Sandberg and Canby bluegrass— "important for soil stabilization…one of the first grasses to green-up in the spring…excellent in low rainfall native mixes - these bluegrasses should be very competitive with cheatgrass)

Slender wheatgrass— "valuable in erosion control because of its rapid development"

Mountain brome— "will establish and grow on rather poor, depleted soils … recommended sites include weedy openings"

Thickspike wheatgrass – rhizomatous / "adapted to disturbed range sites and dry areas subject to erosion"

Crested wheatgrass— "one of the few grasses that has the ability to compete with difficult to control weedy annuals such as cheatgrass"

—Fairway is reported to fade in abundance sooner than other varieties

—Hycrest is "a hybrid between standard and introduced…outstanding seed producer, excellent seedling vigor, easy to establish under harsh conditions"

Sterile hybrid triticale – "hardy and durable – but, not persistent or invasive…adapts to a wide range of soil and moisture conditions"

There may be opportunities to add other species to the seed mix. We suggest that District personnel contact the Utah Division of Wildlife Resources (UDWR) prior to actual purchase of the seed. Depending on seed availability and time of seeding, the Division may have seed for forb and browse species that could be added to the seed mix that would enhance both wildlife habitat and diversity in the area.

We constrained the total number of acres to be seeded by several guiding factors:

Only seed in disturbed areas located on NFS lands.

Generally speaking, seed suitable areas located within some moderate and high / burn severity zones.

Seed areas where pre-burn juniper stands lacked adequate grass seedbank.

The Planting Guide for Utah gives the following information in the " Wildfire Seedings " section. " Steep slopes and rough areas that are not accessible to conventional ground equipment can be aerial seeded … if it is not possible to cover seed, plant late in the fall and increase the seeding rate ... burned sites, including forest and desert ranges are often seeded within a few days or weeks following the fire, in the mistaken belief that the ash will cover the seed … even if an ash residue or a loose seedbed is present, seed only during the appropriate seasons. Do not plant on a loose dry seedbed … plant in the late fall when seedbeds are firm."

MINE ADIT CLOSURES

Purpose of Treatment: As the fire burned the vegetation, mine adits became more visible on the landscape. In some instances wooden barriers at mine entrances were burned and rendered ineffective. The purpose of the closures is to provide public safety and secure the closure of the mine adit.

General Description: Install culvert/rebar grate barriers at 3 mine adit locations in the Mud Flat and Sevier Canyon area to prevent public entry in to these dangerous hazards.

Location: The following mines need immediate attention for public safety.

- Rosebud #1
- Golden Gem
- Jumbo

NOXIOUS WEED EXPANSION MONITORING and SPOT TREATMENT

The Beaver RD weed crew will implement this strategy in 2011 to detect and treat any new infestations of noxious weeds in the burned area. Three aggressive noxious weeds need immediate attention; Scotch thistle, leafy spurge, and musk thistle threaten the area. Several other species on the Utah noxious weed list occur adjacent to the burned area (see Noxious Weed Monitoring and Spot Treatment map). This treatment includes a search for any new individuals of noxious weeds on forest-administered lands along four specific stretches of the fire perimeter, along most of the forest routes in the northeast quadrant of the burned area and the roads in Indian Creek and North Creek. The dozer line in the South Fork of North Creek and also spike camps, drop points, helispots, and some heliwell locations will be monitored. Individuals of noxious weeds generally will be sprayed with herbicide at the same time they are discovered. The search will occur three times during the growing season preferably in May, late-June and early August; about 1,000 acres

CHANNEL TREATMENTS

GRADE CONTROL

Purpose of Treatment: Grade control structures will be constructed slightly higher then current stream elevations to act as low-grade sediment traps. Use of footers and large rock will act as grade control. Cross-vane shape acts to keep thalweg appropriately located. Sills act to prevent down-cutting of floodplains and terraces with subsequent lateral migration of the stream.

General Description: Expected increases in stream peak flows and sediment bedload threatens to cause down-cutting on two streams and aggradation and lateral incision on one stream. Values at risk include a Forest road along one stream with multiple stream crossings and one crossing on each of the other two streams. Habitat for one Bonneville cutthroat trout remnant population will be affected, and two streams in the process of being restored to Bonneville cutthroat trout. Project will install 8 cross-vane structures with sills to help trap and store excess sediment, act as grade controls to prevent down-cutting, and maintain thalwag location to prevent lateral stream migration that would lead to further erosion, bank mass wasting and debris flows. Besides these measures would reduce address the risk to human safety, risk of loss of trail infrastructure. The Utah Division of Wildlife Resources is proposing to install 20 cross-vanes in addition to the 8 proposed by the USFS with the intent to protect BCT habitat. The Forest would coordinate with the Division on locations and implementation.

Location (Suitable) Sites: About half of the structures would be located in the North Fork of North Creek watershed along Forest Road 591 and the other half would be located along Shingle Creek, Fish Creek, and other portions of the Clear Creek watershed along approximately 4 miles on North Fork of North Creek, 1.5 miles of Shingle Creek, and 1.5 miles of Fish Creek.

ROAD AND TRAIL TREATMENTS

(ROAD STABILIZATION)

HARDENED CROSSINGS

Purpose of Treatment: Direct the drainage flows across the road in a single area and prevent water from running parallel to the road which would increase the chances of the road washing out for a further distance.

General Description: The armor consisting of riprap is placed where runoff could possibly cause erosion to the road surface and fill-slope.

Location (Suitable) Sites: North Fork of North Creek, Indian Creek, Shingle Creek, Mill Creek, and Sevier Canyon.

HARDENED / LOW WATER CROSSINGS

Purpose of Treatment: Concrete low water crossings are proposed in order to prevent complete wash-outs of the road without these improvements these three crossings will become impossible to navigate with a vehicle and these locations will necessitate much more expensive repairs to keep the road in a functional condition. These crossings will also provide grade control to the creek. Without grade control, the flow-line of the stream will likely drop throughout the entire length of the stream corridor. These improvements will also aid in the protection of the sensitive Bonneville Cutthroat Trout in the stream from burned-area runoff.

General Description: Install 3 concrete hardened low water crossings in the North Fork of North Creek. Concrete crossings are installed as a solid apron to direct flows across road in one location. Aprons are designed to catch and direct flow back into the channel.

Location: North Fork of North Creek.

SEDIMENT BASIN

Purpose of Treatment: To catch increased sediment that will be carried by the storm runoff that will plug culverts. Prior to the runoff reaching the inlet of a culvert, the sediment basin will allow the velocity of the flow to drop, as will the flow's sediment load into the basin. The much cleaner flow of water that reaches the pipe will have a much smaller possibility of plugging up the culvert. The sediment basin will also protect downstream waterways by capturing transported sediment and debris.

General Description: Basins constructed in flatter topography within drainages where runoff can be directed through the basin to deposit sediment.

Location (Suitable) Sites: Sevier Canyon, Shingle Creek and Mud Flat areas.

DITCH CONSTRUCTION / RECONSTRUCTION

Purpose of Treatment: Construct or repair/clean ditches along roads to direct runoff and flows off of road surface to the channel.

General Description: In some locations the existing drainage ditch is inadaquate for the anticipated runoff flows. In others there is no drainage ditch and one will be necessary to carry the expected drainage flows. Still, in others, they have filled up with debris and sediment since the last storm that occurred since the fire took place. Excavator time will be necessary to make sure that ditches are available and adequate for the anticipated runoff that will occur with storm events.

Location (Suitable) Sites: North fork of North Creek, Shingle Creek, and Sevier Canyon.

CATTLEGUARD CLEANING

Purpose of Treatment: Clean out silted in cattleguard to prevent further erosion that would cause the structure to fail.

General Description: One cattleguard within the burn perimeter has become silted in and needs to be cleaned out for the safety of the travelling public and to maintain the cattleguards functionality.

Location (Suitable) Sites: Sevier Canyon

CULVERTS

Purpose of Treatment: Cleaning culvert pipes and replacing the missing and damaged lids over the drop inlets will enable the drainage system to convey design flows and will reduce the chance of plugging. This will avoid the expensive possibility of long lengths of road washouts and keep the roads safe to drive by keeping water off the road. In some locations where traffic counts are higher and the road is of a higher standard, hardened drainage crossings are not feasible or the best solution. If the culverts are not replaced or exsting culverts upsized, probability of road failure is high and the magnitude of losses could be substantial, since flows often find the edge of road and wash out long portions of the road itself.

General Description: Cleaning includes the cleanout of catch basin culvert inlets, outlets, and the drop inlets. Replacement of existing culverts with larger culverts is the best solution in cases where existing culverts are too small. On higher traveled roads, culverts provide a cost effective way to maintain traffic flow while also passing the drainage flows.

Location (Suitable) Sites: Culvert cleaning will occur within all drainages of the fire along associated roads. Culvert replacement is being recommended for Indian Creek, Mill Creek, Sevier Canyon, and Shingle Creek.

ROAD FILL MATERIAL

Purpose of Treatmetnt: In some cases the road needs to be built up so that the adjacent stream will not wash out long lengths of the road. Without this treatment, the probability of this occuring is high and the cost of repair of such an event is equally high.

General Description: Bring in road fill material to build up road.

Location (Suitable) Sites: Indian Creek, Mill Creek, and Sevier Canyon have been identified as areas needing additional road fill material.

ROAD RECONDITIONING / GRADER AND DOZER

Purpose of Treatment: Several roads are located immediately downhill from burned-areass. Runoff from these areas will directly impact the road for continuous entire longitudinal lengths. Treatment will ensure drainage flow is directed to the nearest drainage structure as necessary so that the flow will sheet off of the road effeciently. This will prevent the the predictable higher flows off of burned-areas from washing out large areas of roads which will be much more costly to repair in the future if that happens.

General Description: Grader reconditioning will remove wheel ruts, re-establish the appropriate cross-slope or out-slope, and install rolling drainage dips where necessary. In those areas where terrian dictates the need for a dozer in leiu of a grader the equipment will be applied as appropriate.

Location: North Creek, Mill Creek, Shingle Creek, Sevier Canyon, and Indian Creek.

(TRAIL STABILIZATION)

Purpose of Treatment: Grade dips, and waterbars will divert water off of the trail preventing erosion and debris flows from degrading the trail. These methods will keep the trail from becoming a stream channel and prevent the loss of the trail.

General Description: Install drainage structures to prevent erosion, mass wasting and debris flows that are predicted to occur following the burn. These measures would also address the risk to human safety, risk of loss of trail infrastructure.

Location (Suitable) Sites: Locate drainage structures along 16.4 miles trails within the Twitchell Canyon fire perimeter. These include: FS trails 048, 049, 050, 054, 058, 202, 203, 208, 211, 281, and 3085.

TRAILHEAD BARRIER RECONSTRUCTION AND HAZARD TREE REMOVAL

Purpose of Treatment: The fire burned through the recreation area around Manderfield Reservoir resulting in the mortality of over 25 % of the trees in and around the reservoir. A dead tree is considered a hazard tree in a high use area setting. Falling and removal of these trees will prevent further damage to improvements

(undamaged by the fire) and also prevent unnecessary injury to the public or their property. Replace the post and pole fencing associated with trailheads will restrict use of the trail system and maintain the use rating of the trails.

General Description: The fire burned through the Manderfield Reservoir day use recreational area, and 8 trailheads, leaving several hazard trees. The treatment is to fall and remove the hazard trees in the day use area and contour fall the hazard trees at trailheads.

Location (Suitable) Sites: Dispersed recreation area around Manderfield Reservoir and 8 trailhead entry points around the fire perimeter.

Design / Construction Specifications: Fall and/or remove all hazard trees which have the potential of striking any Improvement, trailhead sign, or bridges when they fall. Replace the post and pole barriers at trailheads with materials that meet Forest design standards in the same location or a location that is effective in maintaining trail use specifications.

TRAIL HAZARD SIGNS

Purpose of Treatment: The purpose of Burned-Area Warning Signs is to inform the public land users about the potential hazardous conditions associated with the fire.

General Description: This treatment is for the installation of, burned-area warning signs. Burned-area signs consist of a warning to the public identifying of the possible dangers associated with a burned-area. It shall contain language specifying of items to be aware of when entering a burn area such as falling trees and limbs, rolling rocks, and flash floods.

Location (Suitable) Sites: Burned Area Signs - These signs shall be installed at all entries into the fire perimeter. The location of these signs shall be along roads and trails. The field perimeter map shall be used to identify those roads and trails that enter into the fire burn area.

PROTECTION AND SAFETY MEASURES

FOREST ENTRY GATES

Purpose of Treatment: These gates are needed at several locations to prevent traveling public from entering the burned area when it is not safe to do so. The gates will be closed and locked as deemed prudent by FS personnel to protect the public from increased unnecesary risk.

General Description: 8 gates are to be installed at various access points around the fire perimeter.

Location (Suitable) Sites: FS Roads 471, 591, 119, 114, 115, 116, and 1131.

ROAD AND TRAIL / BURNED-AREA WARNING SIGNS

Purpose of Treatment: The purpose of the BURNED-AREA signs is to warn the public of potential hazards resulting from the effects of the fire, such as rolling rocks, falling trees, road washouts, and flash floods.

General Description: This treatment is for the installation of burned-area warning signs. Burned-area signs consist of a warning to the public identifying of the possible dangers associated with a burned-area. It shall contain language listing items to be aware of when entering a burn area such as falling trees and limbs, rolling rocks, and flash floods.

Location (Suitable) Sites: These signs shall be installed at all entries into the fire perimeter. The location of these signs shall be along roads. All signs will be placed facing the direction of travel entering the burn area. Other signs will also be placed within the burn perimeter at key locations.

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I. Monitoring Narrative: BRIEFLY DESCRIBE THE MONITORING NEEDS, WHAT TREATMENTS WILL BE MONITORED, HOW THEY WILL BE MONITORED AND WHEN MONITORING WILL OCCUR. A DETAILED MONITORING PLAN MUST BE SUBMITTED AS A SEPARATE DOCUMENT TO THE R4 / BAER COORDINATOR

A detailed Year # 1 / Monitoring Plan has been prepared by the Fishlake NF / BAER Team for this incident of wildfire; our plan includes a thorough discussion of Year # 1 / monitoring activities on the following topics:

Broadcast Seeding vs Aerial Mulching

Noxious Weed Detection and Eradication

Soil Erosion on Roads / Trails and Storm Flow Monitoring

Explanatory and Safety Signs

D3 – SO Engineering / Storm Patrols

Year # 1 / Monitoring Report and Interim BAER Reports

As requested, a copy of our Monitoring Plan will be sent to R4 / BAER Coordinator – Jeff Bruggink up in Ogden, UT as a separate document from this 2500 - 8 / Initial BAER Report And … at the same time, we're going to paste a copy of our detailed plan right into this document too. This permits our fellow employees, local units of government, other State and Federal Agencies with an opportunity to view our strategy for examining the disturbance.

Year # 1 / Monitoring Plan – Twitchell Canyon Wildfire / Beaver Ranger District

This monitoring plan briefly describes elements of both implementation monitoring and effectiveness monitoring. Our monitoring activities will be qualitative and designed to answer the questions presented in the respective sections below.

BROADCAST SEEDING

Implementation monitoring will provide answers to the following questions.

Were the recommended seed mixes used?

How were applications rates calibrated? Were the low and high elevation seed mixes applied in intended sites and at appropriate levels?

Was the seed applied in the fall of 2010 prior to or just after the first snowfall?

Results from the aerial seeding should include establishing effective ground cover for prevention of accelerated soil loss and to protect areas from noxious and invasive weed establishment and spread. First year monitoring will answer the following questions:

Are desired species regenerating?

Was the area rested from livestock grazing?

What percentage of ground cover is established?

Photo points may be established in May with revisits in June and August of 2011. Adequate moisture from spring storms will be key to successful response. Monitoring results will indicate if a further request for reseeding is warranted and would be requested by the Forest through rehabilitation and restoration funding.

AERIAL MULCHING

Implementation monitoring will occur to determine application rates and areas are covered as specified in the plan and contract. Fire and fuels personnel will be trained to perform inspector duties. During year one post implementation effectiveness monitoring will be conducted after several storm events to determine amount of coverage and effectiveness. This will be accomplished through ground and aerial reconnaissance methods. Photographs will be taken with ocular estimates on amount of mulch on the hillslope. The forest hydrologist will review photos and document monitoring results. Due to the steepness and overall size of the incident aerial reconnaissance is the preferred method to see the treatments. BAER funding is requested for these flights.

NOXIOUS WEED DETECTION / MONITORING

The purpose of this weed expansion detection treatment is to identify the spread of noxious weeds from any currently known location of noxious weeds (see Existing Noxious Weed Location map). Noxious weed species generally will be treated at the same point in time they are discovered.

Beaver RD weed crew will implement the monitoring strategy (see Noxious Weed Monitoring and Spot Treatment map). This treatment includes a search for any new individuals of noxious weeds on forest-administered lands for 300 feet inside the fire perimeter along four specific stretches. Most of the forest routes in the northeast quadrant of the burned area will be monitored for 150 feet on each side of the route. The Indian Creek and North Creek roads, as well as the dozer line in the South Fork of North Creek will be monitored for 300 feet on each side of the route or line. Also, spike camps, drop points, helispots, and some heliwell locations will be monitored. Individuals of noxious weeds generally will be sprayed with herbicide at the same time they are discovered. New weed locations will be documented with GPS positions and photographed when possible. The search of all locations will occur three times during the growing season preferably in May, late-June and early August, 2011. This frequency should allow individual young weeds to be detected and treated before they reach full maturity and set seed. Monitoring levels may be increased if substantial amounts of young noxious weeds are detected.

Monitoring and treatments of noxious weed expansion beyond Year 1 will be funded with rehabilitation and restoration dollars or other appropriated funds.

This noxious weed strategy is early detection and rapid response. Three aggressive noxious weeds need immediate attention; Scotch thistle, leafy spurge, and musk thistle threaten the area. Also, houndstongue might increase in the area and whitetop may spread in the lower reach of Sevier Canyon. Several other species on the State of Utah noxious weed list occur adjacent to the burned area (see Existing Noxious Weed Location map).

D3 / ENGINEERING - STORM PATROL

The district has documented trees falling into stream channels within the burn primarily in North Fork of North Creek. There is a concern that these debris will block culverts and channels during high flow events causing additional damage to roads and other resource values. District resource crews working with Forest equipment operators would patrol roads at critical choke points for debris following short duration, high intensity storms that would generate high water flows and remove debris to maintain the systems capability to handle the runoff.

As storm events occur over the burned area a large portion of the road infrastructure has potential for impacts and damage resulting from runoff and erosion. Roads damaged during the suppression efforts have been repaired to pre-incident levels. However, it is expected that, additional damage will occur. The engineering staff of the Supervisors Office working with district personnel will monitor weather event driven debris flows.

Monitoring will track road drainage, and falling debris that may render road system unusable. Poor road drainage as a result of post fire related damage will be addressed by repairing waterbars, cleaning out plugged culverts, and grading out roadbeds to repair down cutting.

TRAIL DRAINAGE, RECONSTRUCTION AND SIGNAGE

Repairs to trails addressing drainage and erosion issues will be monitored for effectiveness within the first year following implementation. This would occur in the fall of 2011. Monitoring efforts would be carried out by the District recreation staff and other District personnel who may be accessing the area. Monitoring will answer the following questions:

Are waterbars working properly and appear to be adequately spaced?

What signs of future and current erosion are evident?

Are there areas not identified in the original assessment that need treatment to protect the trail infrastructure?

The Forest should be prepared to request rehabilitation and restoration funding based on monitoring results.

SAFETY AND EXPLANATORY SIGNS

Were the signs placed at the designated locations? Was the lettering readable, and was the message clear and appropriate for the location and event? Inspections made through Year 1 will determine if the signs have achieved the intended purposes. Also, it will be assessed and determined if more signs are needed based upon public use and utilization patterns.

Monitoring Activities, Supplies and Aircraft Time	Estimated Costs
Helicopter: 6 hours flight time @ $ 1000 / hour	$ 6,000
Effectiveness Monitoring: 15 specialist days @ 375 / day	$ 5,625
Document Preparation: 10 specialist days @ 375 / day	$ 3,750
Storm Patrol Debris Monitoring and Cleanup: 7 @ $200/day	$1,400
TOTAL … YEAR 1 / MONITORING	**$ 16,775**

BURNED-AREA / EMERGENCY STABILIZATION PLAN # 1 – AERIAL MULCHING

PART F – SPECIFICATION

SPECIFICATION TITLE:	Alt 2 - Aerial Straw Mulch	**JURSIDICTIONS:**	USFS-Fishlake N.F.
PART E: LINE ITEM:	Aerial Straw Mulch to Prevent Unacceptable Degradation of Critical Habitat	**FISCAL YEAR:**	2011
FSM 2520 REFERENCE#:	2523.2.1.b, 2523.2.1.c, 2523.2.2.C 2523.2.3.a	**SPECIFICATION TYPE:**	ES

WORK TO BE DONE

A. Provide a Brief General Description of Treatment

Apply agricultural straw mulch to the ground surface to achieve a continuous cover of uniform thickness, as specified below, to replace ground cover consumed by the fire. Ground cover is needed to maintain soil moisture, accelerate recovery of native vegetation, to protect any seed remaining onsite, and to improve success of stabilization seeding treatment. In addition, the organic mulch will protect soil from solar heating and drying, thereby improving the ability of seeds to germinate.

B. Describe Specific Treatment Location or General Description of Suitable Sites for Treatment

The treatment unit totals 4,158 acres. The location of this treatment is upslope of road and trail infrastructure, reaches of habitat important to Bonneville cutthroat trout, and fish barriers important to the protection of the species. The mulch will be applied in the watersheds of North Fork, Mill Hollow, Twitchell Canyon, Shingle Creek, Fish Creek, and Sevier Creek. Refer to BAER Treatment Map for exact locations.

C. Provide and Number Detailed Design/Construction Specifications

1. Treat areas in designated units with “High” and “Moderate” soil burn severity that are less than 70% slope. Do not treat areas that have needles in trees, exposed rock outcrops, or slopes greater than 70%.
2. Straw application rate: Apply mulch to achieve a continuous cover of uniform thickness over 70% of treatment area at a depth of less than 2.0 inches. Application rate will be approximately 1.0 ton/acre (2,000 pounds). This is about 0.25 inches or 3 straw shafts deep. Aerial application may not achieve desired ground cover, therefore ground crews will likely be needed to spread straw clumps by hand in select locations in each treatment unit.
3. Straw must conform to State Department of Agriculture (SDA), Certified Noxious Weed Free Standards for Noxious Weed Free Forage and Straw (NWFFS). All straw provided must have been planted and harvested during the 2010 growing season. Straw shaft length will not exceed 12 inches. Suitable straw includes barley, rice, and wheat grasses.
4. The straw must be applied dry (less than 12 percent internal moisture content) to ensure proper dispersal during aerial applications. The Forest Service may randomly test bales using a moisture probe.

D. Describe Purpose of Treatment Specification – What Resource will be Protected

This treatment is intended to achieve three sequential objectives:

1. Improve conditions to protect soil productivity by replacing ground cover burned in the fire. Replacing ground cover will: a) decrease erosion by interrupting raindrop impact and surface soil detachment; and b) increase hillslope obstructions to decrease slope lengths which mitigate accelerated overland flow, thereby decreasing sediment delivery. Mulching also helps to protect the native seedbed and retain moisture on the burned slopes to facilitate vegetative recovery of the treatment areas.
2. Decrease overland flow and erosion from high soil burn severity areas upslope of trails or roads, which can intercept surface runoff and result in damage and/or loss of infrastructure.
3. Decrease sedimentation from burned areas and trails upslope of streams that provide important spawning and rearing habitat for Bonneville cutthroat trout, a federally sensitive aquatic species.

The mulching treatments are predicted to lower the estimated soil erosion and subsequent sediment delivery to the streams by up to about 1/2. Mulching will also reduce downstream peak flows by absorbing and slowly releasing overland runoff which is likely to be increased due to reduced soil cover and hydrophobic soil conditions. Mulching treatments in the headwaters of the streams can protect a much larger downstream area from cumulative runoff and sedimentation.

The purpose of the mulching treatment is to reduce the delivery of sediment from severely burned hillslopes to avoid sediment bulking of flows entering sensitive fish habitat and road or trail infrastructure.

The mulching treatments were determined to be the minimum necessary to protect critical values, as defined in FSM 2523.1. The probability of damage or loss to the following critical values is very likely. The critical values are soil productivity, hydrologic function, human safety, road and trail infrastructure, and native/naturalized communities where invasive species and noxious weeds are absent. These values are threatened by the post-fire response to short duration, high intensity precipitation events. The magnitude of consequences is moderate especially to road infrastructure, soil productivity, natural resources, and human safety. Overall, the assessed risk is high for natural resources and human safety.

E. Describe Treatment Effectiveness Monitoring

Visually inspect randomly selected mulch treatment units for proper application rate and uniform thickness during/immediately after treatment. In each unit, measure percent ground cover using a 100ft pace transect method once after treatment, and again in the spring of 2011.

LABOR, EQUIPMENT, MATERIALS, AND OTHER COST:

PERSONNEL SERVICES (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item **Do not include contract personnel costs here (see contractor services below).**	**COST/ITEM**
1. Implementation Leader: GS-12/5 @ $50/hour x 312 hours 2. Contracting Officer: GS-11/5 @ $40/hour x 104 hours 3. Implementation Inspectors: GS7 @ $30.00/hr x 416 hours x 8 inspectors 4. Monitoring: GS7 @ $30.00/hr x 40 hours x 1 fy x 2 crew members	$15,593 $4,158 $124,740 $2,400
TOTAL PERSONNEL SERVICE COST	**$146,891**

EQUIPMENT PURCHASE, LEASE, OR RENTAL (Item @ Cost/Hours or Cost/Day or # Days X # Fiscal Years = Cost/Item) Note: Purchase requires written justification that demonstrates cost/item benefits over lease or rental.	**COST/ITEM**
TOTAL EQUIPMENT PURCHASE, LEASE, OR RENTAL COST	

MATERIAL AND SUPPLIES (Item @ Cost/Each X Quantity X # Fiscal Years = Cost/Item)	**COST/ITEM**
Agricultural Straw: $300/ton x 1 ton/ac x 4,158 acres (cost includes transportation)	$1,247,400
TOTAL MATERIAL AND SUPPLY COST	**$1,247,400**

TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X # Fiscal Years = Cost/Item	**COST/ITEM**
1. Vehicle for Implementation Leader: $200/week x 2 weeks 2. Vehicles for Implementation Inspectors: $200/week x 2 weeks x 2 vehicles 3. Vehicle for Monitoring Crew: $200/week x 1 week	$800 $800 $200
TOTAL TRAVEL COST	**$1,800**

CONTRACT COST (Labor or Equipment @ Cost/Hour X # Hours X # Fiscal Years = Cost/Item)	**COST /ITEM**
Type II (medium) helicopter @ $3,515/hr x 594 hrs (4,158 acres of straw/7 acres/hr)	$2,087,712
TOTAL CONTRACT COST	**$2,087,712**

SPECIFICATION COST SUMMARY

FISCAL YEAR	UNIT	UNIT COST	# OF UNITS	COST	FUNDING SOURCE	METHOD
2011	acre	$838	4,158	$3,483,803	ESR	P/C
TOTALS	acre	$838	4,158	$3,483,803	ESR	P/C

FUNDING SOURCES	SPECIFICATION TYPE	METHOD OF COMPLETION
F= Fire Suppression ESR = Emergency Stabilization & Rehab. OP/O = Agency Operating Fund EWP = Emergency Watershed Program	ES = Emergency Stabilization R = Rehabilitation FS = Fire Suppression	P = Agency Personnel Services C = Contract EFC = Emergency Fire Contract FC = Crew Labor Assigned to Fire

SOURCE OF COST ESTIMATES

Put Letter (P,M,T,C, or F) Next to Appropriate Cost Estimate Source (1-5) Below	
1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	C

3. Estimate supported by cost guides from independent sources or other federal agencies.	
4. Estimates based upon government wage rates and material cost.	P/T
5. No cost estimate required – cost charged to Fire Suppression Account (not tracked in plan)	
P = Personnel Services M = Materials/Supplies T = Travel C = Contract F = Suppression	

RELEVANT DETAILS, MAPS, AND DOCUMENTATION INCLUDED IN THIS REPORT

List Relevant Documentation and Cross-References within ESR Plan
1. Map of treatment units

TOTAL COST BY JURSIDICTION

JURISDICTION	UNITS TREATED	COST
USFS – Fishlake N.F.	4,158 acres	$3,484,404
TOTALS	**4,158 acres**	**$3,484,404**

BURNED-AREA / EMERGENCY STABLIZATION PLAN # 2 - USING TRITICALE

PART F - SPECIFICATION

SPECIFICATION TITLE:	**Aerial seed application on 1,234 acres (see attached map) over the moderate to high severity burn areas of the Twitchell Canyon Fire – Sterile Triticale Hybrid only – Alternative A**	**JURISDICTIONS:**	**USFS**
FISCAL YEAR:	**2011**		

WORK TO BE DONE

Number and Describe Each Task:

A. General Description:

Aerial seed application of 1,234 acres of the moderate to high severity burn areas of the Twitchell Canyon Fire.

B. Location (Suitable) Sites:

Moderate to high severity burn areas of the Twitchell Canyon Fire using Sterile Triticale Hybrid only (see attached map).

C. Design/Construction Specifications:

1. Aerial application of seed mix by fixed-wing aircraft or helicopter.

2. Seed to be applied:

Sterile Triticale Hybrid – 40 lbs. PLS/acre

Total = 40 lbs. PLS/acre

D. Purpose of Treatment Specifications:

The purpose of this treatment is to provide soil stabilization and effective ground cover from seeded grass vegetation. Soil loss tolerance has been predicted from 108% to 1400% in the burned area where seeding is proposed. Seeding will help to prevent soil loss and help to minimize down slope effects to lower watersheds that result from soil erosion by providing effective ground cover more rapidly than these ecological systems would provide without treatment. Soil production and hydrologic function is expected to be severely impacted by this soil erosion following this wildfire if no seeding in these proposed treatment areas are done.

E. Treatment Effectiveness Monitoring:

Study plots will be set up on different slopes, elevations, and vegetation types to monitor representative areas within this proposed seeding area during the growing season following the treatment. This will help to determine the initial success of this treatment.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): **Do not include contract personnel costs here (see contractor services below).**	**COST/ITEM**
Contract Preparation and Site Details = (GS-12 @ $40/hr X 40 hrs) = 1600 Contract Preparation and Site Details = (GS-11 @ $32/hr X 80 hrs) = 2560 Implementation Monitoring (Seed Inspection) = (GS-11 @ $32/hr X 40 hrs) = 1280 Implementation Monitoring (Seed Inspection) = (GS-5 @ $15/hr X 40 hrs) = 600 Implementation Monitoring (Seed Inspection) = (GS-5 @ $15/hr X 40 hrs) = 600 Implementation Monitoring (Seed Inspection) = (GS-5 @ $15/hr X 40 hrs) = 600 Overtime for Seed Inspection (40 hrs for each inspector) = 2440 Effectiveness monitoring (GS-11 @ $32/hr X 80 hrs x 1) = 2560	**$ 12,240**
TOTAL PERSONNEL SERVICE COST	**$ 12,240**
EQUIPMENT PURCHASE, LEASE OR RENTAL (Item @ Cost/Hour or Cost/Day X # Hours or # Days X # Fiscal Years = Cost/Item): (Note: Purchase requires written justification that demonstrates cost/item benefits over lease or rental.)	**COST/ITEM**
4 Vehicles x 500 miles each = 2000 miles x 0.59/per mile = 1180	**$1,180**
TOTAL EQUIPMENT PURCHASE, LEASE, OR RENTAL COST	**$1,180**

MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X # Fiscal Years = Cost/Item):	**COST/ITEM**
Sterile Triticale Hybrid – 40 lbs. PLS/acre = $64/acre x 1234 acres = 90944	**$ 78,976**
TOTAL MATERIALS AND SUPPLY COST	**$ 78,976**
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X # Fiscal Years = Cost/Item):	**COST/ITEM**
Seed Sampling and Testing (Per Diem/Travel Expense for Two FS Employees) = 1000 Vehicle Mileage for Sampling (2000 miles X0.59/mile) = 1180 Seed Testing Costs = 500	**$2,680**
TOTAL TRAVEL COST	**$2,680**
CONTRACT COST (Labor or Equipment @ Cost/Hour X # Hours X # Fiscal Years = Cost/Item):	**COST/ITEM**
Aerial application of seed by fixed wing aircraft or helicopter = $35/acre x 1234 acres	**$ 43,190**
TOTAL CONTRACT COST	**$ 43,190**

SPECIFICATION COST SUMMARY

FISCAL YEAR	UNIT	UNIT COST	# OF UNITS	COST	FUNDING SOURCE	METHOD
FY 1	acre	$ 112.05	1234	$ 138,270	EFR	C
TOTAL				**$ 138,270**		

FUNDING SOURCES:
F = Fire Suppression Account
EFR=Emergency Fire Rehabilitation
OP/O =Agency Operating Fund
EWP = Emergency Watershed Program

SPECIFICATION TYPE
ES = Emergency Stabilization
R = Rehabilitation
FS = Fire Suppression

METHODS FOR COMPLETION
P=Agency Personnel Services
C=Contract
EFC= Emergency Fire Contract
FC=Crew Labor Assigned to Fire

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	P, M, C
3. Estimate supported by cost guides from independent sources or other federal agencies.	
4. Estimates based upon government wage rates and material cost.	
5. No cost estimate required – cost charged to Fire Suppression Account.	

P = Personnel Services **M** = Materials/Supplies **T** = Travel **C** = Contract **F** = Suppression

III. RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

List Relevant Documentation and Cross-References Within ESR Plan:

SEE ATTACHED MAP FOR TREATMENT AREA.

IV. TOTAL COST BY JURISDICTION

JURISDICTION	UNITS TREATED	COST
USFS	1234 acres	$ 138,270
TOTAL COST		**$ 138,270**

BURNED-AREA / EMERGENCY STABLIZATION PLAN # 3 – BROADCAST SEEDING

PART F - SPECIFICATION

SPECIFICATION TITLE:	**Aerial seed application on 13,565 acres (see attached map) over the moderate to high severity burn areas of the Twitchell Canyon Fire – Alternative D**	**JURISDICTIONS:**	**USFS**
FISCAL YEAR:	**2011**	**FISHLAKE NF**	**BEAVER RD**

WORK TO BE DONE

I.

Number and Describe Each Task:

F. General Description:

Aerial seed application of 13,565 acres of the moderate to high severity burn areas of the Twitchell Canyon Fire.

G. Location (Suitable) Sites:

Moderate to high severity burn areas of the Twitchell Canyon Fire. (blue, gold, and striped areas - see attached map).

H. Design/Construction Specifications:

3. Aerial application of seed mix by fixed-wing aircraft or helicopter.

4. Seed mix to be applied on areas not mulched (22+ inches precip.) – 7,043 acres:

Sterile Triticale Hybrid – 20 lbs. PLS/acre

Canby Bluegrass (*Poa canbyi*) – Canbar cultivar – 1 lbs. PLS/acre

Slender Wheatgrass (*Elymus trachycaulus*) – San Luis cultivar – 3 lbs. PLS/acre

Mountain Brome (*Bromus carinatus*) – Bromar or Garnet cultivars – 4 lbs. PLS/acre

Thickspike Wheatgrass (*Elymus lanceolatus*) – Bannock cultivar – 2 lbs. PLS/acre

Total = 30 lbs. PLS/acre

3. Seed mix to be applied on areas not mulched (14-22 inches precip.) – 1,439 acres:

Sterile Triticale Hybrid – 20 lbs. PLS/acre

Big Bluegrass (*Poa ampla*) – Sherman cultivar – 0.25 lbs. PLS/acre

Bluebunch Wheatgrass (*Elymus spicatus*) – Anatone cultivar – 1.5 lbs. PLS/acre

Snake River Wheatgrass (*Elymus waiwaiensis*) – Secar cultivar – 1.5 lbs. PLS/acre

Canby Bluegrass (*Poa canbyi*) – Canbar cultivar – 0.5 lbs. PLS/acre

Sandberg Bluegrass (*Poa sandbergii*) – VNS -0.25 PLS/acre

Slender Wheatgrass (*Elymus trachycaulus*) – Pryor cultivar – 3 lbs. PLS/acre

Mountain Brome (*Bromus carinatus*) – Bromar or Garnet cultivars – 3 lbs. PLS/acre

Thickspike Wheatgrass (*Elymus lanceolatus*) – Bannock cultivar – 1 lbs. PLS/acre

Crested Wheatgrass (*Agropyron cristatum*) – Hycrest cultivar – 2 lbs. PLS/acre

Crested Wheatgrass (*Agropyron cristatum*) – Fairway cultivar – 2 lbs. PLS/acre

Total = 35 lbs. PLS/acre

4. Seed mix to be applied on areas mulched (22+ inches precip.) – 4,239 acres:

Canby Bluegrass (*Poa canbyi*) – Canbar cultivar – 1 lbs. PLS/acre

Slender Wheatgrass (*Elymus trachycaulus*) – San Luis cultivar – 3 lbs. PLS/acre

Mountain Brome (*Bromus carinatus*) – Bromar or Garnet cultivars – 4 lbs. PLS/acre

Thickspike Wheatgrass (*Elymus lanceolatus*) – Bannock cultivar – 2 lbs. PLS/acre

Total = 10 lbs. PLS/acre

5. Seed mix to be applied on areas mulched (14-22 inches precip.) – 844 acres:

Big Bluegrass (*Poa ampla*) – Sherman cultivar – 0.25 lbs. PLS/acre

Bluebunch Wheatgrass (*Elymus spicatus*) – Anatone cultivar – 1.5 lbs. PLS/acre

Snake River Wheatgrass (*Elymus waiwaiensis*) – Secar cultivar – 1.5 lbs. PLS/acre

Canby Bluegrass (*Poa canbyi*) – Canbar cultivar – 0.5 lbs. PLS/acre

Sandberg Bluegrass (*Poa sandbergii*) – VNS – 0.25 PLS/acre

Slender Wheatgrass (*Elymus trachycaulus*) – Pryor cultivar – 3 lbs. PLS/acre

Mountain Brome (*Bromus carinatus*) – Bromar or Garnet cultivars – 3 lbs. PLS/acre

Thickspike Wheatgrass (*Elymus lanceolatus*) – Bannock cultivar – 1 lbs. PLS/acre

Crested Wheatgrass (*Agropyron cristatum*) – Hycrest cultivar – 2 lbs. PLS/acre

Crested Wheatgrass (*Agropyron cristatum*) – Fairway cultivar – 2 lbs. PLS/acre

Total = 15 lbs. PLS/acre

I. Purpose of Treatment Specifications:

The purpose of this treatment is to provide soil stabilization and effective ground cover from seeded grass vegetation. Soil loss tolerance has been predicted from 108% to 1400% in the burned area where seeding is proposed. Seeding will help to prevent soil loss and help to minimize down slope effects to lower watersheds that result from soil erosion by providing effective ground cover more rapidly than these ecological systems would provide without treatment. Soil production and hydrologic function is expected to be severely impacted by this soil erosion following this wildfire if no seeding in these proposed treatment areas are done. A broader range of grass species is used in this proposal to maximize germination and establishment on a broader range of microsites (e.g. slope, aspect, and surface types) within the proposed treatment area. On the 14-22 inches precip. (lower elevation) proposed treatment areas, a primary purpose of this treatment is to provide competition for invasive cheatgrass. Successfully seeded grasses will occupy resources to help reduce cheatgrass that was present in minor amounts on the proposed seeded areas prior to the fire. This cheatgrass is expected to substantially increase following the wildfire if this seed treatment is not done. A broader range of grass species is used in this proposal to maximize germination and establishment on a broader range of microsites (e.g. slope, aspect, and surface types) within the proposed treatment area.

Treatment Effectiveness Monitoring:

Study plots will be set up on different slopes, elevations, and vegetation types to monitor representative areas within this proposed seeding area during the growing season following the treatment. This will help to determine the initial success of this treatment.

ILABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): **Do not include contract personnel costs here (see contractor services below).**	**COST/ITEM**
Contract Preparation and Site Details = (GS-12 @ $40/hr X 120 hrs) = 4800 Contract Preparation and Site Details = (GS-11 @ $32/hr X 200 hrs) = 6400 Implementation Monitoring (Seed Inspection) = (GS-11 @ $32/hr X 120 hrs) = 3840 Implementation Monitoring (Seed Inspection) = (GS-5 @ $15/hr X 120 hrs) = 1800 Implementation Monitoring (Seed Inspection) = (GS-5 @ $15/hr X 120 hrs) = 1800 Implementation Monitoring (Seed Inspection) = (GS-5 @ $15/hr X 120 hrs) = 1800 Overtime for Seed Inspection (80 hrs for each inspector) = 7320 Effectiveness monitoring (GS-11 @ $32/hr X 160 hrs x 1) = 7680	**$ 35,440**
TOTAL PERSONNEL SERVICE COST	**$ 35,440**
EQUIPMENT PURCHASE, LEASE OR RENTAL (Item @ Cost/Hour or Cost/Day X # Hours or # Days X # Fiscal Years = Cost/Item): (Note: Purchase requires written justification that demonstrates cost/item benefits over lease or rental.)	**COST/ITEM**
4 Vehicles x 1500 miles each = 6000 miles x 0.59/per mile = 3540	**$3540**
TOTAL EQUIPMENT PURCHASE, LEASE, OR RENTAL COST	**$3540**

MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X # Fiscal Years = Cost/Item):	**COST/ITEM**
2. Sterile Triticale Hybrid – 20 lbs. PLS/acre = $32/acre x 7043 acres = 225376 Canby Bluegrass (*Poa canbyi*) – Canbar cultivar – $3/acre x 7043 acres = 21129 Slender Wheatgrass (*Elymus trachycaulus*) – San Luis cultivar – $5.25/acre x 7043 acres = 36975 Mountain Brome (*Bromus carinatus*) – Bromar or Garnet cultivars – $10/acre x 7043 acres = 70430 Thickspike Wheatgrass (*Elymus lanceolatus*) – Bannock cultivar – $7/acre x 7043 acres = 49301 **Total = $403,211** **3.** Sterile Triticale Hybrid – $32/acre x 1439 acres = 46048 Big Bluegrass (*Poa ampla*) – Sherman cultivar – $0.75/acre x 1439 acres = 1079 Bluebunch Wheatgrass (*Elymus spicatus*) – Anatone cultivar – $6.75/acre x 1439 acres = 9713 Snake River Wheatgrass (*Elymus waiwaiensis*) – Secar cultivar – $6/acre x 1439 acres = 8634 Canby Bluegrass (*Poa canbyi*) – Canbar cultivar – $1.5/acre x 1439 acres = 2158 Sandberg Bluegrass (*Poa sandbergii*) – VNS - $0.75/acre x 1439 acres= 1079 Slender Wheatgrass (*Elymus trachycaulus*) – Pryor cultivar – $5.25/acre x 1439 acres = 7555 Mountain Brome (*Bromus carinatus*) – Bromar or Garnet – $7.50/acre x 1439 acres = 10792 Thickspike Wheatgrass (*Elymus lanceolatus*) – Bannock cultivar – $3.50/acre x 1439 acres = 5036 Crested Wheatgrass (*Agropyron cristatum*) – Hycrest cultivar – $6/acre x 1439 acres = 8634 Crested Wheatgrass (*Agropyron cristatum*) – Fairway cultivar – $6/acre x 1439 acres = 8634 **Total = $109,362** **4.** Canby Bluegrass (*Poa canbyi*) – Canbar cultivar – $3/acre x 4239 acres = 12717 Slender Wheatgrass (*Elymus trachycaulus*) – San Luis cultivar – $5.25/acre x 4239 acres = 22255 Mountain Brome (*Bromus carinatus*) – Bromar or Garnet cultivars – $10/acre x 4239 acres = 42390 Thickspike Wheatgrass (*Elymus lanceolatus*) – Bannock cultivar – $7/acre x 4239 acres = 29673 **Total = $107,034** **5.** Big Bluegrass (*Poa ampla*) – Sherman cultivar – $0.75/acre x 844 acres = 633 Bluebunch Wheatgrass (*Elymus spicatus*) – Anatone cultivar – $6.75/acre x 844 acres = 5697 Snake River Wheatgrass (*Elymus waiwaiensis*) – Secar cultivar – $6/acre x 844 acres = 5064 Canby Bluegrass (*Poa canbyi*) – Canbar cultivar – $1.5/acre x 844 acres = 1266 Sandberg Bluegrass (*Poa sandbergii*) – VNS - $0.75/acre x 844 acres= 633 Slender Wheatgrass (*Elymus trachycaulus*) – Pryor cultivar – $5.25/acre x 844 acres = 4431 Mountain Brome (*Bromus carinatus*) – Bromar or Garnet cultivars – $7.50/acre x 844 acres = 6330 Thickspike Wheatgrass (*Elymus lanceolatus*) – Bannock cultivar – $3.50/acre x 844 acres = 2954 Crested Wheatgrass (*Agropyron cristatum*) – Hycrest cultivar – $6/acre x 844 acres = 5064 Crested Wheatgrass (*Agropyron cristatum*) – Fairway cultivar – $6/acre x 844 acres = 5064 **Total = $37136**	**$ 656,743**

TOTAL MATERIALS AND SUPPLY COST	**$ 656,743**
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X # Fiscal Years = Cost/Item):	**COST/ITEM**
Seed Sampling and Testing (Per Diem/Travel Expense for Two FS Employees) = 1000 Vehicle Mileage for Sampling (2000 miles X0.59/mile) = 1180 Seed Testing Costs = 2500	**$4680**
TOTAL TRAVEL COST	**$4680**
CONTRACT COST (Labor or Equipment @ Cost/Hour X # Hours X # Fiscal Years = Cost/Item):	**COST/ITEM**
Aerial application of seed by fixed wing aircraft or helicopter= $35/acre x 13565 acres	**$ 474,775**
TOTAL CONTRACT COST	**$ 474,775**

SPECIFICATION COST SUMMARY

FISCAL YEAR	UNIT	UNIT COST	# OF UNITS	COST	FUNDING SOURCE	METHOD
FY 1	acre	$ 86.60	13565	$ 1,174,729	EFR	C
TOTAL				**$ 1,174,729**		

FUNDING SOURCES:
F = Fire Suppression Account
EFR=Emergency Fire Rehabilitation
OP/O =Agency Operating Fund
EWP = Emergency Watershed Program

SPECIFICATION TYPE
ES = Emergency Stabilization
R = Rehabilitation
FS = Fire Suppression

METHODS FOR COMPLETION
P=Agency Personnel Services
C=Contract
EFC= Emergency Fire Contract
FC=Crew Labor Assigned to Fire

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	P, M, C
3. Estimate supported by cost guides from independent sources or other federal agencies.	
4. Estimates based upon government wage rates and material cost.	
5. No cost estimate required – cost charged to Fire Suppression Account.	

P = Personnel Services **M** = Materials/Supplies **T** = Travel **C** = Contract **F** = Suppression

II. RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

III.

List Relevant Documentation and Cross-References Within ESR Plan:

SEE ATTACHED MAP FOR TREATMENT AREA.

IV. TOTAL COST BY JURISDICTION

JURISDICTION	UNITS TREATED	COST
USFS	13,565 acres	$ 1,174,729
TOTAL COST		**$ 1,174,729**

BURNED-AREA / EMERGENCY STABLIZATION PLAN # 4 – NOXIOUS WEED (ED / RR)

PART F - SPECIFICATION

SPECIFICATION TITLE:	**Noxious Weed Monitoring and Spot Treatment Early Detection / Rapid Response to the expansion of noxious weed occurrences**	**JURISDICTIONS:**	**USFS**
FISCAL YEAR:	**2011**	**BEAVER RD**	**FISHLAKE**

WORK TO BE DONE

Number and Describe Each Task:

K. General Description:

Monitor and spot treat the expansion of noxious weeds from any known occurrences. Also detect and treat any new occurrences. This is an early detection / rapid response treatment.

L. Location (Suitable) Sites:

Actions to occur on the specified routes, priority segments of the fire perimeter, drop points, helispots, heliwells, spike camps, and dozer line (see attached map).

M. Design/Construction Specifications:

District weed crew will supply the personnel and vehicles needed, as well as most spray equipment, ATV's, and PPE. This treatment does provide for the District to acquire a horse pack sprayer. The crew will monitor and treat the areas for one week each in May, late June and early August.

N. Purpose of Treatment Specifications:

The purpose of this action is to monitor, detect, and spot treat any expansion of noxious weed species within the fire perimeter or in areas designated on treatment map of specific areas adjacent to the burned area that may be affected because of fire suppression activities.

O. Treatment Effectiveness Monitoring:

Expansion from existing occurrences and any new locations of noxious weeds detected will be documented by photo and GPS.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES (Grade @ Cost/Hours X # Hours X # Fiscal Years = Cost/Item): **Do not include contract personnel costs here (see contractor services below).**	**COST/ITEM**
Noxious Weed Monitoring and Spot Treatment = 1 (GS-11 @ $36/hr X 120 hrs) = $4320 Noxious Weed Monitoring and Spot Treatment = 3 (GS-5 @ $16/hr X 120 hrs) = $5760	**$ 10,080**
TOTAL PERSONNEL SERVICE COST	**$ 10,080**
EQUIPMENT PURCHASE, LEASE OR RENTAL (Item @ Cost/Hour or Cost/Day X # Hours or # Days X # Fiscal Years = Cost/Item): (Note: Purchase requires written justification that demonstrates cost/item benefits over lease or rental.)	**COST/ITEM**
One horse pack spray unit.	**$ 1,500**
TOTAL EQUIPMENT PURCHASE, LEASE, OR RENTAL COST	**$ 1,500**
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X # Fiscal Years = Cost/Item):	**COST/ITEM**
Supplies needed to complete the spot treatment. (PPE and supplemental chemical as needed.)	**$ 500**
TOTAL MATERIALS AND SUPPLY COST	**$ 500**

TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X # Fiscal Years = Cost/Item):	**COST/ITEM**
TOTAL TRAVEL COST	**N/A**
CONTRACT COST (Labor or Equipment @ Cost/Hour X # Hours X # Fiscal Years = Cost/Item):	**COST/ITEM**
TOTAL CONTRACT COST	**$ 12,080**

SPECIFICATION COST SUMMARY

FISCAL YEAR	UNIT	UNIT COST	# OF UNITS	COST	FUNDING SOURCE	METHOD
FY 1	acre	$ 12.08	1,000	$ 12,080	EFR	P
TOTAL				**$ 12,080**		

FUNDING SOURCES:
F = Fire Suppression Account
EFR=Emergency Fire Rehabilitation
OP/O =Agency Operating Fund
EWP = Emergency Watershed Program

SPECIFICATION TYPE
ES = Emergency Stabilization
R = Rehabilitation
FS = Fire Suppression

METHODS FOR COMPLETION
P=Agency Personnel Services
C=Contract
EFC= Emergency Fire Contract
FC=Crew Labor Assigned to Fire

SOURCE OF COST ESTIMATE

1. Estimate obtained from 2-3 independent contractual sources.	
2. Documented cost figures from similar project work obtained from local agency sources.	P, M
3. Estimate supported by cost guides from independent sources or other federal agencies.	
4. Estimates based upon government wage rates and material cost.	P
5. No cost estimate required – cost charged to Fire Suppression Account.	

P = Personnel Services **M** = Materials/Supplies **T** = Travel **C** = Contract **F** = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

List Relevant Documentation and Cross-References Within ESR Plan:

SEE ATTACHED MAP FOR TREATMENT AREA.

JURISDICTION	UNITS TREATED	COST
USFS Fishlake NF, Beaver RD	1,000 acres	$ 12,080
TOTAL COST		**$ 12,080**

Part VI – Emergency Stabilization Treatments and Source of Funds Initial Request

			NFS Lands				Other Lands			All
		Unit	# of		Other	# of	Fed	# of	Non Fed	Total
Line Items	Units	Cost	Units	BAER $	$	units	$	Units	$	$
A. Land Treatments										
Aerial Mulching	Acres	$832	5084	$4,229,888	$0		$0		$0	$4,229,888
Straw Watles-Mandersfield Res \	Lin/Ft	$3	2000	$6,000	$0		$0		$0	$6,000
Implementation Crew for straw w	Each	$5,000	3	$15,000	$0		$0		$0	$15,000
Seeding-Sterile Hybrid only	Acres	$112	1234	$138,270	$0		$0		$0	$138,270
Seeding-Mod to High burn severi	Acres	$87	13565	$1,174,729	$0		$0		$0	$1,174,729
Weed Detection Rapid Response	Days	$805	15	$12,080						$12,080
Initial Approval Request Sterile Triticale / Other seeding				-$375,000						-$375,000
Subtotal Land Treatments				$5,200,967	$0		$0		$0	$5,200,967
B. Channel Treatments										
Grade Structures - N Fk N Ck/Sh	Each	$3,000	12	$36,000	$0		$0	0	$0	$36,000
Grade Structures - N.Fk N.Ck Fis	Each	$0	0	$0	$0		$0	18	$54,000	$54,000
Subtotal Channel Treat.				$36,000	$0		$0		$54,000	$90,000
C. Road and Trails										
Trail Treatments	Miles	$2,391	16.4	$39,210	$0		$0		$0	$39,210
Road Treatments - Hardened Cr	Each	$7,432	33	$245,250	$0		$0		$0	$245,250
Road Treatments - clean cattle g	Each	$409	16	$6,545	$0		$0		$0	$6,545
Trailhead Hazard Tree Removal	Each	$978	8	$7,826	$0		$0		$0	$7,826
Road Treatments-Culvert cleanir	Each	$1,643	21	$34,500	$0		$0		$0	$34,500
Road Reconditioning-Grader wor	Miles	$2,750	14	$38,500	$0		$0		$0	$38,500
Road Reconditioning-Dozer	Days	$990	39.5	$39,105	$0		$0		$0	$39,105
Road Treatments-Import Roadmi	Cu.Yds	$75	1250	$93,750	$0		$0		$0	$93,750
Road Treatments-Install Gravel	Tons	$30	4300	$129,000	$0		$0		$0	$129,000
Road Treatment Sediment Basin	Each	$2,000	10	$20,000	$0		$0		$0	$20,000
Road Treatment-Ditch Constructi	Days	$1,485	6.5	$9,653	$0		$0		$0	$9,653
Road Treatment-Hardened Cross	Each	$30,000	5	$150,000						$150,000
Initail Request Approval				-$100,000						-$100,000
Subtotal Road & Trails				$713,339	$0		$0		$0	$713,339
D. Protection/Safety										
Road Hazard Signs	Each	$625	26	$16,250	$0		$0		$0	$16,250
Trail Hazard Signs	Each	$450	13	$5,850	$0		$0		$0	$5,850
Mine Adit Closure	Each	$2,043	3	$6,128	$0		$0		$0	$6,128
Road Gate Large	Each	$4,400	6	$26,400	$0		$0		$0	$26,400
Road Gate Small	Each	$2,750	2	$5,500	$0		$0		$0	$5,500
Road Gate - Replace	Each	$5,225	1	$5,225	$0		$0		$0	$5,225
Initail Request Approval 10k signs / 15k gates				-$25,000						-$25,000
Subtotal Structures				$40,353	$0		$0		$0	$40,353
E. BAER Evaluation										
Assessment Team	Report		1	$112,500	$0		$0		$0	$112,500
BAER Team Supplies	Each	$1,500	1	$1,500	$0		$0		$0	$1,500
Helicopter FT BAER Recon	Days	$7,500	2	$15,000	$0		$0		$0	$15,000
BAER Report Printing	Each	$2,500	1	$2,500	$0		$0		$0	$2,500
Subtotal Evaluation				$131,500	$0		$0		$0	$131,500
F. Monitoring										
Effectiveness Monitoring	Days	$375	15	$5,625	$0		$0		$0	$5,625
Effectiveness Monitoring-Helo FT	Hours	$1,000	6	$6,000	$0		$0		$0	$6,000
Document Preparation	Days	$375	10	$3,750	$0		$0		$0	$3,750
Storm Patrol	Days	$200	7	$1,400			$0		$0	$1,400
Subtotal Monitoring				$16,775	$0		$0		$0	$16,775
G. Totals				$6,138,934	$0		$0		$54,000	$6,192,934
Previously approved										
Total for this request				$6,138,934						

PART VII - APPROVALS

1. _____ _____ October 18, 2010
Forest Supervisor (signature) **Date**

2. _____ _____ 2010
Regional Forester (signature) **Date**

Soil Resource Summary

Introduction

All of the soils located within the perimeter of the Twitchell Canyon Wildfire were formed in alluvium, colluvium or residuum derived from mixed igneous rocks – meaning, most of the soil material observed along the structural benches, on the upland foothills, steep mountainsides and very steep canyon areas consists of sandy to loamy, sediments and gravitational debris which has been weathered from ancient volcanic deposits. In most locations, the soil pH was considered to be slightly acid to neutral …or, in the range of 6.1 to 7.3. The topsoil on the mountain toeslopes is about 4 to 7 inches thick under the Gambel oak, 1 to 4 inches thick in the PJ / mountain big sagebrush areas and < 1 inch in thickness under the curlleaf mountain-mahogany. Most of the mixed conifer and spruce – fir locations had 7 to 10 inches of topsoil located under a mat of slightly decomposed organic duff ... while the high elevation aspen sites had 10 to 16 inches of topsoil. Elevations within the burned - area ranged from about 6,400 to 11,280 feet. Soils occur in the frigid and cryic temperature regimes. Mean annual precipitation in this part of the Beaver Ranger District is about 16 to 36 inches / year. Soils occur in both the ustic and udic moisture regimes. The freeze-free period is about 40 to 90 days / year. The most common types of USDA - NRCS / Ecological Sites occurring within this fire were as follows:

1) Upland Loam / Mountain Big Sagebrush

2) Upland Gravelly Loam / PJ

3) Upland Stony Loam / PJ

4) Upland Shallow Loam / PJ

5) Mountain Loam / Oak

6) Mountain Gravelly Loam / Oak

7) Mountain Shallow Loam / Curlleaf Mountain – Mahogany

8) High Mountain Loam / Aspen

9) High Mountain Stony Loam / Spruce – Fir

10) Subalpine Stony Loam / Subalpine fir – Engelmann spruce

The following types of soil were mapped, sampled and described in the Tushar Mountains during 1989 – and, were later found to be occurring inside our burned - area:

(Subgroup Level of Soil Taxonomy, 2003)

Pachic Argicryolls / Stable Aspen	Mollic Haplocryalfs / Seral Aspen
Inceptic Haplocryalfs / Mixed Conifers	Alfic Argicryolls / Seral Aspen
Lithic Haplocryalfs / Spruce – Fir	Typic Haplocryalfs / Spruce - Fir
Typic Argiustolls / QUGA	Typic Argiustolls / QUGA
Aridic Haplustolls / ARTR-V	Typic Haplustolls / QUGA
Lithic Haplustolls / CELE	Aridic Argiustolls / PJ
Calcic Argiustolls / ARTR – V	Lithic Argiustolls / CELE

Dominant Vegetative Communities Growing on these Soil Types

Spruce – Fir … Engelmann spruce and subalpine fir with few grasses

Stable Aspen … young, mature and over-mature aspen trees and perennial grasses

Seral Aspen … a mix of aspen with Engelmann Spruce and subalpine fir

Mixed Conifers … white fir, Douglas fir, subalpine fir and scattered aspen

QUGA … Gambel oak with Rocky Mountain Juniper and scattered conifers

CELE … curlleaf mountain – mahogany and perennial grasses

ARTR-V … mountain big sagebrush and perennial grasses

PJ … pinyon – juniper with perennial and annual grasses

Fragile or non-renewable type soils that are situated on steep mountainsides and very steep canyon areas have a maximum erosion tolerance of about 1 to 2 tons / acre / year. If accelerated rates of erosion surpass this stated threshold, it's not too long before the site is adversely affected and long-term soil productivity becomes a serious issue. However, when soil resources are found on deeper sites having nearly level to strongly sloping terrain (0 to 15 % slopes) … they demonstrate a better tolerance for erosion losses … in the range of 3 to 5 tons / acre / year. What we need to understand is … all of these fire-damaged soils can be stabilized, rehabilitated and restored to a normal type of hydrologic function once again.

Observations

What did we observe on this incident of wildfire? Well … it has two dramatically different landscapes currently thought to be " at - risk " to serious resource damage as a direct result of the recent burn. About 15 % of the burn took place on a gently sloping to moderately steep (3 to 25 % slopes) structural benches and upland foothills. In this particular instance, much of the ground was disturbed by a moderate severity burn – and, the unprotected soil surface is very susceptible to the establishment of noxious weeds along with the invasion of cheatgrass.

In contrast, the remaining 85 % of the fire was located along steep to very steep mountainsides (25 to 80 % slopes) with deep canyons. This part of the fire was affected by moderate and high severity burns. Hydrophobic or water – repellent ground conditions are likely to persist for a period of 3 to 5 years – depending upon the intensity and residence time of the burn. Nearly all of the soils in this area are strongly hydrophobic – meaning, it takes longer that 40 seconds for water to infiltrate into the ground at a depth of 0 to 5 inches. The protective duff layer was completely consumed at these high mountain locations – meaning, a large transfer of heat went into the top 6 inches of the ground as a direct result of this wildfire. **Most of the mountains and canyon areas should be considered to be highly erodible landscapes and subject to extreme flooding hazards with the potential for debris flows.** Since the ground is quite sandy in texture … the soils are easily detached and transported when the vegetative cover, surface litter and duff are missing as a direct result of a wildfire. A few of the perennial grasses growing on the mountainside have been killed-off by the extreme heat of the fire; these plants will NOT re-sprout later this year when the site receives additional moisture.

Potential Values at Risk

Loss of topsoil and issues related to long-term / soil productivity and hydrologic function were examined as a potential value-at-risk. Three parameters were analyzed.

1) soil hydrophobicity
2) effective ground cover
3) exceedence of soil tolerance erosion values

Resource Condition Assessment

A. Resource Setting – The soils are typically 10 to 60 inches deep to bedrock with dominantly loam surface textures with 10 to 45 percent gravel and cobble formed from volcanic tuff, rhyolite, latite, andesite and basalt rocks.

Soil Symbols and Hydrologic Groups	Dominant Vegetation	Unburned / Low	Moderate	High	Totals
108 / B	Stable Aspen	508	461	913	1882
109 / B	Mountain Brush	15	27	36	78
110 / C	Perennial Grasses	45	3	0	48
112 / B	Mountain Brush	1065	1564	2067	4696
122 / D	Mountain Brush	459	521	251	1231
124 / B	Mountain Brush	57	60	6	123
125 / C	NA	628	131	21	780
127 / B	Riparian	0	13	0	13
130 / B	Seral Aspen	581	707	878	2166
131 / B	Seral Aspen	1270	509	2107	3886
132 / C	Spruce / Fir	154	189	363	706
136 / D	PJ	333	861	411	1605
137 / B	Mixed Conifer	36	497	74	607
141 / B	PJ	36	23	0	59
146 / B	Mountain Brush	29	100	441	570
147 / B	Upland Brush	223	37	4	264
148 / C	Mountain Brush	983	669	561	2213
153 / B	Upland Brush	464	484	233	1181
159 / D	PJ	19	100	0	119
165 / C	Seral Aspen	160	33	255	448
166 / C	Seral Aspen	81	227	460	768
173 / D	PJ	2	0	0	2
175 / B	Riparian	244	104	8	356
176 / D	PJ	202	764	0	966
194 / D	PJ	47	0	0	47
195 / D	Spruce / Fir	539	533	258	1330
198 / B	Spruce / Fir	81	101	0	182
199 / B	Spruce / Fir	5200	3946	3559	12705
207 / B	Mountain Brush	406	557	442	1405
208 / B	Mountain Brush	510	1195	1365	3070
209 / A	Spruce / Fir	632	634	76	1342
W	Water	0	0	0	24
	Totals	15027	15206	14641	44874

Table 1 – Soil Symbols within the Twitchell Canyon Wildfire taken from the Fishlake National Forest / Tushar- Pahvant - Canyon / Soil Survey Area

B. Findings of the on-the-ground survey and soil erosion modeling

1. Resource conditions resulting from the fire and consequences of the fire on values at risk

Soil Hydrophobicity

The soils were examined for hydrophobicity (water-repellency) and burn severity at several sites and then correlated to the burn severity map.

- ➔ **Unburned / Low Burn Severity** – This fire had 33 % by unburned / low burn severity that had no / low hydrophobicity (less than 10 second water infiltration).

- ➔ **Moderate Burn Severity** - This fire had 34 % moderate burn severity that had no / low hydrophobicity (less than 10 second water infiltration). These sites contained areas with burned duff layers containing recognizable fragments of needles and other litter. Trees and shrubs are charred, with shrub leaves and conifer needles remaining on about 25 % of the remaining vegetation.

- ➔ **High Burn Severity** - This fire had 33 % high burn severity that had moderate to high hydrophobicity (10 to more than 40 second water infiltration). The soil organic matter was consumed, along with deeply charred trees / shrubs. Approximately 75 % of the coarse woody debris has been consumed completely by the fire and the remaining is deeply charred. A thick layer of light or white ash, containing almost no recognizable fragments of litter remains on the surface.

Effective Ground Cover

The high severity burn areas in the mixed conifer had approximately 55 % bare ground and the mountain brush areas about 60 %.

Exceedence of Soil Tolerance Erosion Values

The ERMIT (Erosion Risk Management Tool) Model was used to estimate potential post-fire erosion. Conditions for the dominant soil types with moderate / high severity burn effects (108, 109, 110, 112, 122, 124, 127, 130, 131, 132, 136, 137, 141, 146, 147, 148, 153, 159, 165, 166, 173, 175, 176, 194, 195, 198, 199, 207, 208 and 209) within the burned area were modeled. A slope length of 400 to 500 feet was used for medium to long slopes, 350 feet for medium slopes and 300 feet for short slope lengths. A modified climate was patterned for typical distribution in this area with approximately 27 inches for the spruce / fir, seral aspen and stable aspen areas located higher in the watershed and 15 to 18 inches of annual precipitation in the Chaparral / PJ areas. The Chaparral areas had about 70 % shrub / 20 % Grass / 10 % bare ground pre-existing condition.

Soil Type	Soil Texture	Rock Content	Vegetation Type	Hillslope Gradient Top %	Hillslope Gradient Middle %	Hillslope Gradient Tow %	Hillslope Horizontal Length	Soil Burn Severity Class	Untreated 1st Year Event Sediment Delivery (tons/acre)	Untreated 2nd Year Event Sediment Delivery (tons/acre)	Untreated 3rd Year Event Sediment Delivery (tons/acre)	Soil Loss Tolerance (tons / acre / year)	Seeding 1st Year Event Sediment Delivery (tons/acre)	Seeding 2nd Year Event Sediment Delivery (tons/acre)	Seeding 3rd Year Event Sediment Delivery (tons/acre)	Mulch (1 ton/acre) 1st Year Event Sediment Delivery (tons/acre)	Mulch (1 ton/acre) 2nd Year Event Sediment Delivery (tons/acre)	Mulch (1 ton/acre) 3rd Year Event Sediment Delivery (tons/acre)
108	GRV-L	35	Forest	15	70	15	400	H	9.89	6.2	2.08	4	9.89	3.17	1.66	2.46	2.28	2.08
109	CBV-L	35	Chaparral	15	70	15	400	H	15.71	10.38	5.63	2	15.71	6.83	4.82	4.9	5.46	5.63
110	GRV-L	50	Range	30	80	30	300	M	10.43	5.66	2.15	4	10.43	3.34	1.84	1.2	2.01	2.15

Soil Type	Soil Texture	Rock Content	Vegetation Type	Hillslope Gradient Top %	Hillslope Gradient Middle %	Hillslope Gradient Tow %	Hillslope Horizontal Length	Soil Burn Severity Class	Untreated 1st Year Event Sediment Delivery (tons/acre)	Untreated 2nd Year Event Sediment Delivery (tons/acre)	Untreated 3rd Year Event Sediment Delivery (tons/acre)	Soil Loss Tolerance (tons / acre / year)	Seeding 1st Year Event Sediment Delivery (tons/acre)	Seeding 2nd Year Event Sediment Delivery (tons/acre)	Seeding 3rd Year Event Sediment Delivery (tons/acre)	Mulch (1 ton/acre) 1st Year Event Sediment Delivery (tons/acre)	Mulch (1 ton/acre) 2nd Year Event Sediment Delivery (tons/acre)	Mulch (1 ton/acre) 3rd Year Event Sediment Delivery (tons/acre)
112	GRV-L	35	Chaparral	15	70	15	400	H	12.47	8.19	2.82	4	12.47	2.82	0.62	0	0.94	2.82
122	CBX-L	50	Chaparral	15	70	15	400	M	13.93	8.26	3.83	1	13.93	5.46	2.29	2.15	3.03	3.83
124	GR-L	35	Chaparral	15	70	15	400	M	11.14	6.15	2.47	2	11.14	4.32	2.36	3.58	3.58	2.47
125	-		NA															
127	CL	15	Range	5	15	5	500	M	3.14	1.75	0.84	3	3.14	1.11	0.47	0.74	0.87	0.84
130	STV-SIL	50	Forest	15	70	15	400	H	8.14	2.94	0.29	5	8.14	0.81	0.01	0.3	0.76	0.29
131	STV-SIL	35	Forest	10	40	10	450	H	6.43	2.85	2.04	5	6.43	2.28	1.53	1.96	1.97	2.04
132	STV-SIL	50	Forest	30	80	30	300	H	8.64	4.71	0.69	5	8.64	1.2	0.46	0.37	1.02	0.69
136	GRV-L	50	Chaparral	15	70	15	400	M	14	8.18	3.57	1	14	4.88	2.26	2.41	3.1	3.57
137	CBV-L	35	Forest	10	40	10	450	M	5.4	4.06	0.75	5	5.4	1.68	0.6	1.24	1.35	0.75
141	L	15	Chaparral	5	15	5	500	M	3.15	2.21	1.03	2	3.15	1.49	0.85	1.04	1.1	1.03
146	GRV-L	50	Chaparral	15	70	15	400	H	16.37	10.97	5.26	2	16.37	6.22	3.48	3.23	3.69	5.26
147	GRV-L	50	Chaparral	15	70	15	400	M	13.66	7.88	2.58	2	13.66	4.37	1.65	2.3	2.64	2.58
148	GRV-L	50	Chaparral	30	80	30	300	M	12.28	6.47	20.3	2	12.28	3.82	1.44	1.84	2.07	2.03
153	GRV-L	15	Chaparral	5	15	5	500	M	2.95	1.93	0.9	3	2.95	1.19	0.39	0.06	0.68	0.9
159	CBV-L	50	Chaparral	15	70	15	350	M	13.57	8.45	4.12	1	13.57	5.59	3.21	2.77	3.78	4.12
165	CB-CL	15	Forest	5	15	5	500	H	1.42	0.51	0.2	1	1.42	0.21	0.08	0.07	0.1	0.2
166	CB-CL	15	Forest	5	15	5	500	H	1.42	0.51	0.2	1	1.42	0.21	0.08	0.07	0.1	0.2
173	GRV-SL	35	Chaparral	15	70	15	400	L	4.16	1.21	0.1	1	4.16	0.1	0.08	0.06	0.08	0.1
175	L	15	Range	5	15	5	500	M	5.02	2.71	1.24	5	5.02	1.59	1.12	1.52	1.37	1.24
176	CBV-CL	35	Chaparral	5	15	5	500	M	5.77	3.12	1	2	5.77	1.46	0.78	1.14	1.15	1
194	GRV-SL	50	Chaparral	30	80	30	300	L	6.03	2.78	0.83	1	6.03	0.83	0.5	0.34	0.5	0.83
195	CBX-L	50	Forest	15	70	15	400	M	5.19	2.55	0.34	2	5.19	1.13	0.13	0.05	0.21	0.34
198	GRV-L	35	Forest	10	40	10	450	M	5.4	4.06	0.75	5	5.4	1.68	0.6	1.24	1.35	0.75
199	GRV-L	50	Forest	30	80	30	300	M	6.75	3.65	1.44	2	6.75	2.56	1.4	1.44	1.49	1.44
207	STV-L	35	Chaparral	10	40	10	450	M	9.74	5.85	2.68	3	9.74	3.59	2.07	2.92	2.87	2.68
208	GR-SICL	35	Chaparral	10	40	10	450	H	8.75	4.33	1.31	3	8.75	1.57	0.78	0.45	0.57	1.31
209	CBX-SL	50	Forest	15	70	15	500	M	6.22	2.43	0.72	3	6.22	1.41	0.52	0.7	0.86	0.72
W			Water															

Table 2 – ERMiT data from the Twitchell Canyon Wildfire.

Emergency Determination

The following soils have an emergency for excessive erosion and loss of long-term soil productivity for the soil resource. Rill erosion has already begun in Line Canyon with rain events early in September (estimated at 1.40 inches).

Soil Types	Burn Severities	Percentage Increase Over Soil Loss Tolerance	Excessive Erosion Tons / Acre Over Soil Loss Tolerance	Acres	Priority for Hillslope Treatments (For Long Term Soil Productivity Protection)
199	H	337 %	4.75	12705	1
112	H	311 %	8.47	4696	2
148	M	614 %	10.28	2213	3
136	M	1400 %	13	1605	4
208	H	292 %	5.75	3070	5
122	M	1393 %	12.93	1231	6
130	H	162 %	3.14	2166	7
108	H	247 %	5.89	1882	8
207	M	325 %	6.74	1405	9
146	H	818 %	14.37	570	10
131	H	128 %	1.43	3886	11
176	M	288 %	4.77	966	12
209	M	207 %	3.22	1342	13
195	M	260 %	3.19	1330	14
147	M	683 %	11.66	264	15
132	H	172 %	3.64	706	16
159	M	1357 %	12.57	119	17
124	M	557 %	9.14	123	18
109	H	785 %	13.71	78	19
110	M	260 %	6.43	48	20
137	M	108 %	0.4	607	21
194	L	603 %	5.03	47	22
166	H	142 %	0.42	768	23
198	M	108 %	0.4	182	24
141	M	315 %	1.15	59	25
165	H	142 %	0.42	448	26
173	L	416 %	3.16	2	27
127	M	104 %	0.14	13	28
125	-	-	-	780	29
153	M	0 %	-	1181	30
175	M	0 %	-	356	31
W	-	-	-	24	32

Table 3 – Erosion Modeling for Twitchell Canyon Wildfire.

Treatments to Mitigate the Emergency

- ➔ Ag (Wheat Straw) Mulch Treatments to protect the soil surface.
- ➔ Seeding to increase ground cover from 9 months - 3 years following the fire.

Discussion / Summary / Recommendations

Approximately 29,847 acres of moderate and high severity burned soils were modeled to exceed the soil tolerance in the first year following the fire. The threat and / or value at risk associated the loss of long-term soil productivity with these soil types for emergency treatment is recommended with initial evaluation. Two courses of actions could be taken on these slopes to protect them if necessary.

- ➔ Mulching – This treatment would immediately provide benefit to the high severity burn sites with the additional protection the soil surface. Costs for this treatment would be approximately $832 an acre for the treatment of the high severity burn areas that are suitable (with slope considerations) and could be effectively treated.

- ➔ Seeding – This treatment would not benefit the moderate and high severity burn sites within the first six to nine months, as the grass seed would take some time to establish and protect the soil surface. Costs for this treatment would be approximately $ 80 to 120 an acre for the treatment of the moderate and high severity burn areas that are expected to exceed soil tolerance erosion thresholds.

Soil loss and the downslope effects of subsequent erosion have a secondary effect on human life and safety from accelerated rates of erosion affected from severely burned soils that modify hydrologic function resulting in uncontrolled flows of water and a genuine loss of long-term soil productivity which affects ecosystem function and integrity.

Essentially, there are four factors that influence soil stability. These factors include climate (usually reflected by vegetation type), inherent character of the soil (soil erodibility), topography (slope gradient and lay of the land), and retardants (such as vegetation, coarse woody debris and other effective ground cover). We have little or no management influence over climate, character of the soil, or topography. We can however, influence the nature and type of vegetation we have and subsequently, effective ground cover. Much of the burned area has slopes of greater than 25 %. This means that these areas are at high risk for soil movement with climatic events. In much of the burned area, especially on the steep slopes, the Twitchell Canyon Wildfire burned at moderate to high severity, reducing the vegetation and effective ground cover to very low levels. The lack of vegetation and effective ground cover poses a serious threat those values at risk as described directly above.

References

Fire severity ratings were derived from **Fire's Effects on Ecosystems** (DeBano, et.al., 1998). These ratings were evaluated in the field with the burn severity map.

Low severity burns leave soil color and structure unchanged. Vegetation can be consumed or charred, but surface organic matter is intact. There is a small amount of ash on the surface (DeBano, et.al., 1998). Many root crowns of grasses and shrubs survive the fire and sprout within a few weeks (Parsons, 2002). There is often unburned vegetation within the burned area.

Moderate severity burns can leave the top ½ inch of mineral soil charred but structure is not altered (DeBano, et.al., 1998). Weak or moderate water repellent conditions can exist in the soil surface. Duff layers contain recognizable fragments of needles, leaves and other litter. Light colored ash occurs on the surface. Vegetation is deeply charred, but some needles or leaves can remain on trees (Parsons, 2002). Large logs are not consumed but are charred. Small woody debris is generally consumed (DeBano, et.al., 1998).

High severity burns leave the soil surface orange or red and can char the top 4 inches of the mineral soil (DeBano, et.al., 1998). Soil organic matter is consumed, destroying structure (Parsons, 2002). Vegetation and woody debris are largely consumed. A thick layer of light or white ash, containing almost no recognizable fragments of litter remains on the surface. Moderate or strong water repellent conditions can exist in the top 6 or more inches of the soil (DeBano, et.al., 1998).

GIS Maps and Interpretive Displays

The Initial / BAER Report for this wildfire contains several GIS maps that were made by combining soil resource information taken from the Tushar – Pahvant – Canyon / Soil Survey with USDA – NRCS / land management interpretations.

Soil Suitability Ratings for Broadcast Seeding in Disturbed Areas

(Please refer to the GIS map identified as … Potential for Broadcast Seeding for a display of the Rating Zones)

- **GOOD …** This interpretive rating indicates that a wide selection of plants may be successfully seeded in 7 or more years out of 10.
- **FAIR …** Fewer plants are adapted to these wildland sites and these particular soil resources can be successfully seeded in 5 to 7 years out of 10 in order to control accelerated rates of erosion.
- **POOR …** Only the most drought tolerant plants can be successfully seeded on these locations due to their limited water retention properties caused by rock fragments occurring at the ground surface, limited rooting depths or low amounts of annual precipitation; seeding within these disturbed areas will be successful in about 4 to 5 years out of 10.
- **VERY POOR …** These soils are generally not suited for seeding activities; however, seeding can be considered under emergency circumstances following incidents of wildfire or after mass movements such as slumps and landslides in order to control erosion and maintain long-term soil productivity. Seeding success will only be achieved in about 3 years out of 10 on these fragile sites.

Topsoil Horizons

(Please refer to the GIS map identified as … Topsoil Thickness for a display of the Different Soil Properties)

Topsoil is defined as a dark colored mineral horizon that has been enriched with plant nutrients due to the decomposition of humified organic matter. It is located at or near the surface of the ground. Commonly, it consists of either granular or subangular blocky type structure; it is usually not massive and hard when dry. It is the most fertile part of the soil profile. It supports large populations of soil microbes – which are necessary for the process of nutrient cycling.

The numbers shown on this GIS display represent the average topsoil thickness for each map symbol occurring within the Tushar-Pahvant-Canyon / Soil Survey Area.

Soil Loss Tolerance

(Please refer to the GIS map identified as … T – Factors for a display of the Different Soil Qualities)

Soil loss tolerance is commonly expressed by using what's known as the T Factor; this factor is shown in units of tons/acre/year. It is used in calculations for both the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE). It is defined as the maximum rate of annual erosion that (still) permits long-term soil productivity to be sustained over indefinite periods of time. Simply stated … soil formation occurs at a rate either equal to, or greater than, the annual losses associated with soil erosion. The T Factors are integer values set-up in the range of 1 to 5 tons/acre/year. A T Factor of 1 ton/acre/year would be for a shallow / non-renewable type of site. In this instance, the term shallow indicates < 20 inches of soil material occurs over bedrock or an impermeable layer found in the ground.

A T Factor of 5 tons/acre/year would be assigned to a very deep and renewable type of soil – sites having > 60 inches of soil material before encountering a restrictive layer. The label " renewable soils " means a site has favorable surface horizons, subsoil or substratum layers that can be improved by tillage, fertilizer applications, additions of organic matter or enhanced resource management. Initially, this concept was established to monitor the productivity of our agricultural lands. The Forest Service uses the concept of T Factors in order to identify fragile areas of non-renewable type soils – shallow sites that should be avoided … or, will require special mitigation measures in order to maintain long-term productivity and hydrologic function following a wildfire or the implementation of a land management treatment. Landscapes having a T Factor of 4 or 5 tons/acre/year identify areas " better suited " for continued management actions such as prescribed fire, timber harvesting, outdoor recreation activities, livestock grazing, sagebrush manipulation etc.

Available Water Capacity

(Please refer to the GIS map identified as … Available Water Capacity for a display of the Different Soil Types)

The water retention properties of a soil are primarily a function of its texture and organic matter content. Soil profiles made up of smaller sized mineral separates, such as silt and clay, have a large surface area within their pore network - which allows them to hold more water for plant growth. In other words, soils with a high percentage of fines have a higher water retention capacity when compared with coarse textured sites. The AWC Table located at the right illustrates the differences in water retention as influenced by soil texture. The organic matter content also influences a soils water holding capacity. As the amount of humified OM increases within the topsoil, the water holding capacity increases correspondingly because of the strong affinity the organic matter has for water.

Available Water Capacity by Soil Texture	
Textural Classes	**AWC Numbers (Inches Water / Foot of Soil)**
Coarse Sand	0.25 – 0.75
Fine Sand	0.75 – 1.00
Loamy Sand	1.10 – 1.20
Sandy Loam	1.25 – 1.40
Fine Sandy Loam	1.50 – 2.00
Silt Loam	2.00 – 2.50
Silty Clay Loam	1.80 – 2.00
Silty Clay	1.50 – 1.70
Clay	1.20 – 1.50

- **VERY LOW** … indicates the soil profile only retains about a ¼ inch to 3 inches of plant available water. These sites behave quite droughty due to 1) very shallow and shallow rooting depths, 2) the absence of organic matter, 3) sandy textures, 4) high bulk density measurements – meaning, limited amounts of pore space, 5) a large percentage of rock fragments occur within the ground or 6) the site has a large quantity of clay or soluble salts – which makes the water behave unavailable for plant growth.

- **LOW** … indicates the soil profile retains 3 to 6 inches of plant available water. These sites have a limited amount of water for the existing vegetative communities – especially, in Xeric Moisture Regime areas. These locations are commonly recharged with precipitation – but, the ground does not retain the moisture for long periods of time. Drought tolerant plants should be selected if disturbed areas are to be re-seeded in order to prevent accelerated erosion losses.

- **MODERATE** … indicates the soil profile retains about 6 to 9 inches of plant available water. Most of these locations have an adequate amount of moisture in order to sustain plant growth.

- **HIGH** … indicates the soil profile retains 9 to 12 inches of plant available water. All of these locations are soils with a high content of clay and few, if any, rock fragments. These areas commonly support aspen, silver sagebrush or tall forb plant communities.

- **VERY HIGH** … indicates the soil profile retains > 12 inches of plant available water. These soils have a significant amount of peat, mucky peat or muck occurring within the soil profile. Many sites are actually saturated with water during the plant growing season.

Suitability Ratings for Aspen Regeneration

(Please refer to the GIS map identified as … Potential for Aspen Regeneration for a Display of the Rating Zones)

- **GOOD** … this rating indicates both the soil properties and site characteristics are generally well suited for sustaining a stable type of aspen plant community. These areas should be managed with small disturbances or mortality events *(i.e. low to moderate severity / prescribed fire treatments or instances of wildland fire use, timber harvesting, mechanical thinning etc.)* every 70 to 100 years to provide the aspen clones with an opportunity to re-sprout which perpetuates the health of the stands. Some areas currently rated as good … are presently in over-mature or decadent condition; these sites should be treated as soon as possible. In order to achieve successful aspen regeneration, some stands will need to be protected from grazing by upland big game animals and domestic livestock for a period of 2 to 5 years. This can be accomplished by using fencing or slashing to provide a temporary barrier around the treatment area allowing the aspen suckers continued growth to the desired 6 foot height. A stable aspen community is capable of producing > 2,000 lbs/acre/year of forage during normal climatic conditions; this potential rate of production qualifies for Rangeland Productivity / Class I – which is the highest category in the Intermountain Region of the Forest Service.

- **FAIR** … this rating is being used to identify areas of seral aspen; sites which are currently at-risk to stand replacement by conifers due to the continuing encroachment of subalpine fir, white fir, Douglas fir and Engelmann spruce in the area. Large tracts of land should be treated with a massive disturbance event in an effort to return the existing vegetative conditions back to a younger aspen forest. Once again, additional conservation measures may be necessary to protect the treatment areas from seasonal grazing pressure – especially from deer and elk. **If there is a lack of commitment or a problem associated with assuring adequate protection occurs within a project area – then, the treatments should not be implemented.** It should be noted, some stands of seral aspen which are 1) located on steep to very steep terrain, 2) observed on north aspects or 3) already have > 50 % conifer invasion … may not return to a stable aspen community following our ground-disturbing activities. In these areas, the best opportunity for aspen regeneration would be following a wildfire, after wildland fire use or when implementing prescribed fire treatments.

- **POOR** … this rating means the site is considered to be quite marginal for aspen regeneration following all types of ground disturbances. Most of these locations have > 75 % conifers occurring within the overstory – some locations, were actually identified as being spruce - fir type forests on our existing vegetation map. These soils have limited topsoil development, strong albic horizons, acidic pH conditions, low to moderate water retention properties and few plant available nutrients; in some instances, the unit will be either too dry or simply too moist with respect to its mean annual precipitation to support healthy aspen plant communities. Most disturbances will result in a short-term response of aspen *(< 25 years)* with scattered regeneration observed throughout the treatment area … these sites will quickly revert back to conifers by natural succession. In areas of commercial timber, the harvested locations are commonly planted back to Engelmann spruce as part of our reforestation effort.

- **UNSUITED** … these locations will not support aspen forests. Currently, these areas are supporting non-forested types of vegetation such as perennial grasses, sagebrush, tall forbs, oakbrush, pinyon - juniper etc.

Hydrologic Groupings

(Please refer to the GIS map identified as … Hydrologic Groups for a display of the Rating Zones)

Each bare soil is assigned to a Hydrologic Group based upon its infiltration characteristics and overall potential for surface runoff conditions following periods of prolonged wetting. These groupings of A, B, C or D are commonly used by professional Hydrologist's and Burned-Area Emergency Response (BAER) Teams to estimate overland flows based

upon the results of modeling several typical storm events having different durations following a large incident of wildfire. These erosion / sediment models are frequently used in connection with flood prevention projects; they are normally considered when recommending emergency stabilization treatments or structures that would be effective in preventing a loss of water control. Some of the potential problems associated with flooding are threats to human life and property – including, damages to transportation surfaces, domestic water supplies, urban developments, recreational areas along with right-of-way corridors for power and utility lines.

- **GROUP A** … these soils have a low runoff potential. All of these locations will have rapid infiltration rates even after the ground is thoroughly wetted. Most sites consist of very deep, well to excessively drained sandy type soils; a few areas may contain gravel-sized rock fragments.

- **GROUP B** … these soils have a moderately low runoff potential. Most of the locations will consist of moderately deep to very deep, loamy type soils having a moderately slow to moderately rapid rate of permeability.

- **GROUP C** … these soils have a moderately high runoff potential. Most of these locations will consist of soils having a moderately deep restrictive layer within the subsoil or substratum that actually impedes the downward movement of water. A few examples of these restrictive layers would include 1) silica or carbonate hardpans, 2) soils having pronounced saline–alkali layers, 3) bedrock occurring between the depths of 20 to 40 inches in the profile and 4) soils which are moderately well or somewhat poorly drained – so, a water table exists between the depths of 18 to 36 inches in the ground.

- **GROUP D** … these fragile soils have a high runoff potential. All of these locations consist of soil types having a shallow restrictive layer within the profile that completely impedes the downward movement of water. A few examples of these restrictive layers would include 1) a well-developed claypan horizon, 2) indurated hardpans, 3) bedrock occurring between the depths of 10 to 20 inches in the ground and 4) soils which are poorly drained – so, a permanent high water table exists between the depths of 6 to 18 inches.

(Prepared by Rich Jaros, Forest Soil & Water Program Manager, Dixie National Forest and Michael D. Smith, Soil Scientist, Fishlake National Forest)

Hydrologic Resource Assessment

I. Objectives

The objectives of this assessment are to:

- Assess overall changes to soil and watershed function caused by the fire, particularly those that pose substantial threats to human life and property, and critical natural and cultural resources. This includes evaluating changes to vegetative cover, soil conditions, hydrologic function, and watershed response to precipitation events.

- Identify potential flood and erosion source areas and sediment deposition areas.

- Identify potential threats to life, property, and critical natural and cultural resources in relation to flooding, erosion, and sediment deposition.

- Develop treatment recommendations, if necessary; and

- Identify future monitoring needs, if necessary.

II. Issues

Increased runoff, erosion, and sediment delivery associated after fires will occur within the drainages of the Twitchell Canyon Fire. This assessment determined that there were values at risk to damage from flooding and debris flows on National Forest System lands and below the Forest boundary.

Human Health & Safety:

- Private and/or State Property is at risk of flooding within the Clear Creek, Indian Creek, and North Fork North Creek drainages especially along the Clear Creek highway.

- Forest Service System roads within the drainages of Indian Creek, Sevier Canyon, North Fork of North Creek, Mud Springs, and Shingle Creek are at risk of flooding and debris flows that would potentially threaten people travelling or camping within or along these drainages.

Property:

- Forest roads and trail infrastructure is at risk of failure as a result of increased runoff, flooding, and debris flows especially in Sevier Canyon, North Fork of North Creek, and Indian Creek.

- The Clear Creek Highway may be at risk to flooding overtopping the highway through The Narrows.

- There are 2 downstream improvements in Shingle Creek that were constructed to act as fish barriers to protect introduced populations of Bonneville cutthroat trout. These barriers are threatened by sediment and debris deposits resulting from the increased flows from the burned area.

- The Manderfield reservoir in upper Indian Creek may be at risk to debris flows initiated in the burned headwaters.

Natural Resources:

- An adverse change to hydrologic function is expected due to the large contiguous areas burned at moderate and high severity. These areas are very steep and contain large percentages of hydrophobic soils. Many of the tributary drainages contain accumulated channel sediments that have a high probability of being mobilized in high intensity, short duration rainfall events. This will result in the following changes:

- Channel down-cutting and lateral migration that may result in a loss of riparian areas and access to floodplains.

- Degradation of aquatic and terrestrial wildlife habitat (i.e. BCT).

- Increased runoff, streamflow, and sedimentation causing effects to water quality and downstream beneficial uses (BCT, threat of the spread of whirling disease).

III. Obervations

Background:

Physiography

The analysis covers the west portion of the Tushar Mountain Range Northwest of Beaver, Utah on the Beaver Ranger District of the Fishlake National Forest. The burn perimeter covers portions of the following watersheds: South Fork Pine Creek, Upper Indian Creek, North Creek, Fish Creek, Mill Creek, Headwaters Clear Creek, Bear Canyon, Sulphur Creek, and Mud Springs Hollow-Wildcat Creek. Elevations of the burned area range from about 6,500 feet to 11,200 feet. Several adjacent mountain peaks are over 12,000 feet. Most of the area has steep slopes.

Geology

The area is characterized by fault-block mountains. Perennial streams drain northward and westward from these mountains and provide surface water in the basin and recharge to the groundwater basin. Bedrock uplifts are composed of a variety of rock types including metamorphic, volcanic, and sedimentary rocks of all ages. A majority of the outcropping rocks are Miocene volcanics. Refer to the Soils Report for more detailed information.

Climate

The climate of this region is temperate and is characterized by long cold snowy winters, hot dry summers, and fall thunderstorms. Precipitation in the area is influenced by two of the following major storm patterns:

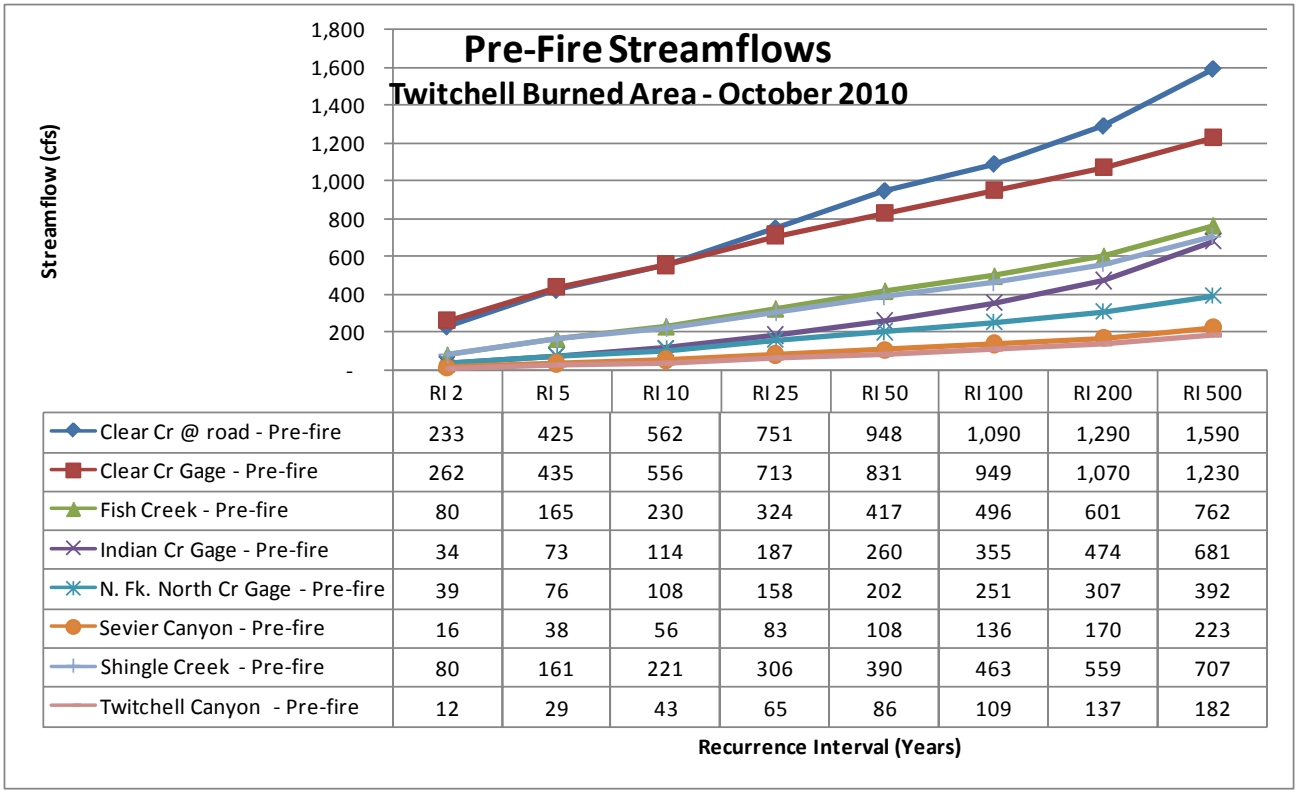
- the occurrence of frontal systems from the Pacific Northwest during winter and spring; and,
- late summer and early fall thunderstorms from the south and southwest.

Temperatures range between -30 (F) in the mountains during winter to 100 (F) in the lower valley during summer. Mean annual temperature is 48 (F). Average maximum & minimum temperatures for the following months are: January - Maximum = 42 (F), Minimum = 14 (F); July - Maximum = 88 (F), Minimum = 50 (F).

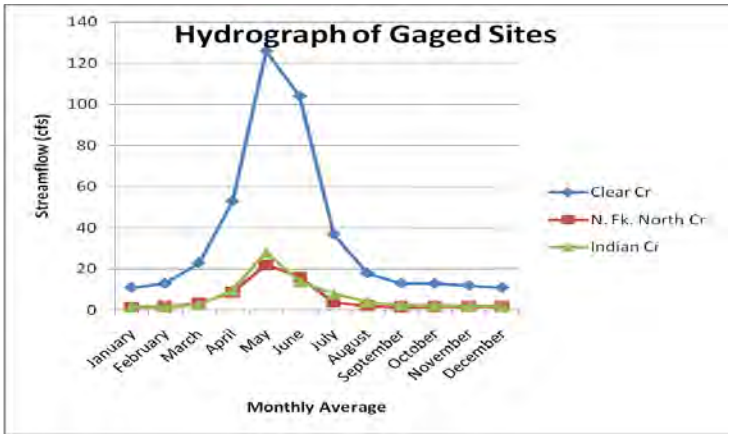
Precipitation ranges from 40 inches in the Tushar Mountains to about 8 inches in the lower desert valley. Average precipitation in the valley area around Beaver is about 11 inches. The Upland Climatic Zone is typical of the climate surrounding the Town of Beaver, (long, cold, snowy winters, and short, warm summers). Precipitation ranges from 12 to 18 inches. The most beneficial moisture is stored in the soil, and delivered in the winter as snow and in the early spring as rain. The area above this zone is normally described as the Mountain Climatic Zone and is characterized by cool, dry summers and cold, snowy winters. Annual precipitation averages 17 inches with a range of 16 to 24 inches.

Hydrology

Several major drainages were affected by the fire, including Fish Creek, Shingle Creek, Sevier Canyon, North Creek and Indian Creek. Fish Creek is the largest watershed and had the largest number of acres burned within the fire perimeter. Shingle Creek, one drainage west of Fish Creek, also had a large portion of its area that had high severity burns. Both of these drainages have high elevations and steep slopes. Both Fish Creek and Shingle Creek drain into Clear Creek, which subsequently drains into the Sevier River. About two miles downstream of this confluence the Sevier River is diverted for irrigation use in the communities to the north. A USGS stream gaging station is located on Clear Creek just inside the Forest boundary (# 10194200). The long-term mean flow for this site is 14 cubic feet per second (cfs) and the historical peak flow (daily average) is 906 cfs recorded on August 26, 1988.



	RI 2	RI 5	RI 10	RI 25	RI 50	RI 100	RI 200	RI 500
Clear Cr @ road - Pre-fire	233	425	562	751	948	1,090	1,290	1,590
Clear Cr Gage - Pre-fire	262	435	556	713	831	949	1,070	1,230
Fish Creek - Pre-fire	80	165	230	324	417	496	601	762
Indian Cr Gage - Pre-fire	34	73	114	187	260	355	474	681
N. Fk. North Cr Gage - Pre-fire	39	76	108	158	202	251	307	392
Sevier Canyon - Pre-fire	16	38	56	83	108	136	170	223
Shingle Creek - Pre-fire	80	161	221	306	390	463	559	707
Twitchell Canyon - Pre-fire	12	29	43	65	86	109	137	182



North Creek and Indian Creek are on the South and Southwest sides of the burned area. These streams are similar to the streams draining to Clear Creek in that a majority of their upper watersheds are within the burned area. However, the bedload produced and mobilized within these streams is about 50 percent larger with cobble to large cobble dominating the bar deposits. As seen in the chart below, the hydrographs are similar for all three drainages with peak flows occurring between mid-April to mid-June annually.

Other streams not affected or having only minor effects are Little North Creek, Pine Creek, Wildcat Creek, and North Wildcat Creek. There are no 303d listed waterbodies within the fire perimeter. There are a number of springs within the burn perimeter. These are used for stockwatering and riparian function. ENEL owns water rights for their geothermal operations in the Sulphurdale area.

A. Reconnaissance Methodology and Results – The purpose of a burned area assessment is to determine if the fire has caused emergency watershed conditions, if there are values at risk, and if emergency stabilization treatments are necessary to mitigate damages to these values. Values at risk may include commercial and residential properties, capital improvements, and critical cultural and natural resources located within or downstream of the fire, that may be subject to damage from flooding, ash, mud and debris deposition, and hill slope erosion. If emergency watershed conditions are found, and values at risk are identified, then the magnitude and scope of the emergency is mapped and described, values at risk and resources to be protected are analyzed, and treatment prescriptions are developed to protect these values. Emergency watershed conditions include assessment of both hydrologic and soil factors. The most significant factor is the loss of soil cover, which can lead to erosion and changes in hill slope hydrologic function in the form of decreased infiltration and increased runoff. Such conditions lead to increased flooding, sedimentation and deterioration of soil condition. Aerial reconnaissance and field observations conducted October 5-10, 2010 were used to modify the BARC in order to produce the final soil burn severity classification.

The major determining factor influencing runoff and erosion from burned hillslopes is the amount of disturbance to the forest floor that protects the underlying mineral soil (Robichaud 2000). The unburned forest floor consists of a litter layer (leaves, needles, fine twigs, bark flakes, matted dead grass, mosses and lichens, O1 soil horizon) and a duff layer (partially decomposed remnants of the material in the litter layer, O2 soil horizon) (Martin and Moody 2001). These layers absorb most of the rainfall, provide storage of water and obstruct the flow of water on hillslopes. The combustion process converts the forest floor into ash and charcoal. Ash and small soil particles seal soil pores (Morin and Banyamini 1977, Neary et al. 1999), decreasing the infiltration rate (Fuller et al. 1995, Barfield et al. 1981) and increasing potential runoff and erosion. When the charcoal and ash are removed from the hillslope by post-fire runoff or wind, the soil is left bare and susceptible to rain splash and overland flow.

Overland flow occurs as a result of rainfall that exceeds soil infiltration capacity and the storage capacity of depressions. On the unburned forest floor, overland flow follows a myriad of interlinking flow paths that constantly change as organic material (litter and duff layers) and inorganic material (rock) are encountered (Huggins and Burney 1982). Consumption of the forest floor by fire alters the path of overland flow by reducing the overall length of the flow path, resulting in the concentration of flow into a shorter flow path. This concentration of overland flow increases the hydraulic energy of the flow and can result in rill erosion. At the watershed scale, the reduction of hillslope flow path lengths and the formation of rills that have a high water conveyance capacity reduce the times of concentration or the amount of time for overland flow to reach a defined point within the watershed. Although less litter, duff, and vegetation is present in desert and range lands than in a forested environment, the same processes occur. However, the differences in infiltration and overland flow between pre-fire and post-fire conditions are less in a desert/rangeland environment than in a forest because there is less ground fuel to burn.

Overland flow is also influenced by the fire-induced water repellency (hydrophobicity) of the soils. The reduction of infiltration due to water repellency can increase overland flow (DeBano et al. 1967). Infiltration curves for water repellent soils reflect increasing wettability over time once the soil is placed in contact with water. Water repellency decreases (hence infiltration increases) with time because the hydrophobic substances responsible for hydrophobicity are slightly water soluble and slowly dissolve, thereby increasing wettability. In general, hydrophobicity is broken up or is sufficiently washed away within one to two years after a fire (Robichaud, 2000).

On the ground field observations and aerial reconnaissance within and downstream of the burn areas were conducted to determine watershed response. Geologic and Landtype Association maps (based on lithology and geomorphology) were used during field surveys to evaluate post-fire hillslope stability, runoff, and erosion/debris flow potential. Channel morphology

related to transport and deposition processes were noted, along with channel crossings and stream outlets. Observations included condition of riparian vegetation and the volume of sediment stored in channels and on slopes that could be mobilized. Burn severity and changes in soil infiltration were also considered.

The hydrology team chose 8 watersheds to model based on the critical values downstream within or downstream of the burned area. These watersheds were delineated using Utah StreamStats (USGS 2010). The delineation of these watersheds also allowed the team to run the online regression equations to develop pre-fire streamflows as listed in the table above. The team also surveyed the stream cross section at 5 sites just above the value of concern. The pre-fire streamflow and the surveyed cross section were then calibrated to pre-fire indicators of bankfull streamflows. The cross section information provides the team with a stage discharge relationship that can be used to assess the particular volume of water and debris that can be processed through these channels. This provided the ability to assess the "true" risk of flows overtopping the road or other improvement.

B. Findings – On October 10th- 15th, 2010, members of the BAER team reviewed conditions on the Twitchell Canyon Fire. The fire consumed ~ 45,117 acres, most of which were on National Forest System lands. Much of the fire consisted of Spruce/Fir, Seral Aspen, and Stable Aspen type vegetation communities located on moderately steep to steep mountainsides. Other vegetative species in the mid- to lower elevations included mixed conifers, Mountain brush, Gambel Oak, Pinion, Juniper, Mountain Big Sagebrush, and grasses/forbs. Many of the steeper slopes consisted of rock outcrops and talus slopes, however, overall these rocky slopes made up less than 5 percent of the burned area.

The amount of moderate to high severity burned acres within the fire perimeter is about 66 percent. The mid- to upper slopes of the watersheds within almost two-thirds of the burned area were burned at least moderately. When pour points were delineated for the hydrology analysis, it was found that Sevier Canyon and Twitchell Canyon burned 75 and 64 percent respectively in the moderate to high severity classes.

Unburned	Low Severity	Moderate Severity	High Severity
5,854 (13%)	9,368 (21%)	15,242 (34%)	14,653 (32%)

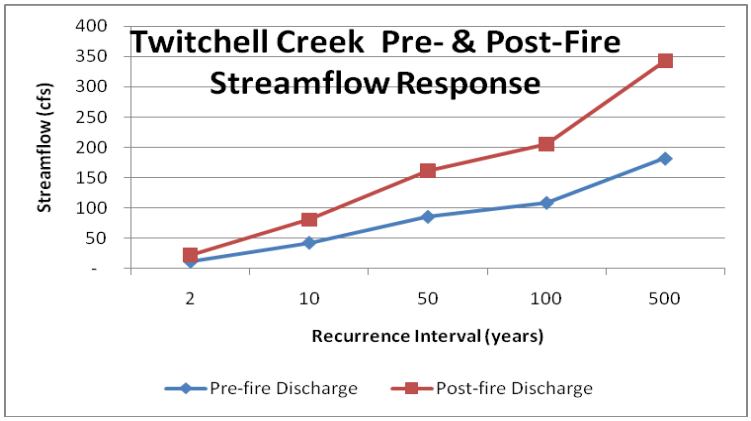
Generally, the upper portions of many drainages experienced a high intensity, high severity burn as indicated by the consumption of vegetation. Soil burn severity in riparian and lower elevations areas was generally lighter then the upper headwater areas (see BARC Map).

Several major drainages were affected by the fire, including Fish Creek, Shingle Creek, Sevier Canyon, North Creek and Indian Creek. Fish Creek is the largest watershed and had the largest number of acres burned within the fire perimeter. Shingle Creek, one drainage west of Fish Creek, also had a large portion of its area that had high severity burns. Both of these drainages have high steep slopes in the upper parts of the watersheds. Both Fish Creek and Shingle Creek drain into Clear Creek, which subsequently drains into the Sevier River.

Portions of the Indian Creek Drainage were burned quite severely. Twitchell Canyon and Mill Hollow, which drain from the north into Indian Creek, had large portions of their drainages that were severely burned. Manderfield Reservoir, part of the Indian Creek Drainage, is used for irrigation and sports fisheries. Some low and moderate burning occurred above Manderfield Reservoir to the south.

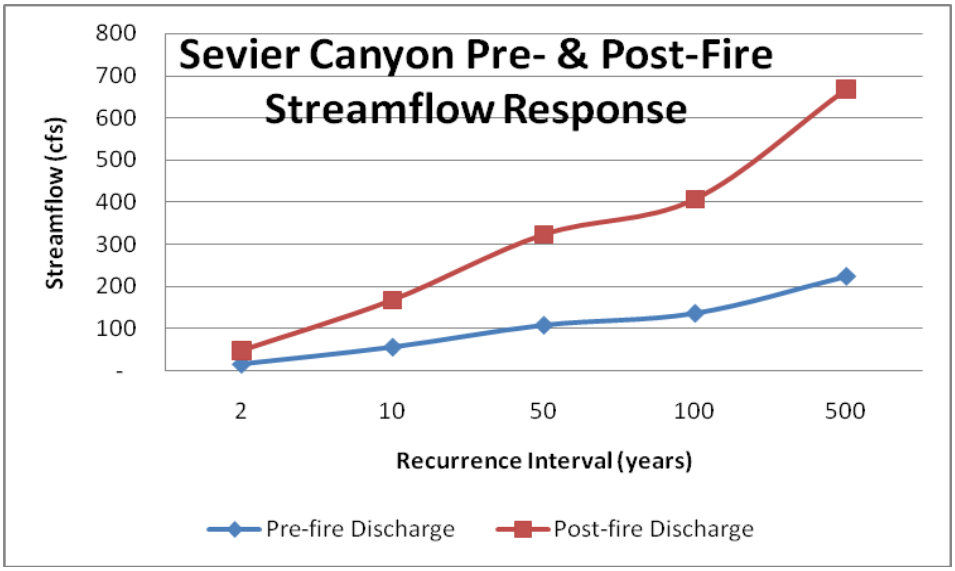
Significant portions of the steep upper slopes of the North Fork North Creek drainage had high severity burns. The lower part of this stream has homes nearby and some water is diverted and used for irrigation. Pole Creek, a small tributary to North Fork North Creek, had high intensity burn areas in portions of its drainage. South Fork North Creek also had a few areas with high severity burns.

Watershed Response



The primary watershed response of this fire is expected to include periodic flushes of ash-laden runoff, sediment, rock, and organic debris in response to high-intensity rain events, for the first few years following the fire. The fire was mapped as predominantly moderate to high severity in the upper headwaters between the inner gorge upwards to the upper slopes and low severity in the lower portions of the drainages and some ridgetops. A high watershed response is related to high erosion potential, due to the inherent characteristics of this steep and rugged terrain. Debris producing events are expected to be localized, and should be limited to

redistribution from steep, upper landscape positions to deposition on toe slopes and debris cones. Sediment-laden runoff will likely occur periodically for the first few years following the fire or until vegetation recovers and begins to filter hill slope runoff again. After this period, runoff should start to decline and return towards background levels. Temporary increases in spring flow may occur due to the reduction in interception and evapo transpiration where vegetation was burned adjacent to springs.



Natural recovery of annual grasses and other vegetation, as well as long-term reestablishment of the shrub component is expected to reduce this baseflow to within normal levels within 5 to 10 years. Vegetation recovery is largely dependant on climatic cycles. If wet winters occur, vegetation recovery could be rapid with forbs and grasses providing ground cover. By the third winter, season forbs and grasses in the Twitchell Canyon Fire should provide sufficient cover to reduce any increase in watershed response to pre-fire levels. Once sprouting vegetation begins to produce brush crowns and a duff/litter layer, watershed response will be reduced further. However, if winters are dry, vegetation recovery will be slow, and thus the establishment of ground cover and shrub communities will be slow, and watershed response will remain elevated over pre-fire conditions.

Eight watersheds were evaluated, and of those, there were five watersheds that had a high to very high risk to erosion, large increases to streamflow, and large debris flow events following thunderstorm-type events. The five watersheds that will experience the most significant changes to their watershed response are Sevier Canyon, Twitchell Canyon, Shingle Creek, Fish Creek, and North Fork North Creek. We found that Twitchell and Sevier Canyon had the largest number of acres burned at moderate to high severity. These two watersheds were also modeled to have the largest difference between pre-fire and post-fire discharge. All five watersheds are very likely to experience significant changes to their hydrologic function (downcutting, lateral migration, loss of floodplain access, and impacts to functioning riparian areas). However, Twitchell and Sevier Canyon are prone to severe flooding and debris flows during high intensity, short duration rainfall events. The Forest Service roads and infrastructure (culverts and vented fords) are threatened, even in smaller rainfall events. These roads must be patrolled often to maintain fully functioning infrastructure and unplugged culverts.

The charts and tables in this section illustrate the modeled or estimated change to streamflow which can be used as an indicator of the magnitude of flooding events at equivalent recurrence interval rainfall events. Keep in mind that flooding and debris flows following large-scale fires is a very complex process and the modeling that is used to predict streamflow cannot account for all of the possibilities. For instance, on the Cerro Grande Fire in New Mexico (Discussion with Kuyumjian, 2001) a series of debris jams impounded small ponds of water until the uppermost pond broke loose. This caused a “domino effect” and created a streamflow and debris flow response that was orders of magnitude larger than any modeled scenario.

It is expected that Fish Creek and Shingle Creek will experience very high streamflows that are debris laden in the upper two-thirds of each of these watersheds. However, much of the debris will settle out in the lower one-third of each of these watersheds due to the long stretches of lower gradient stream channel. Clear Creek highway is downstream from the confluence of these drainages. At its lowest point in The Narrows, this highway is at risk of the high streamflows overtopping the road surface in an event that would resemble a 50-100 year precipitation event. Such an event will not likely damage the road, but rather deposit silt and finer debris on the road surface.

The North Fork North Creek watershed is very steep with the majority of the watershed's slopes greater than 60 percent. This watershed also had a large percentage of its area burned at moderate to high severity. The streamflow and debris flow response from this drainage is expected to be significant and poses a large threat to the Forest Service road downstream. Just downstream from the Forest Service boundary there are a few diversions used for irrigation. Due to the distance, and the lower gradient stream sections between the fire perimeter and these diversion intakes it is expected that damage may be possible, however, not major. These structures will receive silt and finer materials that may deposit at these intakes, requiring more frequent cleaning for at least 2 years.

Comparison of Pre- & Post-Fire Streamflows at Focus Drainages

Sevier Canyon @ Mouth

Return Flow (# of years)	Pre-fire Stage	Pre-fire Discharge	Post-fire Discharge	Watershed Acres	Moderate to High Severity	Percent Severely Burned
2	1.30	16	32	2,348	1,764	75
10	2.17	56	112			
50	2.60	108	215			
100	2.78	136	271			
500	3.23	223	444			

North Fork North Creek @ Forest Boundary

Return Flow (# of years)	Pre-fire Stage	Pre-fire Discharge	Post-fire Discharge	Watershed Acres	Moderate to High Severity	Percent Severely Burned
2	1.1	39	63	9,032	3,429	38
10	1.75	108	176			
50	2.33	202	328			
100	2.57	251	408			
500	3.2	392	637			

Clear Creek @ Highway (The Narrows)

Return Flow (# of years)	Pre-fire Stage	Pre-fire Discharge	Post-fire Discharge	Watershed Acres	Moderate to High Severity	Percent Severely Burned
2	2.95	233	349	65,353	16,314	25
10	4.79	562	842			
50	6.53	948	1,420			
100	7.2	1,090	1,632			
500	>8.9	1,590	2,381			

Twitchell Creek @ Mouth

Return Flow (# of years)	Pre-fire Stage	Pre-fire Discharge	Post-fire Discharge	Watershed Acres	Moderate to High Severity	Percent Severely Burned
2	0.75	12	23	2,107	1,354	64
10	1.4	43	81	XS Q Pro BFL Stage		
50	2.05	86	162	37		
100	2.35	109	205	XS Q Pro HWM Stage		
500	3.05	182	343	98		

Shingle Creek just below Confluence with Clear Creek

Return Flow (# of years)	Pre-fire Stage	Pre-fire Discharge	Post-fire Discharge	Watershed Acres	Moderate to High Severity	Percent Severely Burned
2	1.5	80	132	11,039	4,395	40
10	2.45	221	364	XS Q Pro BFL Stage		
50	3	390	642	60		
100	3.2	463	762	XS Q Pro HWM Stage		
500	3.8	707	1,164	35		

IV. Recommendations

A. Fire Suppression Rehabilitation

1. Enter Specification Title: There were no recommendations for suppression rehabilitation.

Description: There were no recommendations for suppression rehabilitation.

B. Emergency Stabilization

1. Management (Specification-related)–

Enter Specification Title:

Aerial Mulch

Description:

Apply agricultural straw mulch to the ground surface to achieve a continuous cover of uniform thickness, as specified below, to replace ground cover consumed by the fire. Ground cover is needed to maintain soil moisture, accelerate recovery of native vegetation, to protect any seed remaining onsite, and to improve success of stabilization seeding treatment. In addition, the organic mulch will protect soil from solar heating and drying, thereby improving the ability of seeds to germinate.

Location or General Description of Suitable Sites

The treatment unit totals 4,158 acres. The location of this treatment is upslope of road and trail infrastructure, reaches of habitat important to Bonneville cutthroat trout, and fish barriers important to the protection of the species. The mulch will be applied in the watersheds of North Fork, Mill Hollow, Twitchell Canyon, Shingle Creek, Fish Creek, and Sevier Creek. Refer to BAER Treatment Map for exact locations.

Detailed Design/Construction Specifications

1. Treat areas in designated units with "High" and "Moderate" soil burn severity that are less than 70% slope. Do not treat areas that have needles in trees, exposed rock outcrops, or slopes greater than 70%.

2. Straw application rate: Apply mulch to achieve a continuous cover of uniform thickness over 70% of treatment area at a depth of less than 2.0 inches. Application rate will be approximately 1.0 ton/acre (2,000 pounds). This is about 0.25 inches or 3 straw shafts deep. Aerial application may not achieve desired ground cover, therefore ground crews will likely be needed to spread straw clumps by hand in select locations in each treatment unit. Discussion with Pete Robichaud on October 14, 2010 regarding a rate of 0.5 tons/acre identified that patching or stripping has not proved to be successful in the past. It was determined that the energy created between patches or strips of treated area overwhelms the next treated area and/or undercuts with rilling. Relevant examples included monitoring associated with stripping a hydromulch treatment on the Cedar Fire of 2003.

3. Straw must conform to State Department of Agriculture (SDA), Certified Noxious Weed Free Standards for Noxious Weed Free Forage and Straw (NWFFS). All straw provided must have been planted and harvested during the 2010 growing season. Straw shaft length will not exceed 12 inches. Suitable straw includes barley, rice, and wheat grasses.

4. The straw must be applied dry (less than 12 percent internal moisture content) to ensure proper dispersal during aerial applications. The Forest Service may randomly test bales using a moisture probe.

Purpose:

The purpose of the mulching treatment is to reduce the delivery of sediment from severely burned hillslopes to avoid sediment bulking of flows entering sensitive fish habitat and road or trail infrastructure.

This treatment is intended to achieve three sequential objectives:

1. Improve conditions to protect soil productivity by replacing ground cover burned in the fire. Replacing ground cover will: a) decrease erosion by interrupting raindrop impact and surface soil detachment; and b) increase hillslope obstructions to decrease slope lengths which mitigate accelerated overland flow, thereby decreasing sediment delivery. Mulching also helps to protect the native seedbed and retain moisture on the burned slopes to facilitate vegetative recovery of the treatment areas.

2. Decrease overland flow and erosion from high soil burn severity areas upslope of trails or roads, which can intercept surface runoff and result in damage and/or loss of infrastructure.

3. Decrease sedimentation from burned areas and trails upslope of streams that provide important spawning and rearing habitat for Bonneville cutthroat trout, a federally sensitive aquatic species.

The mulching treatments are predicted to lower the estimated soil erosion and subsequent sediment delivery to the streams by up to about 1/2. Mulching will also reduce downstream peak flows by absorbing and slowly releasing overland runoff which is likely to be increased due to reduced soil cover and hydrophobic soil conditions. Mulching treatments in the headwaters of the streams can protect a much larger downstream area from cumulative runoff and sedimentation.

The mulching treatments were determined to be the minimum necessary to protect critical values, as defined in FSM 2523.1. The probability of damage or loss to the following critical values is very likely. The critical values are soil productivity, hydrologic function, human safety, road and trail infrastructure, and native/naturalized communities where invasive species and noxious weeds are absent. These values are threatened by the post-fire response to short duration, high intensity precipitation events. The magnitude of consequences is moderate especially to road infrastructure, soil productivity, natural resources, and human safety. Overall, the assessed risk is high for natural resources and human safety.

Effectiveness Monitoring

Visually inspect randomly selected mulch treatment units for proper application rate and uniform thickness during/immediately after treatment. In each unit, measure percent ground cover using a 100ft pace transect method once after treatment, and again in the spring of 2011

Grade Stabilization Structures were also recommended and developed by the fisheries biologist, Jim Whelan. These grade stabilizers are meant to protect the hydrologic function of the streams. It is very likely that extensive downcutting and lateral migration will occur as a result of the severely burned soils changing the voume of runoff and erosion. The grade stabilizers will be placed by a qualified hydrologist in locations just above wider, lower gradient channels. This will minimize the risk of the stabilizers being “bypassed” by a depositional event in the wider floodplain or alluvial fan. Refer to the fisheries report and the BAER report for more design specifications.

2. Monitoring: There were no recommendations for monitoring emergency stabilization. Enter Specification Title: There were no recommendations for monitoring emergency stabilization.

C. Rehabilitation

1. Management –

Enter Specification Title: There were no recommendations for suppression rehabilitation.

2. Monitoring - There were no recommendations for suppression rehabilitation.

Specification Title: There were no recommendations for suppression rehabilitation.

D. Management Recommendations (non-specification related)

Educate the public about the expectations following a fire of this magnitude and to watch the weather forecasts before travelling in or near the burned areas. This is especially true for the North Fork North Creek, Indian Creek, and Sevier Canyon areas due to the road positions within these watersheds. Closing the roads in these watersheds should be considered, expecially in Sevier Canyon. The road that travels up the channel from Mill Creek to Rattlesnake Ridge is not sustainable and should be strongly considered for relocation. Using the FS Road #1020 would provide a much safer and sustainable route for the future and should be considered by the district.

The water systems that have been burned over need to be checked and brought back to working condition to minimize or prevent damage due to unguided flow over the hillside (due to burned or broken pipes). They also provide the water for livestock grazing in the pastures and allotments to be used during the rest period within the burned area. These water systems are a priority to repair prior to the next grazing season.

V. Consultations

Name, title, and agency
Adan Solt, Hydrologist, Fishlake National Forest, regarding past watershed response and BAER treatments
Terry Kenney, Hydrologist, USGS, regarding the use of Regression Equations for modeling post-fire response
Pete Robichaud, Civil Engineer, RMRS, BAER Monitoring and Research regarding aerial mulch and rates of application.

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(Prepared by Brooke Shakespeare, Hydrologist, Dixie National Forest; Pete Haraden, Hydrologist, Fishlake National Forest and TJ Clifford, Hydrologist, Boise District, BLM)

APPENDIX A

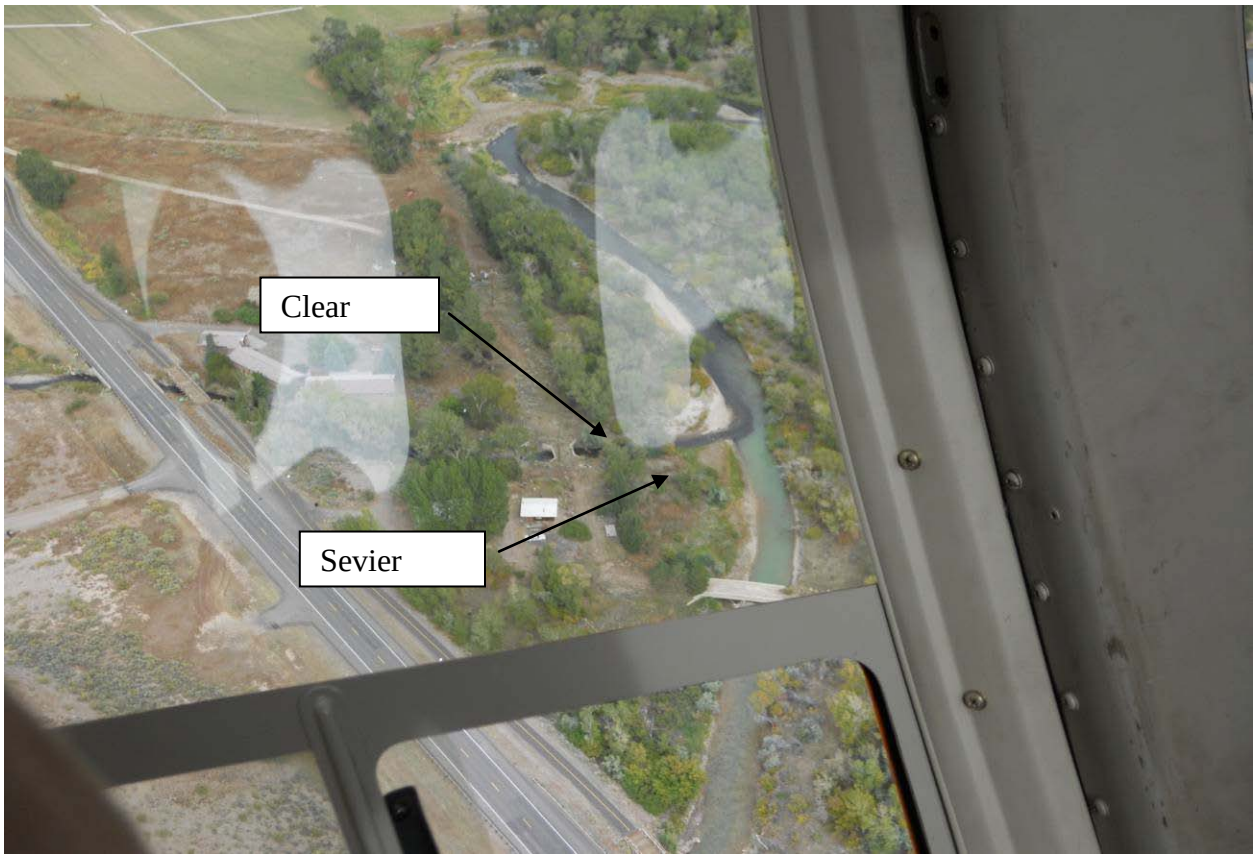
Hydrology Photo Page of Watershed Conditions and Values at Risk for the Twitchell Canyon Fire

Upper North Fork North Creek

Lower Fish Creek During Rain

Lower Shingle Creek During Rain

Fish Barrier on Clear Creek During Rain



Sediment From Fire Flowing Into Sevier River From Clear Creek Three Days After Rain

Rill Development on Steep Slopes Shows Evidence of Hillslope Erosion Even Before Fire Containment Upper Twitchell Canyon Drainage

High Burn Severity in Line Creek Drainage, One of Fish Creeks Upper Tributaries

Engineering Resource Assessment

I. OBJECTIVES

The purpose of this report is to summarize the findings of a field investigation of existing forest service roads and related infrastructure within the boundary of the Twitchell Canyon Wildfire located on the Beaver Ranger District of the Fishlake National Forest. The field investigation was conducted to identify the condition of the roads following the wildfire event and to assess potential impacts from the post-fire landscape to roads, bridges, culverts, and stream crossings. The investigation also included an assessment of gates and signage to determine their adequacy in protecting the public from hazards posed by the burned landscape and to minimize disturbance to the sensitive watersheds.

This report will identify emergency conditions related to the road infrastructure and recommend actions to protect this infrastructure and the values it supports including public safety, property and natural resources.

II. ISSUES

64 roads with a cumulative total of 36.56 miles of road exist within the boundary of the Twitchell Canyon Wildfire. Of these, two roads are classified as maintenance level 3 routes and the remaining are maintenance level 2 routes. The roads provide access to private property, overhead power lines, water resource development, and public recreational opportunities. They also support administrative access to forest lands. The increased runoff volumes and sediment and debris that will flow from the post-fire watersheds will threaten the continued stability of the roads and their associated values. Specific direct risks to the road system include: plugged culverts, washed-out roads, sediment and debris deposits on roads, blown-out stream crossings, and significant rutting from poor road drainage. Resultant risks to supported values include: threatened access to private property and public utilities, public safety hazards, reduced water quality, harm to sensitive aquatic resources, diminished public recreational opportunities, and compromised forest administrative access.

III. OBSERVATIONS

A. Field Investigation

A field investigation was conducted between the dates of October 7 - 12, 2010 by an engineering team. Each road, culvert and stream crossing within the wildfire boundary, along with several other drainage structures located outside of the boundary but along impacted drainages, was investigated by the engineering team during the reconnaissance. The condition of burned watersheds and general fire intensity within specific watersheds was evaluated to predict the likely future runoff behavior and the resultant probability of damage or loss. The engineering team also collaborated with hydrologists, scientists, and other environmental professionals to identify threatened values, assess risks, share observations, and discuss conclusions.

B. Findings and Recommendations

18 roads were identified as requiring emergency treatment measures. It was determined that the conditions of the remaining roads do not warrant emergency treatment measures at the time of this writing. The majority of proposed measures are located within the wildfire boundary. Those measures that are not located within this boundary are placed at key locations where high runoff and debris flows will require emergency action outside of the burned perimeter.

In general, the most expensive treatment recommendations are proposed for those roads supporting the most significant critical values. Less expensive solutions are proposed for those routes supporting less

critical values. A discussion of each of the roads for which emergency treatment measures are proposed is provided below, with the roads listed in order of priority.

Road # 113 - Mill Creek Canyon Road (Maintenance Level 3)

Mill Creek Canyon Road is a major access to the northern portion of the Beaver Ranger District and is a critical component to the travel network on this portion of the Forest. In addition, it provides access to private property and to overhead power line utilities. Only a portion of this road is threatened by post-fire runoff, but the probability of damage within this portion of road is very likely due to expected high flood and debris flows through Sevier Canyon and into Mill Creek. One emergency treatment is proposed for this road: the replacement of an existing culvert at the mouth of the Sevier Canyon drainage. A 72" squash culvert is proposed for this location.

Road # 119 – Indian Creek Road (Maintenance Level 3)

Indian Creek Road is a very popular road that provides access to Manderfield Reservoir, some private property, and dispersed recreation. The probability of damage for this road varies from likely to very likely. It is anticipated that a high volume of sediment and debris will be conveyed from the burned watersheds into Indian Creek, and there is significant concern that unless the road infrastructure is improved, substantial road damage requiring extremely expensive repairs will be required. The road features four existing concrete low water crossings installed along its length. These crossings have been highly successful at conveying high flood flows without compromising the integrity of the stream channel or the adjacent roadway; however, they are highly susceptible to being compromised by large debris flows. For this reason, two cross vanes are proposed at each low water crossing in order to keep the anticipated flood flows entering into the crossings at the correct angle and grade in order to protect the integrity of these structures.

One existing culvert at the base of Twitchell Canyon is undersized with respect to the flood flows that are predicted for the area. Therefore, this culvert is proposed to be replaced with a 60" squash culvert with a flared end section. Other emergency actions proposed for this road consist of installing hardened crossings at existing drainage swale locations and importing fill material in two locations to raise the road surface elevation and provide greater vertical separation between the road surface and adjacent drainages. Proposed grader road reconditioning will also be required to help preserve the road's integrity.

The existing gate at the forest boundary is inadequate and proposed for replacement. One additional gate is proposed in order to prevent traffic from route 589 from accessing the upper reaches of the road. Locking and unlocking of these gates will be coordinated by District personnel as deemed necessary.

Road # 114 – Shingle Creek Road (Maintenance Level 2)

In addition to serving as a popular route for recreationists, Shingle Creek Road is proposed as a key access route for seeding and mulching slope stabilization efforts due to its strategic location in relation to a large portion of the Twitchell Canyon Wildfire. As a result, this route is proposed for significant emergency treatments in order to support the stabilization efforts and to prevent the road from falling into significant disrepair, thereby requiring significant funds to bring it back into service. Furthermore, this route was heavily utilized by fire traffic during fire suppression efforts. Fire traffic significantly impacted the road and fire funds were expended to grade the road to help bring it back up to standard. Additional emergency measures are needed to further improve the road's drainage and protect the investment that has been placed in maintaining this road as a functional component of the forest travel network. The probability of damage for this road is very likely due to steep slopes and high fire intensity.

The first 1.5 miles of Shingle Creek Road is proposed for the installation of gravel surface material to support the heavy delivery truck traffic that will support the aforementioned slope stabilization efforts. This stretch of road is in very poor condition and in need of significant improvement in order to allow passage by heavy traffic. The proposed gravel surface will fix the worst stretch of the road and allow the delivery trucks to reach their proposed destination towards the end of the road.

The road features a single crossing of Shingle Creek not far from the road's origin. A concrete low water crossing has been installed at this location. This structure functioned admirably for quite some time but has recently fallen into disrepair, primarily due to the heavy fire equipment that utilized it during suppression efforts. It is anticipated that the compromised state of this structure will not hold up under the anticipated high flood flows, and therefore the structure is proposed for emergency replacement. If the structure fails, the entire crossing location will likely be compromised and the road will become impassable until additional, more expensive repairs are made.

Other emergency measures proposed to protect the integrity of this road and ensure that it remains navigable consist of the installation of one new culvert, one sediment basin, excavator work to improve drainage ditches, and road grading. There is an existing gate on the road that is in disrepair and proposed for replacement.

Road # 116 – Sevier Canyon Road (Maintenance Level 2)

Sevier Canyon Road is a highly-traveled route that provides access to private property and mining claims. The probability of damage for this route is very likely due to its unfavorable location roughly paralleling the stream that drains the Sevier Canyon watershed. This watershed is expected to deliver high flood flows, and in several locations there is inadequate vertical and horizontal separation between the road and the stream. The emergency measures proposed for this road consist of the minimum amount of work needed to keep the route functional; continuing observation and monitoring will be needed in future years to identify additional measures needed to protect the road and the values it supports.

In addition to dozer road reconditioning, the proposed emergency actions for Sevier Canyon Road consist o installing riprap along the roadbed to armor it against high flood flows and some excavator work to improve the drainage at one critical location along the road. Proposed gates at two ends of the road will allow a portion of the road to be isolated as necessary should road conditions further deteriorate.

Road # 591 - North Fork of North Creek Road (Maintenance Level 2)

The North Fork of North Creek Road provides access to a unique dendritic fern rock quarry at its terminus. The creek itself holds a unique strain of sensitive Bonneville Cutthroat trout. The road is popular with recreationists and provides dispersed recreational opportunities. The road's probability of damage is very likely due to extreme fire conditions combined with the area's steep slopes. It is expected that if emergency actions are not taken to protect this road from the predicted high volume flood and debris flows, it will fall into significant disrepair requiring extensive repairs at a very high cost. For this reason, a significant amount of emergency measures are proposed for this road, bearing in mind that if action is not taken and the road falls into disrepair, the cost of bringing it back into service will be substantially greater than the cost of the proposed preventative measures. Furthermore, the proposed treatments will help protect the unique strain of Bonneville Cutthroat trout from diminished water quality that would result from portions of the road washing away into the creek.

There are 11 stream crossings along the North Fork of North Creek Road. Concrete low water crossings are proposed for three of these crossing locations. These structures will help preserve the integrity of the road crossings, which otherwise are destined for certain failure under high runoff and debris flows. The proposed adjacent cross vanes will help hold the stream grade at key locations along the streambed, in

addition to helping preserve important aquatic habitat. Imported fill and riprap will be needed to protect several stretches of the road from flooding and erosion. Several sediment basins are proposed to prevent sediment from depositing upon the road and from washing into the creek. Grader road reconditioning is proposed to improve the overall road drainage, and some additional excavator work is proposed to improve roadside ditches along the upper reaches of the road. One gate is proposed to be installed on road 471at its intersection with the North Fork of North Creek Road and another is proposed for the North Fork of North Creek Road just past its intersection with road 654.

Road # 115 – Mud Flat Road (Maintenance Level 2)

The Mud Flat Road provides access to overhead power line utilities and to some private property. It is also an integral connecting route to access Fish Creek, which was nominated at one time to be set apart as a wild and scenic river. Mud Flat Road parallels I-70 and has several existing culverts that empty onto the I-70 right-of-way. The probability of damage for this road is likely.

The overall condition of Mud Flat Road is marginal due to poor native material and generally poor drainage. However, the road is highly traveled and is a key component to the travel network in this portion of the forest. Therefore, several emergency actions are proposed for the road in order to ensure that it will continue to function as needed to support several critical values. Sediment basins are proposed to be installed just upstream of existing culverts in order to help prevent the culverts from plugging and to ensure that the runoff transported down gradient to the I-70 corridor is free from large sediment deposits. And several new culverts are proposed in order to improve the road drainage at several locations and prevent the road from washing out during the anticipated flood flows. Grader reconditioning work will also be necessary to keep the road functional. One gate is proposed for this road near its intersection with the Mill Creek Road.

Road # 1020 (Maintenance Level 2)

Road 1020 connects Sevier Canyon Road to road 2051, which intersects Mud Flat. This road receives significant traffic from recreationists during the summer months and the road's probability of damage is likely. Several emergency stabilization measures are proposed to protect those portions of the road that are at risk of being severely compromised from high runoff and debris flows. Specifically, several hardened crossings, sediment basins, and additional excavator work to improve drainage will protect the road's integrity from high runoff and debris flows.

Roads 608, 471, 543, 2141, 2342, 1026, 2343, 2003, 2344, 1037, and 480 (Maintenance Level 2)

Road 608 connects Mud Flat to road 1020 and several hardened crossings are proposed for this road due to its likely probability of damage and susceptibility to washouts in several locations.

Road 471 intersects the North Fork of North Creek Road and will be significantly impacted from flood flows stemming from a severely burned watershed. The probability of damage is very likely. This road is in rough condition and is proposed for grader road reconditioning to help keep the road from washing out under high flows.

Road 543 intersects Indian Creek Road and has a very likely probability of damage. Dozer road reconditioning is proposed for this route to prevent erosion of the road into the Indian Creek drainage.

Roads 2003, 2344, 2341, 2342, 1026, and 2343 intersect Shingle Creek and are all in areas of likely to very likely damage probability. Grader and/or dozer road reconditioning is proposed for these routes to improve drainage and prevent erosion of the roads which could potentially remove the roads from the landscape completely.

Roads 1037 and 480 intersect Sevier Canyon Road and are in areas of very likely damage probability. Dozer work will be required to prevent the roads from washing away under high flood and debris flows.

C. Route Obliterations

The proposed emergency actions also include the obliteration of several unauthorized routes that were identified during the field investigation. In the post-fire landscape, the potential for unauthorized use of these routes has increased significantly as they are much more apparent since the vegetative cover has burned away. Use of these routes presents a public safety hazard, and work will be needed to close the routes from future use.

D. Signage

In order to help protect the public from the hazards associated with burned areas, several Burned Area Warning Signs are proposed. These signs will warn the public of the potential hazards of the burned landscape. The proposed sign locations include all entries into the fire perimeter and at other popular destination locations inside the fire perimeter.

IV. SUMMARY

Many of the roads threatened by the post-fire landscape of the Twitchell Canyon Fire support critical values that merit emergency actions to protect the roads and their associated values. The intent of the proposals provided herein was to prioritize emergency actions based on the probability of damage and the magnitude of consequences for these road systems. The recommended actions will protect the integrity of the threatened roads, their related infrastructure, and the values that depend on them.

V. CONSULTATIONS

T.J. Clifford, National BAER Team Leader, Bureau of Land Management, Boise District Office, 208-384-3459

Brooke Shakespeare, Hydrologist, USDA Forest Service, Dixie National Forest, Escalante Ranger District, 435-826-5434

Jim Whalen, Fisheries Biologist, USDA Forest Service, Fishlake National Forest, 435-896-1061

(Prepared by Garon Sandall, P.E. and Dan Child, Civil Engineers, Fishlake National Forest)

Vegetation Resources Assessment

OBJECTIVES

The objectives of this vegetation assessment covered four general themes: 1) evaluate the consequences to vegetation related to the possible loss of soil productivity and hydrologic function; 2) evaluate the presence of, and potential risks from, invasive species including noxious weeds; 3) recommend possible mitigations for these risks including seeding treatments; and 4) evaluate the situation within the burned area for Forest Service sensitive plant species.

ISSUES

Much of the burned area of Twitchell Canyon Fire is at substantially higher elevations than is typical for past fires on the Fishlake. The magnitude of this incident, particularly with contiguous blocks of high burn severity in steeper drainages at higher elevations, presents a major risk to long-term soil productivity and hydrologic function. Loss of these critical values would pose a major threat to significant vegetative components and functions of ecological systems. Major losses of soil from the mountain slopes will compromise these fire adapted ecosystems.

A major vegetation issue identified during field visits included threats to the ecological integrity of the area from the expansion of invasive species in, and adjacent to, the burned area. Cheatgrass has the potential to dominate these areas that burned where pinyon and juniper trees and lower reaches of Gambel oak and other mountain brush species dominated the pre-fire community. Abundant cheatgrass has the potential to change the fire regime and alter the soil structure.

Noxious weeds, particularly Scotch thistle, leafy spurge, and musk thistle pose a threat to the burned area. These three species are particularly aggressive and need immediate attention. Each one has the potential to adversely affect hundreds of acres of public lands. Several other less serious noxious weeds also occur within the burned area.

OBSERVATIONS

Background

The burned area of the Twitchell Canyon Fire is within the northwestern portion of the Beaver Ranger District with elevations from about 6,400 to 11,300 feet. Precipitation generally ranges from 14 to over 35 inches per year. All aspects are well represented.

The area blackened by fire was dominated by spruce/fir, aspen, mountain brush and pinyon/juniper on the slopes below the distinct band of cliffs and steep rocky canyons with mixed-conifer above. The vegetation map of the burned area shows the following proportions of major vegetation types: spruce, subalpine fir, white fir, Douglas-fir, with minor amounts of limber pine, ponderosa pine and aspen (36%); aspen, typically with some conifer (31%); mountain brush (16%); pinyon pine and juniper (7%); Gambel oak (4%); and mountain big sagebrush (3%) along with rock (2%) and riparian (1%).

Aspen provides the dominant cover for a third of the area within the perimeter, and conifer species with aspen as a minor component dominate another third of the burned area. There is potential for aspen to have a positive response with root suckers in nearly two-thirds of this area. At least two dozen fire adapted species also add to the potential positive vegetative response. The Fire Effects Information System (FEIS) includes this information about aspen. The Fire Ecology section stated, “Quaking aspen is highly competitive on burned sites. Even where quaking aspen was a barely detectable component of the prefire vegetation, it often dominates a site after fire.” The Fire Effects section adds, “Moderate-severity fire does not damage quaking aspen roots insulated by soil. Severe fire may kill roots near the soil surface or damage meristematic tissue on shallow roots so that they cannot sprout. Deeper roots are not damaged by severe fire and retain the ability to sucker.”

The recent publication, *Pinon and Juniper Field Guide: Asking the Right Questions to Select Appropriate Management Actions* (Tausch, *et al*. 2009), is excellent and applies to the northeastern 15% of this burned area. They discuss areas with increased amounts of juniper in their introduction:

"Both infilling and expansion affects soil resources, plant community structure and composition, water and nutrient cycles, forage production, wildlife habitat, biodiversity, and fire patterns across the landscape. Another impact is the shift from historic fire regimes to larger and more intense wildfires that are increasingly determining the future of this landscape.

"The major goal of woodland management is to reverse these changing patterns by attempting to restore a functioning and resilient ecosystem through a more balanced plant community. … a properly functioning ecosystem is better able to resist dominance by cheatgrass and other exotic weed species after fire or other disturbances. … significant management will also be directed towards treatment following wildfire. Developing a management approach for implementing either preventative treatments or post wildfire restoration can be a difficult task. This is because of uncertainty about how the vegetation, soils, hydrologic function, and wildlife will respond to treatment."

Reconnaissance Methodology

During field reconnaissance trips, visual estimates were made to provide answers to several questions that were considered:

What are the values at risk?

What are the general ages and conditions of the major cover types and dominant species?

What intensity and soil burn severity did the fire have in the various cover types?

What are the general age classes of forest and woodland species in the area?

Is cheatgrass in the area? Is it abundant?

Are noxious weeds in the area? Are any abundant?

Are there native bunchgrass communities in the area? How did this fire affect them?

What was the vegetative response to past fires in this general area?

Rich Jaros, Mark Madsen, Brooke Shakespeare, TJ Clifford, Pete Haraden and Bob Campbell did much of the field work, either in groups, pairs, or by individual forays from the edges of the burn to the high and low interior areas. The field assessment included trips to North Creek; Indian Creek and Manderfield Reservoir basin; headwaters of Trail Canyon, Twitchell Canyon and Line Canyon; the interiors of Fish Creek and Shingle Creek drainages, Sawmill Bench, Mud Flat, Rattlesnake Ridge, Fish Creek Meadows and several trips thru Sevier Canyon. Formal transects and periodic, random tests for soil hydrophobicity were done during the field visits. Most also participated in aerial assessments of the area which confirmed the magnitude of the incident and the extent of the contiguous areas of high burn severity.

Findings

After doing the field assessment of the burned area, and reviewing other resource information from the District Office and the Supervisor's Office, three major values at risk became clearly apparent with respect to the ecosystem integrity and vegetation of this burned area. These include loss of soil productivity, loss of hydrologic function, and potential for noxious weeds and invasive species to spread into and increase dramatically in the burned area. These threats are generalized in this burned area by the integration of precipitation and elevation (see map). The first two threats apply primarily to the nearly 85% of the burned area that receives more than 22 inches of precipitation annually. The threat from invasive species is most compelling in the remaining 15% at the incidents northeastern edge.

Loss of Soil Productivity and Hydrologic Function

The areas of high burn severity in Line Canyon, Fish Creek, Shingle Creek, Sevier Canyon, Twitchell Canyon, Mill Canyon, North Creek, Pole Creek and Pine Creek present the high likelihood of substantial soil loss. We observed minor areas where soils have already washed away and exposed the roots of aspen and other woody species. These burned areas sustained ecosystems with fire-adapted species. **From a vegetation perspective, a major issue is how to keep soils from washing off these high-elevation, steep slopes and rugged terrain for the next 2 to 3 years**. Loss of substantial amounts of soil will expose root systems, remove root crowns and rhizomes that can grow new plants, and remove the soil seed bank including the loss of sometimes century-old dormant seed that requires a heat treatment from fire before germination is possible.

A list of the major species that we saw during the field assessment is almost simultaneously a list of highly fire-adapted and fire-dependent species. Aspen is fire-adapted and will have viable roots remain to give rise to a new generation of aspen sprouts with potential to establish, grow and retain aspen on these slopes. Other fire adapted species that should respond well might include manzanita, snowberry, alder-leaf mountain-mahogany, serviceberry, Oregon grape, mountain lover, Rocky Mountain maple, Wood's rose, Gambel oak, chokecherry, willows, mountain hollyhock, arnica, fireweed, sedges and grasses. A seeding with a higher elevation mixture of cultivars would be an important consideration to help retain soil on these steep mountain slopes. Adding sterile hybrid to the mix might also be a way to "grow mulch on site."

Threat of Expanding Infestations of Noxious Weeds and Invasive Species

The northern and southern edges of the burned area and portions of the western side have potential for cheatgrass invasion. We focused on the northeastern portion of the burned area because of the lower elevations, drier sites, and proximity to large amounts of cheatgrass in the vicinity. Cheatgrass could invade and/or increase rapidly here from modest amounts of cheatgrass already present. The benches and lower drainages in this portion of this burned area have the potential to convert to a sea of cheatgrass. The steeper slopes also have the potential for cheatgrass to establish and move up slope though in lesser abundance.

Cheatgrass is one of the few species that can grow under a juniper canopy. The cheatgrass establishes under the juniper and pinyon pine in low-densities, inconspicuous amounts in the conditions represented in this area, and following a disturbance such as fire, is poised to both increase and spread. It responds quickly, can thrive, reproduce, and dominate a landscape in a sea of cheatgrass in 3-4 years. Cheatgrass is also present under the Gambel oak canopy in small amounts at the lower edge of the oak zone. **Another major vegetation issue is how to prevent a rapid increase of cheatgrass infestation in the lower oak brush and pinyon/juniper zones at the northeast portion of the burned area.**

For these reasons, we will propose a seeding of about 15 pounds/acre that is intended to supplement the post-fire response of the existing grasses and compete well with cheatgrass that is poised to increase rapidly in the burned area if unoccupied space is available. This seeding should counter the potential establishment, spread and increase of noxious weeds.

The landscape of this burned area shows a "relay race" of less desirable species. A weed is a plant out of place. Preburn, pinyon and juniper moved into the mountain sagebrush-mountain brush/grass/forb steppe. After this fire, the area is primed to "pass the baton" and replace the pinyon and juniper with an invasive species and become a sea of cheatgrass. In time, cheatgrass would change the fire regime from the historical 20 to 40 years to 5 to 10 years and alter the soil structure. A subset of invasive species, 'noxious weed' is a political designation that varies from county to county and state to state. Four aggressive noxious weed species in the vicinity need immediate attention: musk thistle, leafy spurge, Scotch thistle, and spotted knapweed. These four species are capable of displacing the native vegetation within portions of the burned area. Also, musk thistle, leafy spurge, and spotted knapweed have the potential to spread, over a period of years, to the top of the mountain. These four noxious weed species can even thrive in, and potentially displace, a sea of cheatgrass. Other less aggressive noxious weed species also occur on forest-administered lands near the burned area: black henbane, bull thistle, dalmatian toadflax, field bindweed (morning glory), houndstongue, Russian-olive, saltcedar (tamarisk), and whitetop.

This burned area is essentially free of noxious weeds. Specifically, there are only a few known locations of noxious weeds within the burned area: one each of musk thistle and dalmatian toadflax in North Creek and some of whitetop in lower Sevier Canyon. However, the area's north and west sides are on the receiving edge of invasive species and noxious weeds. Known occurrences of Scotch thistle, musk thistle, and leafy spurge are located on the Forest north of the burn

perimeter. Several other species of less aggressive noxious weeds are also in the vicinity. This portion of the Forest is a great place to use an early detection/rapid response strategy with the noxious weed program.

The vegetation of this area is described above as fire adapted. However, the advent of cheatgrass at these elevations above 7,000 feet and now the presence of serious noxious weeds represent a changed condition that was not a historical part of these fire-adapted systems. This changed condition require vigilance with early detection and rapid response or the invasive cheatgrass and later more serious noxious weeds will ultimately displace the fire adapted species, shortened the fire return to 5 to 10 years, and ultimately occupy these landscapes completely.

Other Observations about Vegetation

Gambel oak, a fire-adapted species, is a major component of the vegetation cover lower elevation. This oak will sprout from existing roots systems that survived the fire and begin to re-establish a dominant shrub cover on the lower slopes. Gambel oak communities are rich in biodiversity and have a variety of fire-adapted understory species including sego lily and wild onion. Native grass species observed in the area that are expected to re-establish over time include Indian ricegrass, needle-and-thread grasses, and squirreltail. It will be decades before pinyon and juniper begin to dominate the lower benches and slopes between Fish Creek and Mill Creek in the northeastern portion of the burned area.

Research Natural Areas (RNAs)

Research Natural Areas provide these important functions: 1) reference areas for monitoring sustainable ecosystems, 2) protected locations of biological diversity, and 3) areas for research and advanced educational experience at the collegiate level. RNAs in Utah have special designation and fall under the direction of the Director of the Rocky Mountain Research Station (RMRS) in Fort Collins, Colorado.

The Upper Fish Creek RNA, located northwest of Mt Belknap in the headwaters of Fish Creek, includes a total area of 1,718 acres. Thirty percent (524 ac) is outside this burned perimeter. Of the 1,194 acres inside the fire perimeter, 30% (355 ac) are unburned/unchanged, 38% (455 ac) had low burn severity, 32% (381 ac) moderate burn severity, and less than 1% (3 ac) high severity. During the Twitchell Canyon Fire, forest specialists conferred regularly with Dr. Stanley Kitchen, stationed at the Shrub Sciences Lab, in Provo, who is the RMRS's coordinator for all RNAs in Utah. Neither the fire suppression activities had, nor any proposed BAER treatments will have, any direct or anticipated indirect impacts on this RNA.

The Bullion Canyon RNA, located east of Mt Belknap and north of Delano Peak was not affected by this incident.

Rare Plants

There are not any known occurrences of federally listed endangered or threatened plant species known to occur on the Beaver Ranger District. Also, no Forest Service sensitive plant species occur within, or adjacent to, the burned area of the Twitchell Canyon Fire. Furthermore, none of the proposed BAER treatments are likely to pose a threat to any known population of any sensitive plant species.

Substantial Deer and Elk Range

Much of this area is designated by the Utah Division of Wildlife Resources as substantial deer and elk range. Fire consumed many of the shrubs and mountain brush species that comprised key components of this important wildlife range. Establishing new populations of desired browse species will take some time before this range will be restored. Competition from cheatgrass and noxious weeds has the potential to compromise the restoration of this range for wildlife values on the northeastern and southwestern portions of the burned area.

RECOMMENDATIONS

Seeding Treatments

The purposes of the aerial broadcast seedings are to protect the soil productivity, hydrologic function, and ecological integrity of the extensive burned areas. Also, seed areas that will be compromised by an invasion of cheatgrass where the pinyon, juniper and mountain brush cover type burned and resulted in moderate and high burn severity. These later treatments are intended to prevent an alteration of the fire regime. If these lower areas convert to a cheatgrass dominated community, the fire return interval might be nearly 10 times as frequent as the historical fire patterns.

Four themes guided our thoughts on how to identify areas to apply seed on only portions of the forest-administered lands. 1) Seed many of the contiguous high and moderate burn severity areas in the major drainages of the burned area. These areas may have the greatest potential in the burned area to produce flood events. 2) Seed under any areas that are proposed for mulch. 3) Where mulch is not feasible, or possible because of steep slopes, seed with a sterile hybrid to grow mulch on site and protect long-term soil productivity. 4) Be proactive and aggressive with a seed mix, and mulch or sterile hybrid, designed to prevent an infestation of cheatgrass and other undesirable invasive species as well as to protect soil productivity.

<u>Treatments Proposed</u>

Five seed treatments are proposed (see Aerial Seeding Treatment map):

1) Use Seed Mix #1 for lower areas that will be mulched – 844 acres
   This treatment is designed to prevent a cheatgrass infestation.

2) Use Seed Mix #1 plus 20 lbs/ac of sterile hybrid for lower areas that will not be mulched – 1,439 acres
   This treatment enhances Treatment #1 to grow mulch on site to protect the soil and cover the seed.

3) Use Seed Mix #2 for higher areas that will be mulched – 4,239 acres
   This treatment provides a modest amount of 4 native grass species to supplement the expected natural response from fire-adapted species on site.

4) Use Seed Mix #2 plus 20 lbs/ac of sterile hybrid for higher areas that will not be mulched – 7,043 acres
   This treatment enhances Treatment #3 to grow mulch on site to protect the soil and cover the seed.

5) Use sterile hybrid triticale at 40 lbs/ac – 1,234 acres
   This treatment is designed specifically for the steep slopes and less receptive soils of the North Fork of North Creek to protect the slopes and keep the soil from washing off the mountain.

These seed mixes were developed specifically for emergency rehabilitation treatments within the context of Forest Service Manual (2523.2 p. 22; effective 5/26/2004): "Mulching, seeding, or planting of grass, forbs, shrubs, or trees when needed to prevent unacceptable erosion, to stabilize critical or significant natural or cultural resources, to prevent permanent impairment to critical habitat for Federal and State listed, proposed, or candidate threatened or endangered species, or to prevent detrimental invasion by non-native plants. Use only planted materials that should be effective within two growing seasons." We feel these are seed mixes "of species known to be effective for erosion control, adapted to the target area and compatible with future management objectives" (FSH 2509.13,20 p. 13). These seed mixtures will help to keep the soil on the mountain slope and promote hydrologic and ecosystem function. At the northeast portion of the fire protect against the rapid increase of cheatgrass. These mixes contain a strong component of native species as well as some introduced species. In light of Executive Order 13112 (2/3/1999) on invasive species, we considered and determined that the introduced species in this mix <u>will not</u> be "likely to cause economic or environmental harm or harm to human health."

Price estimates were obtained from Granite Seed Company in Salt Lake City. Actual costs may vary depending on availability at time of purchase from the successful bidder. The following table shows the pounds per acre of seed (PLS) that is used in each mix. Cost for aerial application is estimated at $35 per acre.

The seed purchased will be certified to the variety claimed. Also, the mix will be certified that NO noxious weed seeds are present. Pure live seed (PLS) equals the percent of purity times the percent total germination (PLS = % P x % TG).

These seed mixes include the recommendations of District and Forest specialists. We referred to seed mixes previously used with success on the Forest and the Intermountain Planting Guide, from Utah State University Cooperative Extension Service, while designing these seed mixes to achieve the FSM objectives listed above. Dr. Stanley Kitchen from the Rocky Mountain Research Station's Shrub Sciences Lab in Provo also provided input on the seed mixtures.

Seed Mixture #1 will be applied in areas that receive about 14 to 22 inches of precipitation annually and Seed Mixture #2 in the 22+ inch precipitation range. Some of the species in each of these mixes have the ability to dominate a stand depending on the location. The value of multiple species in the seed mix provides the flexibility for different species in the seed mix to thrive in a micro-site that is best suited for that certain species.

Native or Introduced	Species to be Seeded	Seed Mix #1 14 to 22 in. ppt.	Seed Mix #1 14 to 22 in. ppt. +Triticale	Seed Mix #2 22+ in. ppt.	Seed Mix #2 22+ in. ppt. +Triticale	Triticale Only
	< ---- Pounds / Acre (PLS) ---- >					
N	Big bluegrass "Sherman"	0.25	0.25			
N	Bluebunch wheatgrass "Anatone"	1.5	1.5			
N	Snake River wheatgrass "Secar"	1.5	1.5			
N	Canby bluegrass	0.5	0.5	1	1	
N	Sandberg bluegrass (not canbyi)	0.25	0.25			
N	Slender wheatgrass "Pryor"	3	3			
N	Slender wheatgrass "San Luis"			3	3	
N	Mountain brome "Bromar" or "Garnet"	3	3	4	4	
N	Thickspike wheatgrass "Bannock"	1	1	2	2	
I	Crested wheatgrass "Fairway"	2	2			
I	Crested wheatgrass "Hycrest"	2	2			
I	Sterile triticale hybrid		20		20	40

Total Pounds / Acre	15.00	35.00	10.00	30.00	40.00
Total Seeds / ft² 1/	71	76	43	48	10
Estimated Seed Cost / Acre	$44.00	$76.00	$25.25	57.25	64.00
Estimated Cost Seed Mix/Pound	$2.93	$2.17	$2.53	$1.91	$1.60

1/ Recommended rates for broadcast seeding mixes are about 50 – 100 seeds per square foot.

Specific ecological attributes valued for some of the species include the following:

Big bluegrass— "when properly managed, will compete with cheatgrass"

Bluebunch and Snake River wheatgrass— "long-lived, drought tolerant, widespread"

Sandberg and Canby bluegrass— "important for soil stabilization…one of the first grasses to green-up in the spring…excellent in low rainfall native mixes"
(These bluegrasses should be very competitive with cheatgrass.)

Slender wheatgrass— "valuable in erosion control because of its rapid development"

Mountain brome— "will establish and grow on rather poor, depleted soils … recommended sites include weedy openings"

Thickspike wheatgrass— rhizomatous and "adapted to disturbed range sites and dry areas subject to erosion"

Crested wheatgrass— "one of a few grasses that has the ability to compete with difficult to control weedy annuals such as cheatgrass"
— Fairway is reported to fade in abundance sooner than other varieties
— Hycrest is "a hybrid between standard and introduced…outstanding seed producer, excellent seedling vigor, easy to establish under harsh conditions"

Sterile hybrid triticale— "hardy and durable – but, not persistent or invasive…adapts to a wide range of soil and moisture conditions"

There may be opportunities to add other species to the seed mixes. We suggest that District personnel contact the Utah Division of Wildlife Resources prior to actual purchase of the seed. Depending on seed availability and time of seeding, the Division may have seed for forb and browse species that could be added to the seed mix that would enhance both wildlife habitat and diversity in the area (see more detail in Other Recommendations #1 below).

We constrained the total number of acres to be seeded by these guiding factors:

Only seed in disturbed areas located on NFS lands.
Generally, seed suitable areas located within some moderate and high burn severity zones.
Seed areas where pre-burn juniper stands lacked adequate grass seed bank.

The Planting Guide for Utah gives the following information in the "Wildfire Seedings " section.

"Steep slopes and rough areas that are not accessible to conventional ground equipment can be aerial seeded … if it is not possible to cover seed, plant late in the fall and increase the seeding rate ... burned sites, including forest and desert ranges are often seeded within a few days or weeks following the fire, in the mistaken belief that the ash will cover the seed … even if an ash residue or a loose seedbed is present, seed only during the appropriate seasons. Do not plant on a loose dry seedbed … plant in the late fall when seedbeds are firm."

Rest the seeded area, and entire burned area, from livestock grazing for two full growing seasons. This will give the seeded species and residual plants two seasons to grow, set seed and begin to re-establish. When livestock are allowed to return, the treated areas could be grazed late season after seed set. The livestock hoof action would help to work some of the shattered ripe seed into the soil which will continue to extend the value of the treatment.

Noxious Weed Expansion Detection

The purpose of this noxious weed expansion detection treatment is to identify the spread of noxious weeds from any currently known location of noxious weeds. This is an early detection and rapid response strategy. Three aggressive noxious weeds need immediate attention; Scotch thistle, leafy spurge, and musk thistle threaten the area. Also, houndstongue might increase in the area, and whitetop may spread in the lower reach of Sevier Canyon. Several other

species on the State of Utah noxious weed list are present adjacent to the burned area (see Existing Noxious Weed Locations map).

This treatment includes a search for any new individuals of noxious weeds on forest-administered lands for 300 feet inside the fire perimeter along four specific stretches (see Noxious Weed Monitoring and Spot Treatment map). Most of the forest routes in the northeast quadrant of the burned area will be monitored for 150 feet on each side of the route. The Indian Creek and North Creek roads, as well as the dozer line in the South Fork of North Creek will be monitored for 300 feet on each side of the route or line. Also, spike camps, drop points, helispots, and some heliwell locations will be monitored. Individuals of noxious weeds generally will be sprayed with herbicide at the same time they are discovered. New weed locations will be documented with GPS positions and photographed when possible. The search of all locations will occur three times during the growing season, preferably in May, late-June and early August. This frequency should allow individual young weeds to be detected and treated before they reach full maturity and set seed. Monitoring levels may be increased if substantial amounts of young noxious weeds are detected.

Other Management Recommendations

These recommendations do not qualify for BAER funding but were discovered during the assessment process.

1. It would be well to add additional forb and shrub species to seed mixture #1 for wildlife benefit. Species to consider include mountain big sagebrush, antelope bitterbrush, cliffrose, Palmer penstemon, firecracker penstemon and showy goldeneye. Other species to be added will require approval by the Forest Supervisor.

2. Adequate moisture from spring rains will be key to a successful response from the seeding. Forest personnel should anticipate the need to monitor in 2011, and be prepared to seed a second time in late fall 2011.

3. Also, it will be important to monitor the regrowth of vegetation that was on site prior to the burn in the low soil burn severity areas. Are the desirable species establishing or regrowing in the low soil burn severity areas? Is cheatgrass increasing in these areas? If desirable species do not respond reasonably well in the first growing season, it would be important to seed the areas that would be prone to a cheatgrass invasion.

4. It would be well for the Beaver Ranger District's weed specialists to update the weed inventory near the north and west edge of the burned area on, and adjacent to, the Forest.

5. District weed specialists might coordinate with the Beaver County Cooperative Weed Management Area (CWMA) and the South-Central Utah CWMA about the spreading infestation of Scotch thistle near the north, northwest and southwest edge of the burned area and encourage cooperation from adjacent ownerships about controlling the thistle. This is a serious noxious weed issue near the burned area and along major and other well-used travel routes in the Clear Creek, Sulphurdale, Pine Creek, and North Creek areas. These areas underscore the need for continued vigilance and early detection/rapid response to new occurrences on the Forest.

CONTACTS

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(Prepared by *Mark Madsen, Botanist – Dixie National Forest; Bob Campbell, Ecologist and David Tait, Botanist – Fishlake National Forest*)

Broadcast Seeding / Monitoring of BAER Treatments

A. Critical Values

Long-term Soil Productivity & Hydrologic Function – In high and moderate soil burn severity areas the fire completely consumed the vegetation canopy and the effective ground cover that dissipates rainfall and regulates snowmelt runoff. Even with average precipitation, erosion rates will be accelerated in combination with higher surface runoff efficiencies. Soil loss tolerance has been predicted from 108 % to 1400 % in the burned area where seeding is proposed. A 2- or 5-year rainstorm event occurring during the first two years following the fire will greatly increase the potential for loss of topsoil, including the ash from the burned plant litter and duff that also replenish the soil nutrient pool, and reduce the soil productivity of these sites. The potential soil loss due to snowmelt and thunderstorm runoff jeopardizes the natural vegetation recovery.

Natural revegetation to establish vegetative ground cover to protect the soil surface in high and moderate soil burn severity areas will vary. The non-forest cover types (mostly south facing slopes) will likely be 5 - 10 years, while forested lands may take up to 10 or more years to establish pre-fire vegetative ground cover. Lack of vegetative cover and litter can contribute to chronic erosion and perpetual hillslope instability.

Invasive Plant Species and Noxious Weeds - Also of concern is native plant diversity due to minor amounts of noxious weeds and cheatgrass adjacent to high severity burn areas. Plant communities and soil productivity can be severely impacted in the burned area due to the spread of noxious weeds from existing populations and the introduction of noxious weeds and invasive species into new areas as a result of fire suppression efforts and emergency stabilization treatments. In addition, recreational use of the roads and trails leaves the burned area highly susceptible to the expansion and introduction of noxious and invasive plant species.

B. Emergency Treatment Objectives:

The goal of the burned area emergency rehabilitation is to:

- Mulch and vegetation treatments are intended to mitigate soil loss and impaired hydrologic function. Elevated soil erosion, sedimentation, runoff, and stream flows are expected to occur at decreasing rates over two to five years after the fire, until vegetation has sufficiently recovered to restore the surface soil-hydrologic function and processes of the watersheds that burned at moderate and high severity. At lower elevations (14-22 inches precip.), this treatment will also allow some seeded grasses germinate and establish to a point where they will compete with invasive species such as cheatgrass and other noxious weeds. Vegetative recovery and early detection of invasive and noxious weed species (monitoring) are needed to determine if soil productivity objectives are being achieved.

Treatment Narrative:

Seeding

Purpose of Treatment: To seed with grasses in high and moderate severity burn to aid in preventing soil productivity loss, erosion, and debris flows that severely impact soil productivity and hydrologic function. At lower elevations (14-22 inch precip), a primary purpose of this seed treatment is to minimize the spread of minor amounts of adjacent cheatgrass and noxious weeds.

General Description: Aerially seed with grasses in conjunction with mulch treatments on 14,799 acres of other areas to increase the likelihood of success for soil stabilization, establish vegetation in high and moderate severity burn and to prevent additional soil productivity loss. The seeding applications are most effective beyond the first growing season. However, some success has been achieved within the first year using sterile Triticale in the mix.

On the Mill Flat wildfire in 2009, sites above 8,000 feet and below 8,000 feet. Seeded sites without mulch averaged 16 % effective ground cover from seeded grasses (including Triticale) in the first year. These plots averaged 45 % absolute frequency (occurred in 45 out of 100 plots). Plots below 8,000 feet averaged 7 %

effective ground cover from seeded grasses (including Triticale) and 21 % absolute frequency in the first year. On the Bull Complex fire in 2006 (6700 feet) seeded grasses (including Triticale) yielded about 8 % effective ground cover and 20 % absolute frequency of seeded grasses. Rates of aerial seed application on each of these fires was 20 lbs. PLS/acre of sterile Triticale and 15 - 20 lbs. PLS/acre of other perennial grasses. On the Dammeron wildfire of 2005, recovery rates of effective ground cover with similar seeding (including natural recovery) was 8 % in the first year, 23 % in the second year, and 57 % in the third year. In comparison, natural recovery alone (the control site with no seed treatment) was 3 % in the first year, 16 % in the second year, and 25 % in the third year. Photo examples are shown below.

Bull Complex BAER Seeding – 8 % effective ground cover (6,800 feet)

Mill Flat BAER Seeding – 6 % effective ground cover (5,800 feet)

Mill Flat BAER Seeding – 16 % effective ground cover (above 8,500 feet)

Mill Flat BAER Seeding – 15 % effective ground cover (above 8,300 feet)

Mill Flat BAER Seeding – 6 % effective ground cover (5,800 feet)

All of this data was gathered in May and June, therefore effective ground covers are expected to increase as sterile Triticale stalks fell over during the summer.

Below is an example of a mulched site in May 2010 (1 ton per acre done the previous fall after wind dispersion). This example was fairly representative of our mulch sites with proper application. In this example mulch was dispersed by wind which was common on this BAER treatment. Measured effective ground cover in this example is 49 %. Where it stayed in place, germination and establishment of seeded grasses was high as is obvious from the picture. However, further dispersion from wind, after the seeded grasses germinate and establish is inhibited by the seeded grass. This provides an argument for seeding under mulch as a valid BAER treatment. The seeded grasses help inhibit further wind dispersion of straw mulch during the late spring and summer prior to late summer monsoonal rain events. Seeded grasses help to maximize the coverage of straw by keeping straw in place during the late spring and summer. Clearly, as would be expected, covering seed with mulch improves germination and establishment. In the example below, absolute frequency of seeded grasses is 68 % and sterile Triticale is 24 %.

Mill Flat BAER Mulch & Seed Treatment – 49 % effective ground cover (5,700 feet)

On the Twitchell Canyon wildfire, 9,663 acres of the 14,799 acres proposed (65 %) are above 8,000 feet elevation. On Mill Flat, seeded grasses provided for an average 16 % effective ground cover. If we were to seed 9,663 acres above 8,000 feet as proposed, it is possible to expect 16 % effective ground cover from our seed. This would provide 1,546 acres of effective ground cover at 100 % coverage from seeded grasses alone. Using Mill Flat, Dammeron, and Bull Complex wildfires as a yardstick, below 8,000 feet, we may expect an average of 6 % effective ground cover attributable to the proposed seed treatment. On the remainder of our seed treatment (5136 acres or 35 % of the treatment area), this would provide an additional 308 acres of effective ground cover at 100 % from seeded grasses alone. This would occur by the following May or June. Sterile Triticale stalks usually cure off and begin to fall over by July and August. This would likely increase the effective ground cover as summer progressed. These effective ground cover estimates may me conservative by the time high intensity monsoonal storms come. Therefore, the seeding would be expected to cover 1854 acres at 100 % effective ground cover. At $832/acre for mulch, 1854 acres would cost $1,542,528. This proposed seed treatment would cost $1,273,956 ($687/acre) and would be 50 % more effective than mulch (100 % ground cover vs. a wind and snow dispersed 50 % mulch ground cover) by the late spring following application. Although this treatment might be spread out over a much larger area, it may be more cost effective than a mulch treatment.

Concern has been expressed that using sterile Triticale may suppress other seeded perennials in these proposed seed mixes. However, given recent experience with seeding sterile Triticale with other perennial grasses on Mill Flat, Dammeron, and Bull complex wildfires, uncovered (e.g. unmulched) seeded areas often do not respond well in Year 1 following a wildfire. If this seed comes up at all (depending on its' competing nature), it does so in Years 2 - 5 after the Triticale is long gone. Therefore, little direct competition for resources from germinating seed is expected.

However, when all things are considered, the success of seeding treatments is largely dependent upon favorable soil and climatic conditions during germination and establishment periods.

<u>Location (Suitable) Sites:</u>

Moderate to high severity burn areas of the Twitchell Canyon Fire. (blue, gold, and striped areas - see attached map).

Design/Construction Specifications:

Aerial application of seed mix will be by fixed-wing aircraft or helicopter.

Five seed treatments are proposed (see Aerial Seeding Treatment map):

1. Seed mix #1 (without Triticale) to be applied on areas mulched (14-22 inches precip.) – 844 acres:

Big Bluegrass (*Poa ampla*) – Sherman cultivar – 0.25 lbs. PLS/acre

Bluebunch Wheatgrass (*Elymus spicatus*) – Anatone cultivar – 1.5 lbs. PLS/acre

Snake River Wheatgrass (*Elymus waiwaiensis*) – Secar cultivar – 1.5 lbs. PLS/acre

Canby Bluegrass (*Poa canbyi*) – Canbar cultivar – 0.5 lbs. PLS/acre

Sandberg Bluegrass (*Poa sandbergii*) – VNS -0.25 PLS/acre

Slender Wheatgrass (*Elymus trachycaulus*) – Pryor cultivar – 3 lbs. PLS/acre

Mountain Brome (*Bromus carinatus*) – Bromar cultivar – 3 lbs. PLS/acre

Thickspike Wheatgrass (*Elymus lanceolatus*) – Bannock cultivar – 1 lbs. PLS/acre

Crested Wheatgrass (*Agropyron cristatum*) – Hycrest cultivar – 2 lbs. PLS/acre

Crested Wheatgrass (*Agropyron cristatum*) – Fairway cultivar – 2 lbs. PLS/acre

Total = 15 lbs. PLS/acre

2. Seed mix #1 to be applied on areas not mulched (14-22 inches precip.) – 1,439 acres:

Sterile Triticale Hybrid – 20 lbs. PLS/acre

Big Bluegrass (*Poa ampla*) – Sherman cultivar – 0.25 lbs. PLS/acre

Bluebunch Wheatgrass (*Elymus spicatus*) – Anatone cultivar – 1.5 lbs. PLS/acre

Snake River Wheatgrass (*Elymus waiwaiensis*) – Secar cultivar – 1.5 lbs. PLS/acre

Canby Bluegrass (*Poa canbyi*) – Canbar cultivar – 0.5 lbs. PLS/acre

Sandberg Bluegrass (*Poa sandbergii*) – VNS -0.25 PLS/acre

Slender Wheatgrass (*Elymus trachycaulus*) – Pryor cultivar – 3 lbs. PLS/acre

Mountain Brome (*Bromus carinatus*) – Bromar cultivar – 3 lbs. PLS/acre

Thickspike Wheatgrass (*Elymus lanceolatus*) – Bannock cultivar – 1 lbs. PLS/acre

Crested Wheatgrass (*Agropyron cristatum*) – Hycrest cultivar – 2 lbs. PLS/acre

Crested Wheatgrass (*Agropyron cristatum*) – Fairway cultivar – 2 lbs. PLS/acre

Total = 35 lbs. PLS/acre

3. Seed mix #2 (without Triticale) to be applied on areas mulched (22+ inches precip.) – 4,239 acres:

Canby Bluegrass (*Poa canbyi*) – Canbar cultivar – 1 lbs. PLS/acre

Slender Wheatgrass (*Elymus trachycaulus*) – San Luis cultivar – 3 lbs. PLS/acre

Mountain Brome (*Bromus carinatus*) – Bromar cultivar – 4 lbs. PLS/acre

Thickspike Wheatgrass (*Elymus lanceolatus*) – Bannock cultivar – 2 lbs. PLS/acre

Total = 10 lbs. PLS/acre

4. Seed mix #2 to be applied on areas not mulched (22+ inches precip.) - 7,043 acres:

Sterile Triticale Hybrid – 20 lbs. PLS/acre

Canby Bluegrass (*Poa canbyi*) – Canbar cultivar – 1 lbs. PLS/acre

Slender Wheatgrass (*Elymus trachycaulus*) – San Luis cultivar – 3 lbs. PLS/acre

Mountain Brome (*Bromus carinatus*) – Bromar cultivar – 4 lbs. PLS/acre

Thickspike Wheatgrass (*Elymus lanceolatus*) – Bannock cultivar – 2 lbs. PLS/acre

Total = 30 lbs. PLS/acre

5. Sterile Triticale only to be applied on North Fork of North Creek – 1234 acres:

Sterile Triticale Hybrid – 40 lbs. PLS/acre

Total = 40 lbs. PLS/acre

(Prepared by Mark Madsen, Botanist, Dixie National Forest and Bob Campbell, Ecologist, Fishlake National Forest)

FISHERIES ASSESSMENT

Objectives

The objectives of this fisheries assessment are to 1) evaluate the risk to fisheries and their habitat from effects of the Twitchell Canyon fire, 2) recommend actions that can reduce adverse impacts to hydrologic function and associated fisheries values, 3) evaluate the value of other teams recommended actions to hydrologic function and associated fisheries values, and 4) discuss recovery actions for native Bonneville cutthroat trout and how they interrelate to the Twitchell Canyon fire, its effects, and BAER proposed actions.

Existing Conditions

The table below summarizes fish species, aquatic macroinvertebrate samples, survey dates, habitat impacts, limiting factors and current condition for the fish supporting streams affected by the Twitchell Canyon fire.

Stream Information Summary

HUC Number	Macro - invert.	Sport fish	Surveys	Current habitat impacts	Limiting Factors	Current Condition Summary
1603000301 Clear Creek (mainstem)	Below S&G. No trend data	Brown trout, brook trout	Electroshock 2000, 2003, 2006 IRE 2005	Freeway and highway, recreation	Temperature, water quality	Stream in relatively good condition but altered channel and water quality due to road/freeway.
160300030101 Fish Creek	Below S&G. No trend data	Brown trout, rainbow trout, Bonn. cutthroat trout*	Electroshock 2003, 2006 IRE 2005	OHV, grazing, past flooding damage (1983), historic mining	Sedimentation (upper), temperature (lower), channel morphology/ few pools on lower stream near/upstream from I-70	Upper stream is in relatively good condition but is impacted by user created OHV route along stream. Route closed out in 2009 and 2010. Area upstream from I-70 for several miles affected by grazing, which has limited recovery from 1983 flooding.

HUC Number	Macro - invert.	Sport fish	Surveys	Current habitat impacts	Limiting Factors	Current Condition Summary
160300030102 Shingle Creek	Below S&G. No trend data	Brown trout, rainbow trout, Bonn. cutthroat trout*	Electroshock 2002, 2003, 2004, 2007, 2010 IRE 2005	Grazing (lower), prescribed fire, recreation, OHV	Sedimentation, temperature, channel/pool (lower)	Upper stream is in relatively good condition. Lower stream affected by grazing and recreational use. Fish distribution appears to be potentially limited by temperature at lower end.
160300030104 Mill Creek	No data	Rainbow trout	Electroshock 2003 IRE 2005	Heavy recreational use, grazing, recreational dredging	Sedimentation	Banks in poor condition along road
160300070101 Indian Creek	Above S&G. No trend data	Brook trout, rainbow trout	Electroshock 2008 IRE 2003	Encroaching road, grazing, 1993 dam breach, flooding, and old mines. Whirling disease recently introduced into reservoir.	-	Good stream fishery. Popular reservoir fishery.
160300070203 South Fork of North Creek	No data	Rainbow trout, cutthroat hybrids	IRE 2003	Dam/water management, localized grazing.	-	Unknown numbers and trend but appears to be good fishery. Stream is near potential condition.
160300070208 North Fork of North Creek	Below S&G. No trend data	Bonn. cutthroat trout – trend up after treatments to eliminate lower hybrids	Electroshock 2001, 2009 IRE 2003	Road, grazing, recreation, OHV	Pool volumes, sedimentation	Stream has excessive riffles from past watershed impacts. Current impacts from road, grazing, and OHVs. Additional flood impacts in May 2005

HUC Number	Macro - invert.	Sport fish	Surveys	Current habitat impacts	Limiting Factors	Current Condition Summary
160300070501 Pine Creek (Sulphurdale)	Below S&G.	Bonn. cutthroat trout – trend static at low numbers 1995-2001, slightly up by 2005 after grazing rest for prescribed fire.	Electroshock 2001, 2005, 2008 IRE 2002	Grazing, road along creek with numerous stream crossings, recreation, prescribed fire	Pool volume, sedimentation	Sedimentation and bank damage has limited cover and pools.

*Bonneville cutthroat trout – Approved for reintroduction, recovery projects initiated.

The Fishlake N.F. Forest Plan specifies yearly monitoring of aquatic macroinvertebrates and has a Standard and Guideline relating to the Biotic Condition Index (BCI). The table below summarizes the BCI values for past aquatic macroinvertebrate monitoring on streams affected by the Twitchell Canyon fire.

Aquatic Macroinvertebrate Samples: Biotic Condition Index (BCI)

STATION	87	88	89	90	93	95	96	97	98	99	00	01	02	03	04	05	06	07	10
NFNC 1	-	-	-	-	-	-	-	-	68	68	-	-	-	-	-	69	-	-	-
NFNC 2	-	-	-	-	-	-	-	-	73	71	-	-	-	-	-	-	-	-	-
Indian Cr1	-	-	-	-	72	-	-	-	-	75	-	-	-	-	-	-	-	-	-
Indian Cr2	-	-	-	-	66	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pine 1	-	-	-	-	-	-	-	-	62	71	-	-	-	-	-	83	-	-	-
Pine 2	-	-	-	-	-	-	-	-	-	71	-	-	-	-	-	72	-	-	-
Low Clear	-	-	-	-	-	-	-	-	-	-	-	-	-	58	-	-	-	-	-
Clear Cr 5	-	-	-	-	-	-	-	-	-	-	-	-	-	60	-	-	76	-	C*
Shingle 1	-	-	-	-	-	-	-	-	-	-	-	-	-	62	-	-	-	-	C*
Shingle 2	-	-	-	-	-	-	-	-	-	-	-	-	-	65	-	-	-	-	-
Shingle 3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C*
Shingle 5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	C*
Fish Cr 1	-	-	-	-	-	-	-	-	-	-	-	-	-	64	-	-	-	-	-
Fish Cr 2	-	-	-	-	-	-	-	-	-	-	-	-	-	68	-	-	-	-	-

Note: BCI data for the table is found in Mangum (various dates) and Vinson (various dates). These reports are on file at the Fishlake N.F. Supervisor's Office.

*C-Collected pre-fire but not yet sent to lab

Other then Bonneville cutthroat trout no other sensitive fish species occurs in the vicinity of the Twitchell Canyon fire. There are no threatened, endangered, candidate, or proposed aquatic species in the general vicinity of the Twitchell Canyon fire. There are no sensitive amphibian species in the general vicinity of the Twitchell canyon fire. Leopard frogs, considered a common amphibian although quite restricted on the Forest, occur in upper Clear Creek and northern tributaries of Clear Creek outside of the fire affected area.

The Hydrologic Resource Assessment and Vegetation Resources Assessment contain background information regarding watershed size, geology, precipitation regimes, and plant cover helpful to understanding fisheries. The reader is referred to these two reports for additional information.

Potential Effects – Watershed Area Burned

Monitoring of southern Utah fires on the Dixie and Fishlake National Forests shows that percentage of the watershed burned in moderate to high severities can be used to predict the level of effects to stream fish populations and their habitats. The following figures were obtained by using GIS derived burned acres and watershed areas for HUC6 watersheds and smaller 7th and 8th field subwatersheds containing the Twitchell Canyon fire. Logical population extent boundaries were used for the analysis, such as confluences and diversions. Where HUC6 figures were used they are identified, otherwise the smaller subwatersheds were summed to create the figures.

South Fork of North Creek
HUC6 Watershed – 8% Moderate to High Severity
Pine Creek tributary – 48% Moderate to High Severity (24/24)

North Fork of North Creek
Watershed – 38% Moderate to High Severity
Pole Creek tributary - 54% Moderate to High Severity (47/7)

Indian Creek
Watershed –38% Moderate to High Severity
Twitchell Canyon tributary – 50% Moderate to High Severity (3/47)
Mill Hollow tributary - 74% Moderate to High Severity (26/48)

Wildcat Creek – No fishery

Pine Creek (Sulphurdale)
Watershed – 2% Moderate to High Severity

Sulphur Creek – No fishery

Cove Creek – No fishery

Shingle Creek
Watershed – 41% Moderate to High Severity
[Note: total above includes dry side drainages near confluence-fish portion only about 45-50% burned.]
Snow Canyon tributary - 21% Moderate to High Severity (6/15)

Fish Creek
HUC6 Watershed – 47% Moderate to High Severity
Hop Canyon (face drainage) - 96% Moderate to High Severity (32/64)
Line Canyon – 83% Moderate to High Severity (7/76)
Trail Canyon – 53% Moderate to High Severity (27/26)

Picnic Creek – 59% Moderate to High Severity (41/18)
Note: Line-Trail-Picnic subwatersheds together are 66% Moderate to High Severity (25/41)
East Fork Fish Creek - 19% Moderate to High Severity (11/8)
Upper Fish Creek - 39% Moderate to High Severity (24/15)

Mill Creek
HUC6 Watershed – 19% Moderate to High Severity
Sevier Creek tributary - 74% Moderate to High Severity (27/47)

The following table shows the above watershed burned figures in context with other large fires on the Dixie and Fishlake National Forests over the past decade. It can be seen that several of the watersheds within the Twitchell Canyon fire affected area are burned at levels where serious effects to fish populations and their habitat can be expected.

Fire Effects to Fisheries – Southern Utah 2000-2010

Stream	Total % M-H Severity	Fish Pop. Effects	Channel Effects	Fire/Year
Pine Creek (Sul)	2%	Expected-none	Expected-none	Twitchell/2010
Shingle Creek	2% (8% stream length)	Reach scale decline	Minimal	Pres. Burn/2002
SF North Creek	8%	Expected-minimal	Expected-none	Twitchell/2010
Oak Creek	12%	Extirpated*	1 to 2 foot downcutting*	Devils Den/2006
Pine Creek (Sul)	12%	Minimal	None	Pres. burn/2004
Mill Creek	19%	Expected-reach scale	Expected-minimal	Twitchell/2010
Sanford Creek	30% (Majority at moderate)	Extirpated - year 2	Minor	Sanford/2002
Deer Creek	37%	Extirpated	Moderate	Sanford/2002
Indian Creek	38%	Expected-severe upper, extirpated lower	Expected-major	Twitchell/2010
NF North Creek	38%	Expected-extirpation	Expected -major	Twitchell/2010
Shingle Creek	41%	Expected-extirpation	Expected-major	Twitchell/2010
Cottonwood Creek	45%	Extirpated	Major	Sanford/2002
Fish Creek	47%	Expected - extirpation	Expected-major	Twitchell/2010
Deep Creek	56%	Extirpated	Extensive	Sanford/2002

*A debris flow prone subwatershed with about 90% moderate to high severity burn was located at the head of the Oak Creek fishery. A 25-year storm event in October following the fire generated a 100-year flood event with extensive sediment from the burned subwatershed, accounting for the serious effects despite a relatively low overall watershed percentage burned.

The above table shows that the fish populations in North Fork of North Creek, Fish Creek, and Shingle Creek are at high risk of extirpation and major channel effects such as downcutting, aggradation, and lateral migration

are likely. South Fork of North Creek may have fish kills below the Pine Creek tributary confluence. North Fork of North Creek and its Pole Creek subwatershed will likely lose all fish. Upper Indian Creek was mostly moderate to low fire severities and will likely support trout but have decreased numbers for the next 2-5 years. Debris flows from the Twitchell and Mill Hollow subwatersheds that connect mid-canyon will likely have serious effects to fish populations and their habitat below their confluences. Pine Creek will not likely have any effects from the Twitchell Canyon fire. Shingle Creek will likely suffer extirpation and serious habitat effects in the mainstem, but some fish will likely survive in the Snow Canyon tributary. Fish Creek will likely suffer extirpation and serious habitat effects below the confluence of Line Canyon, Trial Canyon, and Picnic Canyon tributaries. Some fish will likely survive in the headwaters of Fish Creek and the upper elevation tributary East Fork of Fish Creek.

Initial Fire Effects – October 4 to 5, 2010 Ash Flow

To help with the BAER team work, we made a quick assessment on 10/10/2010 of the effects to fisheries from the ash flow that came down the streams on 10/4 to 10/5 during the rain event. The rain was gentle but prolonged, producing peak flows near or just over bankfull (i.e. a normal peak runoff flow; not a flood level). The following are the results:

South Fork of North Creek was not assessed. Only minor impacts would be expected in the mainstem, but impacts could be higher in the Pine Creek tributary.

North Fork of North Creek – Station 03 (upper canyon)

	Fish / Mile	Lbs / Acre
2010	117	7.8
2009	354	28
2002	290	17

The three sites checked in the upper canyon of North Fork of North Creek averaged 82 fish/mile. The figure dropped to 45 fish/mile and 3.6 lbs/acre at the fish barrier in the lower canyon.

Indian Creek was not assessed but probably had moderate impacts. We do have data from 2 stations in 2008 for a baseline for future assessments. Reports from the road crew are that some fish did survive the ash flow.

Pine Creek (Sulphurdale) was not assessed but probably had very minor impacts.

Shingle Creek – Station 01 (lower canyon)

	Fish / Mile	Lbs / Acre
2010	0	0
2007	1690	100.5
2004	483	30.6
2003	177	8.5
2002*	60	9.9

*0.5 miles of riparian area/stream was burned above S01 about 6 weeks before the 02 sample date. The 2007 population level would be a typical level for this stream. The increase in numbers and biomass from 2002 to 2007 shows the recovery of this station from the fire effects of the localized burn just upstream.

Fish Creek just above the confluence with Clear Creek had 13 fish/mile and .3 lbs/acre.

Clear Creek – Station 05 (upper between Fish Creek and Shingle Creek)

	Fish / Mile	Lbs / Acre
2010	0	0
2006	1575	111
2002	778	97.4

Clear Creek – Visitor Center Station (Fremont Indian State Park)

	Fish / Mile	Lbs / Acre
2010	211	8.6
2003	982	51

Mill Creek was not assessed, but was running clear on 10/4 near its confluence with Clear Creek. Impacts are possible below the Sevier Canyon confluence.

Typical fish abundance figures for the Fishlake N.F. would range from about 400 fish/mile (often streams with poorer water quality but with fewer larger fish) up to 2000 fish/mile. Typical standing crop figures for the Fishlake N.F. are about 50 to 60 lbs/acre with higher quality streams supporting over 100 lbs/acre. This is a better figure to compare [across] streams as it reflects the biomass that the stream is actually supporting (i.e. the streams productivity).

The above results are just the effects from the initial ash flow off of the burned areas and in the case of upper North Fork of North Creek, direct fire effects such as water heating. Future effects from sediment delivery off of burned areas into the stream channels, including possible debris flows, are expected to be much higher and more significant. This will impact not just the populations but the habitat that supports them.

Aquatic macroinvertebrates were checked at most of the sample sites. Very few aquatic macroinvertebrates were found at all sites except lower Clear Creek. Interestingly, almost all individuals observed were of a single mayfly taxon, although some were larger individuals. For comparison, greater numbers of live macroinvertebrates were seen when collecting a sample on a recently rotenoned stream [Pine Creek (Escalante) 2001].

Treatments

Grade Stabilizers

Grade stabilizers are designed to prevent channel incising and downcutting by providing grade control to systems that may become destabilized from increased storm runoff and velocities. It is expected that four streams directly affected by the Twitchell Canyon fire would likely be subject to channel grade changes that could affect infrastructure, human safety, hydrologic function, and secondarily fisheries habitat. These streams are North Fork of North Creek, Indian Creek, Shingle Creek, and Fish Creek. In addition, the Clear Creek mainstem was identified as having potential to downcut. Discussion with Forest Service and Utah Division of Wildlife Resources fisheries biologists and Forest engineers and hydrologists identified 30 potential grade stabilizer locations on these streams. Analysis indicated that 12 of these locations met the primary BAER objectives of immediate protection to Forest infrastructure, human health and safety, and preventing adverse changes to hydrological function. The other 18 locations act in concert with the 12 initial sites to further stabilize large stream reaches to prevent adverse changes in hydrologic function. By preventing or reducing adverse changes in hydrologic function these treatments will secondarily protect important fisheries habitat.

Cooperator funding will be requested through other avenues to construct the 18 additional grade stabilizers not included in the BEAR funding request.

Grade stabilizers would be constructed from large rocks in stream reaches where loss of large areas of upstream watershed vegetation and soil cover will result in increased runoff that would cause channel downcutting. Values at risk include hydrologic function on four watersheds with large areas of high to moderate burn severities. Loss of hydrologic function and downcutting would increase channel sediment bedload, lower water tables supporting riparian vegetation and decrease stream fisheries habitat condition and complexity. Other associated values protected by this project include Forest roads along two streams with multiple stream crossings and one crossing on each of the other two streams. One stream provides habitat for a remnant population of Bonneville cutthroat trout, a Forest Service sensitive species, and two streams are approved Bonneville cutthroat trout restoration streams where reintroduction work been initiated. Without treatments continued Bonneville cutthroat trout restoration work would likely be delayed resulting in a loss of momentum in species recovery projects being conducted under the Conservation Agreement and Strategy for this subspecies.

Grade stabilizer locations for BAER funding are shown on the Engineering map and their specifications are included in the Engineering specification sheets. General locations for grade stabilization work including both BAER funding and cooperator funding are shown on the Grade Stabilization map.

Construction: For each grade stabilizer site:

1. A hydrologist or fisheries biologist and engineer will coordinate to identify the treatment site by staking, flagging, and marking GPS coordinates.

2. Estimate the size and amount of material required for each structure.

3. Ensure rock is large enough to withstand the erosive force of the stream channel. Estimate the width of the channel for the targeted high flows to ensure the structure is built so that it is not outflanked by them.

4. Construct the structure at grade, which requires excavation.

5. Spread excavated material on the slopes and/or use it to fill around the rocks.

6. Inspect and monitor the structures for any signs of erosion after the first storm event.

Other treatments

The Hydrologic Resource Assessment identified that besides risk to human health and safety, Forest roads and trails, and the Shingle Creek fish barriers, adverse changes to hydrologic function are expected in several watersheds, which could result in channel downcutting and lateral migration which would further result in loss of riparian habitat and stream access to their floodplains. This would degrade aquatic habitat for Bonneville cutthroat trout existing remnant populations and restoration habitat, as well as non-native recreational trout fisheries. The Hydrologic Resource Assessment identified five watersheds as having a very high to high risk of erosion, large increases of peak stream flow, and debris flow events. These watersheds are Fish Creek, Shingle Creek, North Fork of North Creek, and two fishless tributary subwatersheds – Sevier Canyon (Mill Creek) and Twitchell Canyon (Indian Creek). To counter these risks the Hydrologic Resource Assessment identified 4,158 acres of aerial mulch treatments. These areas would be mulched at about 1.0 ton/acre on high to moderate soil burn severities on slopes under 70%. Watersheds treated would be the North Fork of North Creek, Twitchell Canyon and Mill Hollow tributaries in Indian Creek, Shingle Creek, Fish Creek, and the Sevier Canyon tributary of Mill Creek.

The Vegetation Resources Assessment found high potential for substantial soil loss in Fish Creek and its Line Canyon tributary, Shingle Creek, Sevier Canyon (Mill Creek tributary), Twitchell Canyon and Mill Canyon (Indian Creek tributaries), North Creek and its Pole Creek tributary, and Pine Creek (South Fork of North Creek tributary). Another risk was invasion of noxious weeds and cheatgrass into burned areas, which could displace native plants, disrupting and shortening the natural fire intervals leading to increased fire effects to streams in the future. The Vegetation Resources Assessment recommended seeding 844 acres of lower elevation areas to reduce cheatgrass infestation, seeding of higher elevation areas with native plants only on the 4,158 acres mulched and an additional 7,043 acres not mulched with native plants and 20 lbs/acre of a sterile hybrid (grows for one year to provide organic matter for soil cover and protection). Finally, 1,234 acres of steep slopes on less receptive soils in upper North Fork of North Creek (Bonneville cutthroat trout habitat) would be seeded at 40 lbs/acre with the sterile hybrid for organic cover but with no native seeds (these slopes are too steep for effective mulching).

Analysis

The streams with portions in the Twitchell Canyon fire include recreational fisheries, a remnant native Bonneville cutthroat trout stream, and two streams already identified and approved for recovery of native Bonneville cutthroat trout. Monitoring to date has shown that just the initial ash flow off of the burned areas into the streams reduced fish numbers in North Fork of North Creek and lower Clear Creek, nearly eliminated fish from lower Fish Creek, and eliminated fish from lower Shingle Creek and upper Clear Creek. High peak flows with high levels of sediment from spring runoff and summer thunderstorm events over the next few years are likely to extirpate fish populations in most of Fish Creek, Shingle Creek, and North Fork of North Creek based on the watershed burn percentages. Hydrologists and ecologists have identified large areas of the burn at risk for adverse changes in hydrologic function, soil loss, and invasion of noxious weeds and cheatgrass. Without treatments fish population loses would be even more severe, extending down into areas with lower burn percentages, and negative habitat effects would likely carry on for an extended period, perhaps beyond 5 years. Invasion by cheatgrass could increase long-term fire frequency and stream sedimentation rates in low to moderate elevation zones. Treatments will not likely be effective in preventing fish population loss in the most heavily burned watersheds. They will still be *critical*, however, for long-term habitat recovery. The Hydrologic Resource Assessment indicated that the mulch treatment would likely reduce sediment deliver off of the treated areas by 50%. They will also reduce downstream peak flows. The seeding treatments for areas unsuitable for mulching will be critical for stabilizing high burn severity units too steep to mulch, especially in Line Canyon and the upper watershed of North Fork of North Creek. The grade stabilization structures will act in concert with the above treatments, which reduce sediment delivery to the stream, to minimize stream downcutting and lateral migration on North Fork of North Creek, Indian Creek, Shingle Creek, and Fish Creek. Downcutting and lateral migration can result in further large sediment delivery to streams. Preventing downcutting is critical to maintaining the streams access to its floodplain for long-term fisheries habitat stability. These treatments acting together will shorten the watershed recovery time, reducing the time until fish population recovery actions can be undertaken (also see the Bonneville cutthroat trout write-up below).

Monitoring

For the Grade Stabilizers the following monitoring will be conducted by a fisheries biologist or hydrologist.

Implementation Monitoring

• Was the treatment implemented as designed?
• Is the structure at grade?
• Is the structure long enough to avoid outflanking?
• Were State or Federal streambank permit final reports submitted?

Effectiveness Monitoring

• Regularly inspect drainage structures and tread condition for the next 5 years or until side slopes revegetate noting the following items:
• What type of storm events did the structure receive prior to monitoring?
• Are there indications of channel downcutting? If so, are more structures needed?
• Is grade stabilizer structure maintenance needed?
• Did the structure function as designed?

Besides the BAER treatment monitoring described above for grade stabilizers, Fishlake N.F. and UDWR fisheries biologists will monitor fish survival, fisheries habitat, and aquatic macroinvertebrates in the affected streams.

Bonneville Cutthroat Trout

Bonneville cutthroat trout are a Forest Service Region 4 sensitive species and a Utah conservation species. They have been managed under a Conservation Agreement and Strategy since 1997. The Conservation Agreement was recently renewed in 2008 and the Conservation Strategy is currently undergoing revision for an expected renewal in the near future. The Conservation Agreement and Strategy direct signatory agencies to both protect populations and habitat, as well as undertake further recovery actions. Goal number 2 of the Conservation Agreement is to "Enhance or restore habitats used by conservation populations, including habitat associated with populations identified for restoration or expansion, to a desired, properly functioning. Actions should be also undertaken to curtail undesirable impacts from ongoing land uses, to the extent possible." (BVCT State of Utah Conservation Team 2008: p2.)

Bonneville cutthroat trout have been petitioned for listing as a threatened species multiple times. In the latest review the Fish and Wildlife Service (FWS) found they were not warranted for listing, in part due to the Conservation Agreement and Strategy protections and recovery actions. The Fish and Wildlife Service noted in their decision that their rationale was based on the fact that continued recovery actions would take place under the Conservation Agreement and Strategy with the expectation that the near future rate of recovery actions (i.e. momentum) would continue at recent levels. They further noted that it was important to work to recover Bonneville cutthroat trout into higher quality streams then have been done in the past, and that it was important to create metapopulations (connected populations within larger watersheds) of Bonneville cutthroat trout.

Bonneville cutthroat trout historic range is broken into separate Geographic Management Units (GMUs) in the Conservation Agreement and Strategy. The Fishlake N.F. is located in the southern GMU. The southern GMU currently has the smallest amount of historic habitat occupied by Bonneville cutthroat trout, currently about 11%. This makes the southern GMU vulnerable should a petitioner ask for listing of Bonneville cutthroat trout in a portion of their range instead of range-wide.

The Fishlake N.F. has a successful cooperative program with the Utah Division of Wildlife (UDWR) for restoration of Bonneville cutthroat trout. In the past decade on the Forest two new remnant populations have been identified and three additional streams have been restored to Bonneville cutthroat trout, although two of these are marginal lower quality streams.

The expected effects from the Twitchell Canyon fire place one historical remnant population in North Fork of North Creek at risk of extirpation. This population is considered a conservation population but is slightly introgressed. Habitat improvement projects (rock sills to create pools) have been constructed in North Fork of North Creek to improve Bonneville cutthroat trout habitat, and are threatened by high peak water flows and sediment from the burned areas.

The Twitchell Canyon fire will also impact current recovery efforts. Two larger higher quality drainages on the north side of the Tushar Mountains were selected and approved for recovery in a UDWR and FWS NEPA Environmental Analysis (EA), along with several other additional streams. With the planned recovery work four of the tributaries of Clear Creek would be restored to native Bonneville cutthroat trout, raising the potential of creating a southern Utah metapopulation. To begin the recovery work Shingle Creek had two fish barriers constructed at its confluence with Clear Creek in 2009. The first of two renovation treatments was planned for summer 2010 but was precluded by the fire. A natural barrier was identified in the upper portion of Fish Creek and initial treatment in upper Fish Creek was planned for 2011. High flows and sediment from the burned areas could threaten the Shingle Creek fish barriers. Unstable habitat in these drainages could delay these recovery projects for 2-5+ years, especially if treatments to reduce flood peaks and sediment delivery are not undertaken.

The general public has a neutral stance on native trout restoration – primarily they are interested in being able to catch a decent sport fish in a reasonable amount of time and effort. The effects of the Twitchell Canyon fire present both challenges and opportunities to the restoration of native Bonneville cutthroat trout. Fire watershed effects will greatly reduce habitat quality in the short term, and will likely increase the challenge of treating streams. Sport fisheries in the Clear Creek drainage and mainstem will be severely impacted by flooding and sedimentation and may suffer extensive declines and even extirpation over the next 2 to 5 years. If Bonneville cutthroat trout recovery actions are delayed by extended fire effects and do not take place until after the sport fishery and its habitat has recovered, the recovery work would impact public sport fishing for a second time. Public support for the native fish program would decline as anglers would not be supportive of treatments that impact their sport fishing after the fishery has recovered from an extended absence. If, on the other hand, BAER treatments, restoration and recovery treatments, and NFWF fisheries and cooperator funded treatments can speed habitat recovery, and management actions and funding can be undertaken to conduct native trout recovery actions timed to occur with the recovering habitat, there will likely be high public support. The latter scenario also ensures Bonneville cutthroat trout recovery momentum is maintained, thus supporting the Fish and Wildlife Service decision that listing is not warranted.

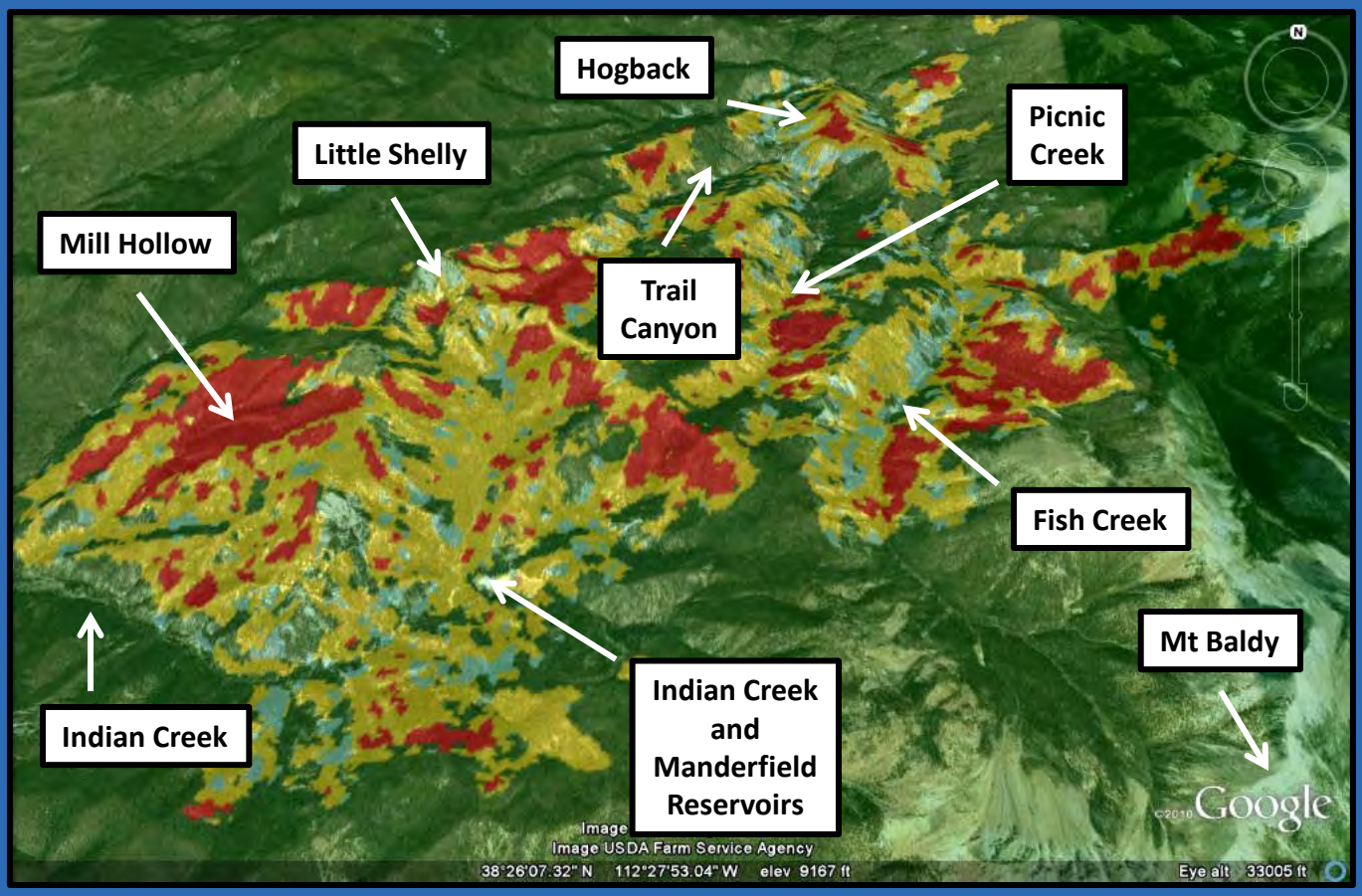
References

BVCT State of Utah Conservation Team. 2008. Conservation agreement for Bonneville cutthroat trout (*Oncorhynchus clarki utah*) in the State of Utah. Utah Division of Wildlife Resources, Salt Lake City, Utah.

(Prepared by Jim Whelan, Fisheries Biologist – Fishlake National Forest)

Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q … BARC Image / 09-13-2010



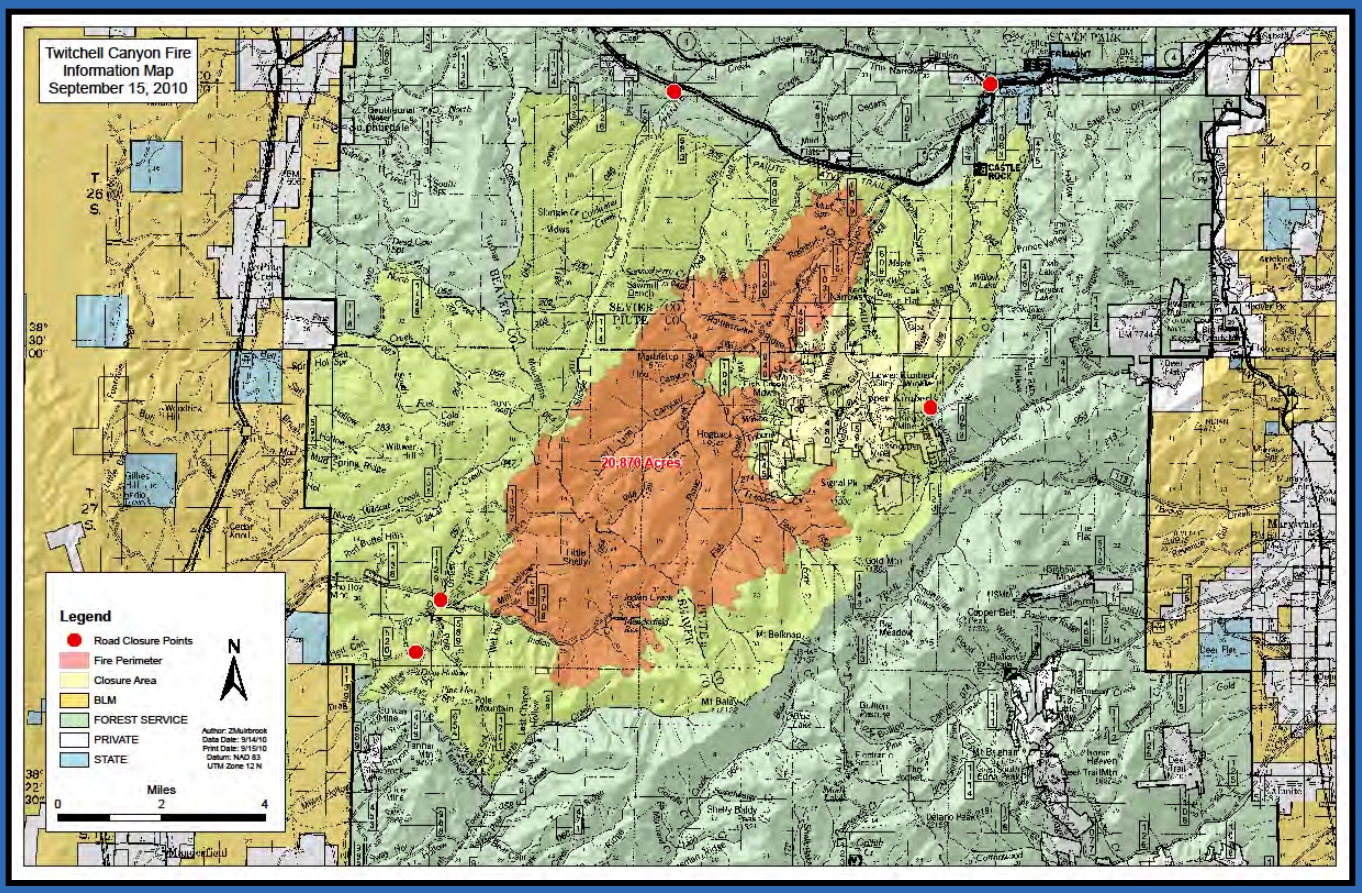
Burn Severity Map # 1 – 10,624 Acres

The best Burn Severity Maps are actually a combination of using BARC 256 Imagery, making observations about the fire while taking several reconnaissance flights over the burn - and, by having the BAER Team conduct field sampling activities -- looking for ... water-repellent ground conditions. Usually, it takes about 48 to 72 hours to make a really good Burn Severity Map – it just depends upon the size and complexity of the incident.

The task is very important because ... 1) it helps the BAER Team determine values-at-risk on NFS lands, 2) it allows the Team to quantify the amount of emergency treatments required to stabilize severely burned terrain and 3) it identifies fire-damaged areas that may be prone to debris flows, mudslides & flooding hazards .

Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 09-15-2010



Public Information Map – 20,870 Acres

The purpose of this map was to provide up-to-date information to local residents, Forest Visitor's and our own employees about the status of the Twitchell Canyon Fire; this burn is located on the Beaver Ranger District of the Fishlake National Forest. Our map contains specific information … including the current perimeter of the burn, areas which are temporarily closed for logistics or safety reasons, it identifies several road closures and security check points – and, it displays the various ownerships of private and public lands involved with the incident.

At this time, our decision remains to manage the burn for the following multiple objectives: 1) do NOT expose firefighters to safety hazards, 2) minimize negative impacts to private property, 3) promote ecological health, 4) expect the burn to be long-term – lasting > 60 days & 5) accept the risks involved with this decision.

Fishlake National Forest

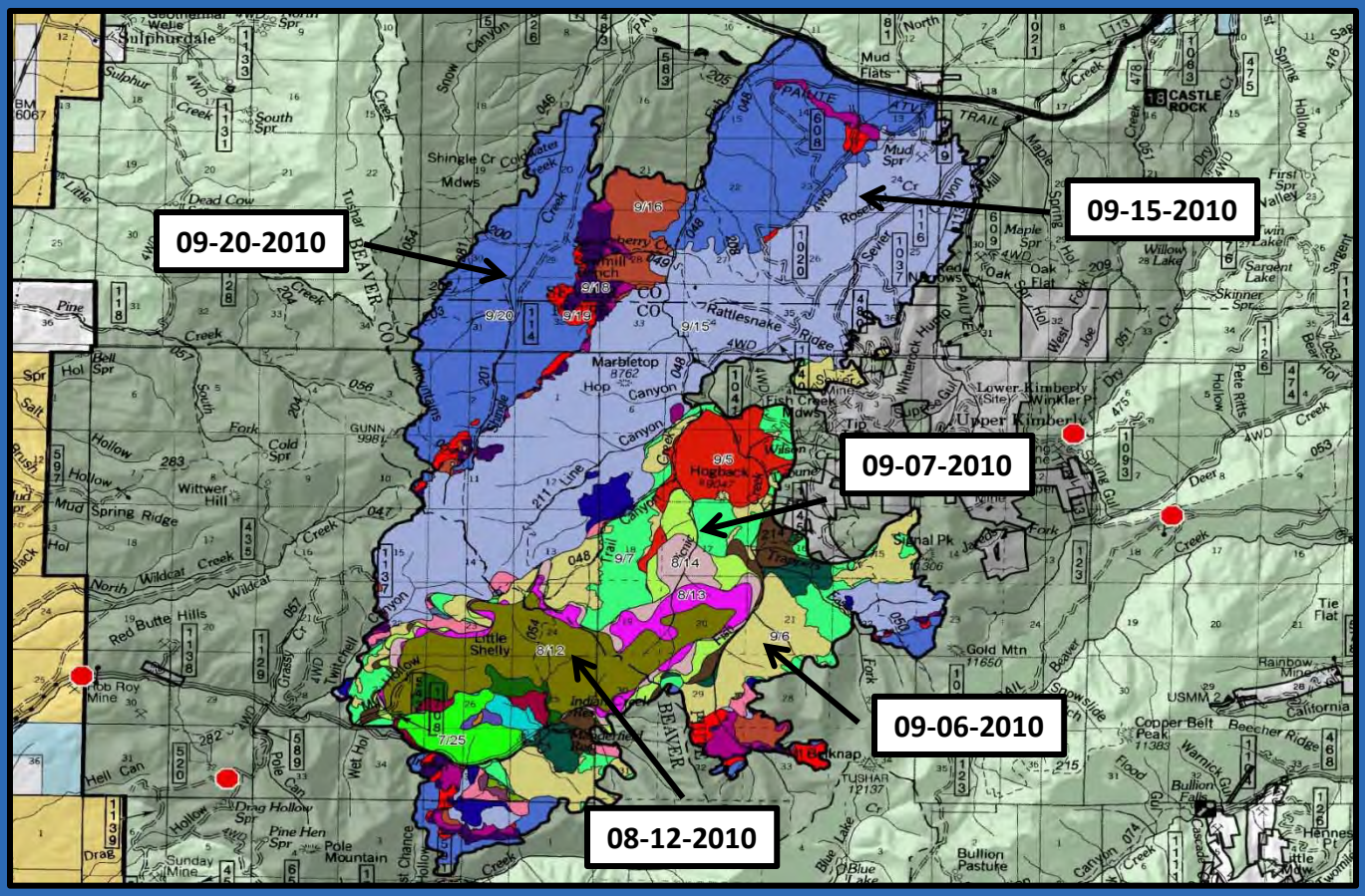
Twitchell Canyon Fire – P4FL8Q … Salt Lake Tribune

" … bad news came in 2's for the field crews battling the Twitchell Canyon Fire. As of Friday, the south-central Utah blaze neared 22,000 acres – and, weather forecasters warned of gusty, hot and dry conditions through the weekend.

The National Weather Service's red flag warning alerted much of the State that the potential for wildfires was extreme — not what about 320 firefighters battling the two-month-old, lightning-sparked Twitchell Canyon blaze wanted to hear. Meteorologist / Mark Struthwolf warned of steady, 15 - 20 mph winds with gusts of up to 30 mph for the Twitchell Canyon area. The fire's remote, rugged and steep terrain already was posing enough challenges there for crews that had hoped to make progress over the weekend with fresh personnel, six water-bearing helicopters and two bulldozers joining the fight. Periodically, heavy smoke from the fire, which was burning in conifer and shrub lands, continued to restrict traffic along a 12 - mile stretch of Interstate - 70 located about 7 miles northeast of Manderfield Reservoir. "

Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 09-20-2010



	Date	Growth	Cumulative
	7/21/2010	7	7
	7/22/2010	40	47
	7/25/2010	518	565
	7/31/2010	131	696
	8/4/2010	136	832
	8/6/2010	210	1,042
	8/12/2010	1,998	3,040
	8/13/2010	571	3,611
	8/14/2010	552	4,162
	8/16/2010	491	4,654
	9/2/2010	441	5,094
	9/4/2010	358	5,453
	9/5/2010	923	6,376
	9/6/2010	2,420	8,796
	9/7/2010	1,743	10,539
	9/8/2010	28	10,567
	9/9/2010	31	10,598
	9/10/2010	28	10,627
	9/11/2010	38	10,664
	9/12/2010	309	10,973
	9/13/2010	320	11,293
	9/15/2010	9,579	20,872
	9/16/2010	866	21,738
	9/17/2010	461	22,200
	9/18/2010	589	22,788
	9/19/2010	508	23,296
	9/20/2010	6,754	30,051

Fire Progression Map – 30,051 Acres

Another form of information sharing commonly used by the Public Affairs Team … is to distribute a Fire Progression Map to local residents, Forest Visitor's and fellow government employees. In this particular instance, our wildfire has been growing in size every couple of days since the ignition was started by a lightning strike on July 20th, 2010 at 1100 hours. According to the attached legend … the fire was quite active on August 12th along with September 6th and 7th, September 15th – and, once again on September 20th.

Fishlake National Forest

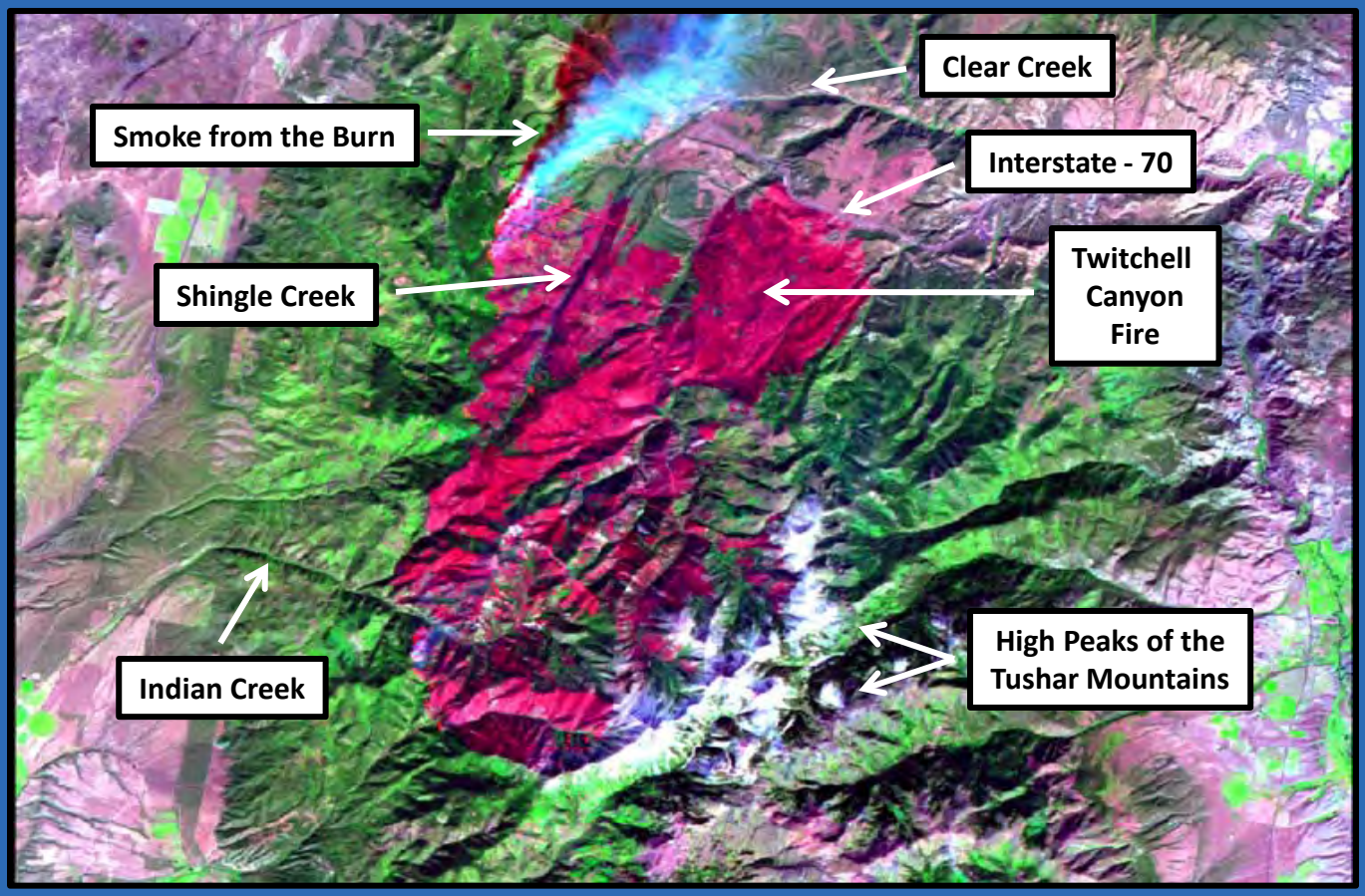
Twitchell Canyon Fire – P4FL8Q / 09-20-2010

NASA Photograph – 33,071 Acres

The Expedition 24 / Crew aboard the International Space Station photographed the Twitchell Canyon Fire in central Utah on September 20th. The fire near Utah's / Fishlake National Forest is reported to cover an area of approximately 13,383 hectares – or, about 33,071 acres. This detailed image shows smoke plumes generated by several fire spots close to the southwestern edge of the burned-area. The fire was started by a lightning strike on July 20th, 2010. Whereas many of the space station images of Earth look straight down (nadir), this photograph was exposed at an angle. The station was located over a point approximately 316 miles to the northeast, near the Colorado / Wyoming border, at the time the image was taken. Southwesterly winds continue to extend smoke plumes from the fire to the northeast.

Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 09-21-2010



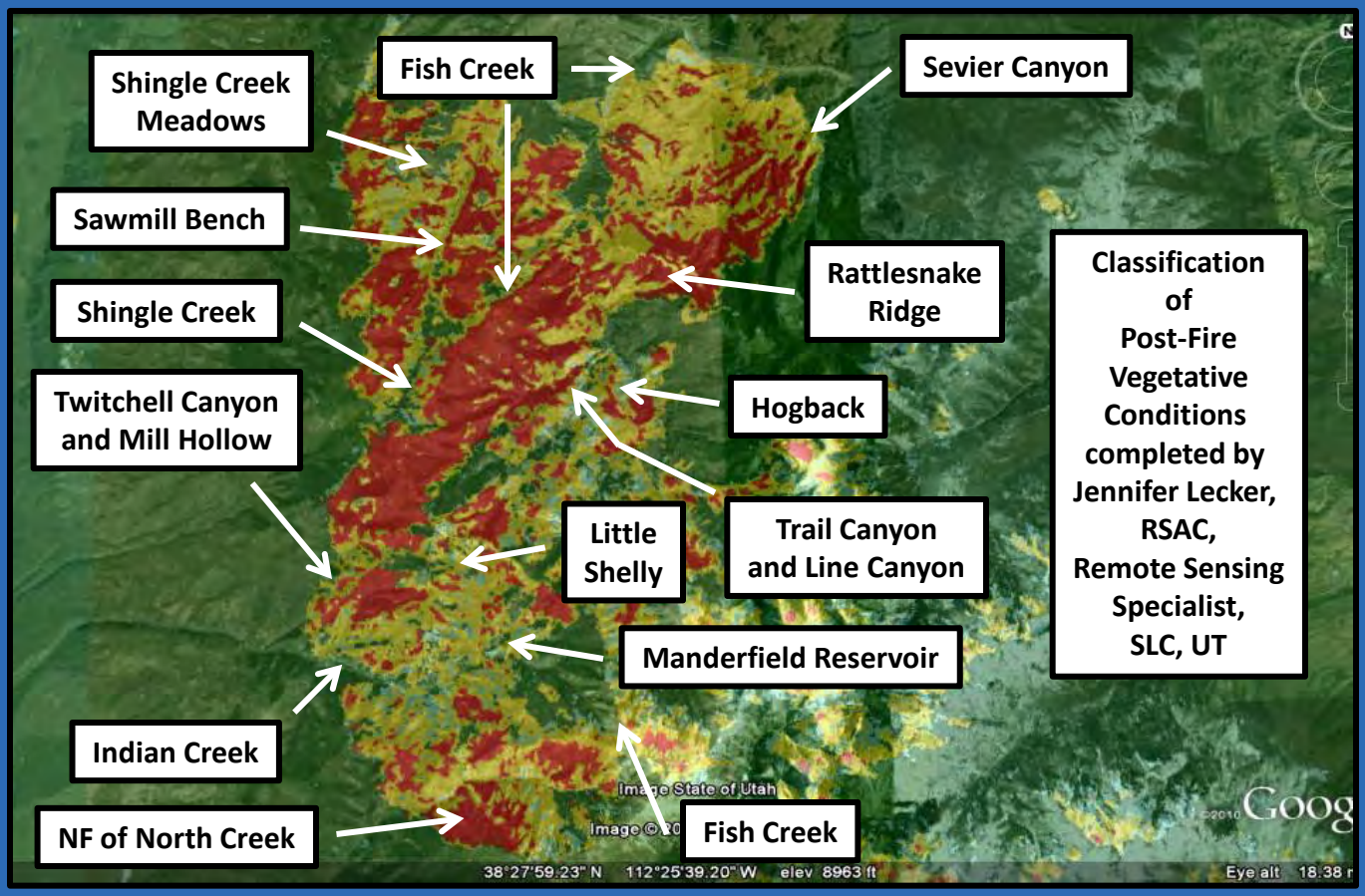
Landsat 5 / Satellite Image – 38,652 Acres

Initially, the EROS / Data Center of Sioux Falls, SD acquires and owns the Landsat 5 imagery; typically, several scenes are purchased by the WO / RSAC Staff and processed into a BARC Map for the requesting BAER Team.

A Burned Area Reflectance Classification (BARC) is a satellite-derived map of the post-fire vegetative condition. This product is used by the BAER Team as essential input to making a high quality Burn Severity Map.

Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q … BARC Image / 09-21-2010



Classification of Post-Fire Vegetative Conditions completed by Jennifer Lecker, RSAC, Remote Sensing Specialist, SLC, UT

Burn Severity Map # 2 – 38,652 Acres

BARC / Burn Severity Classes	Number of Acres	Percent of the Incident
Unburned	9,147	23.6 %
Low	5,055	13.0 %
Moderate	12,548	32.4 %
High	11,880	31.0 %
*** Total ***	38,652	100 %

Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 09-30-2010

Fishlake National Forest
www.fs.fed.us/r4/fishlake
http://inciweb.org/incident/2036/

Team Whalen
Interagency Incident
Management Team

Mike Whalen,
Incident
Commander

FIRE UPDATE

Thursday, September 30, 2010 – 8:00 a.m.

- FOR IMMEDIATE RELEASE -

FOR MORE INFORMATION PLEASE CONTACT:
Annette Grijalva-Disert - Incident Information Officer (435) 527-3727
Incident Command Post is located at the Elsinore City Park at Elsinore, UT
E-mail: twitchell.cyn@gmail.com

Start date: 7/20/10 11:20	Cause: Lightning	Estimated Size: 42,427 acres	% Contained: 28	Total Personnel on Incident: 433
Injuries to date 29	Estimated Containment: TBD	Closures: Campgrounds, road: and trails closures around the fire area are implemented	# of 20-person hand crews: 14	Other committed resources 5-Helicopters 10-Engines

Twitchell Canyon Fire Update

Elsinore, UT – Firefighters made good progress on the southern flank of the Twitchell Canyon Fire yesterday. A dozer line was inserted from existing fireline toward Baldwin Ridge. Several Type I Hot Shot crews are working direct on the fireline to halt fire spread toward occupied areas along North Creek. Heavy-lift helicopters worked most of the day dropping upwards of 2,000 gallons of water per drop, cooling the fire front so firefighters can work. Heavy air tankers dropped retardant on Baldwin Ridge to halt fire spread.

There have been 29 reportable injuries since the start of the fire. Approximately one-third of them were minor bodily injuries, and the rest were illness, generally respiratory issues. No serious injuries resulting in lost time have occurred.

Today, additional resources are being added to the south end, including a structure protection group in the North Creek area. Residents will see increased fire traffic in the North Creek area for the next few days as suppression activity progresses. The burnout on the northwest corner near Cove Fort was successful and crews have been mopping up that area since yesterday. Containment lines on the west side of the fire are progressing from south to north as more resources arrive.

Due to the proximity of the Twitchell Canyon Fire, *forest roads in the area have been temporarily closed* to provide for firefighter and public safety as fire suppression operations continue.

The following roads are closed to provide for public and firefighter safety:

- Forest Road 119 Indian Creek Road at the west Forest boundary
- North Wildcat Creek Road (Forest Road 435) at the intersection with the Frontage Road
- Mud Spring Road also known as Brush Hollow Road (Forest Road 597) at the intersection with the Frontage Road
- The Frontage Road east of Interstate 15 at the Sulphurdale Exit
- The Frontage Road south of Interstate 70 at the Cove Fort Exit
- Shingle Creek Road (Forest Road 114) south of intersection with Highway 4/Clear Creek Road
- Forest Road 1026 and Forest Road 1027 south of Interstate 70 at Ranch Exit 7
- Forest Road 113 south of Interstate 70 at Fremont Indian State Park Exit 17
- Forest Road 113 at Upper Kimberly junction with Max Reid ATV Trail
- North Fork of North Creek (Forest Road 591) north of intersection with Forest Road 589 (Tanner Hollow)

Castle Rock Campground remains under evacuation

For more information, maps, and pictures on this and other fires, please visit www.utahfireinfo.gov or www.inciweb.org.

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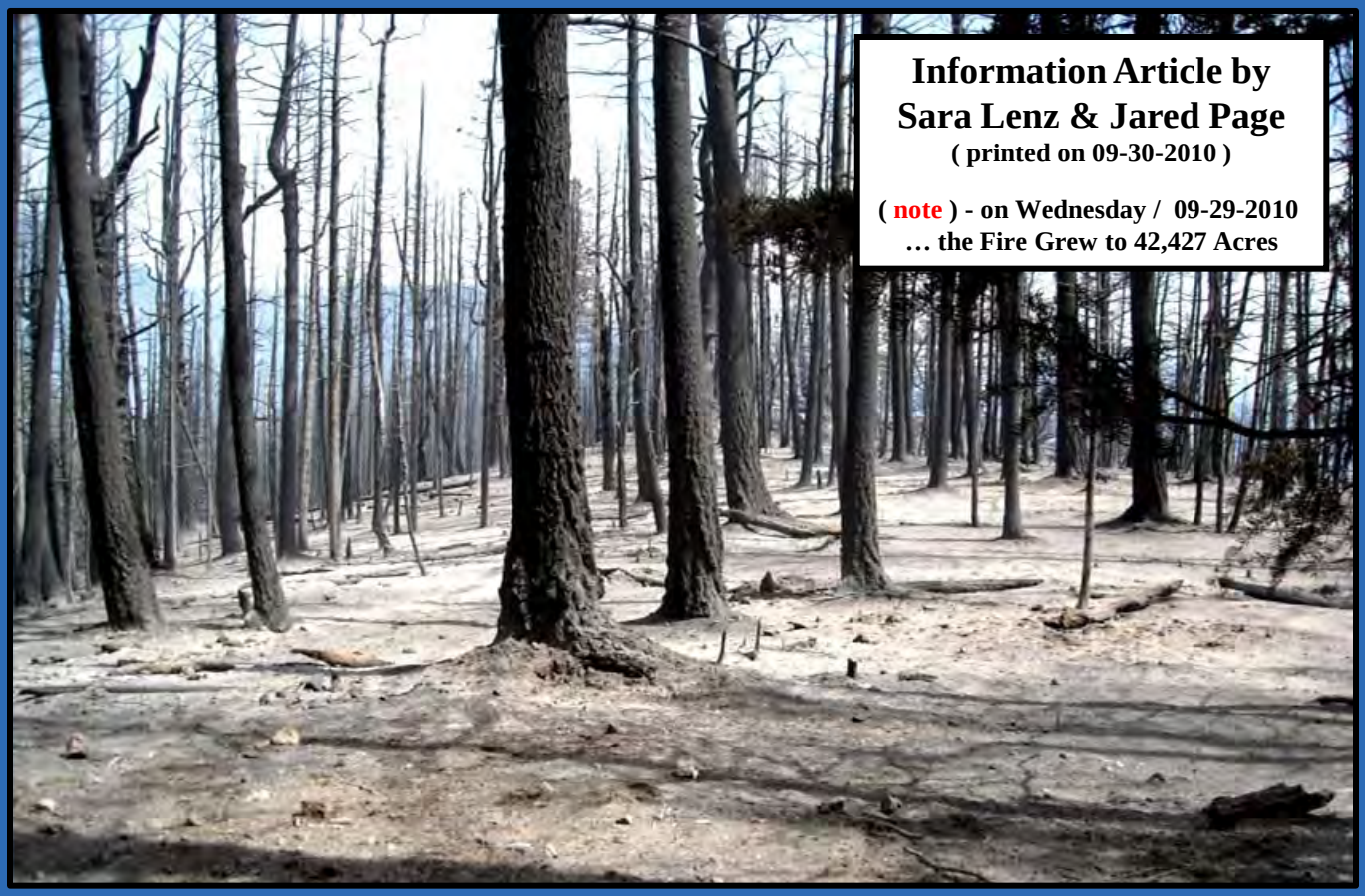
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q … Deseret News



" … this lightning - caused wildfire has been burning on the Fishlake National Forest since July 20th -- it now covers about 42,000 acres. As of 8 PM – Wednesday / September 29th … it was 28 percent contained, said Joe Coldwell, Public Affairs Spokesman for the firefighting effort.

The fire is currently active in the area near North Creek and on the Tushar Mountain slope located on the west side of the fire, about 5 miles east of Sulphurdale officials said. Fire retardant and water are being dropped by air tankers and helicopters to keep the fire from moving onto private property. Thus far, 520 firefighters have battled the blaze. Coldwell said he expects the fire to continue burning until the area gets snow or a substantial rainfall event – and, he encourages drivers traveling through the area -- to be cautious.

I - 70 remained open Wednesday, though several roads, trails and campgrounds in the immediate area of the burn have been closed for safety reasons. "

Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-01-2010

Fishlake National Forest
www.fs.fed.us/r4/fishlake
http://inciweb.org/incident/2036/

Team Whalen
Interagency Incident
Management Team

Mike Whalen,
Incident
Commander

FIRE UPDATE

Friday, October 1, 2010 - 8:00 a.m.

- FOR IMMEDIATE RELEASE -

FOR MORE INFORMATION PLEASE CONTACT:
Annette Grijalva-Disert - Incident Information Officer (435) 527-3727
Incident Command Post is located at the Elsinore City Park at Elsinore, UT
E-mail: twitchell.cyn@gmail.com

Start date: 7/20/10 11:20	Cause: Lightning	Estimated Size: 44,446 acres	% Contained: 30	Total Personnel on Incident: 572
Injuries to date 29	Estimated Containment: TBD	Closures: Campgrounds, road: and trails closures around the fire area are implemented	# of 20-person hand crews: 14	Other committed resources 6-Helicopters 15-Engines

Twitchell Canyon Fire Update

RED FLAG WARNING

Elsinore, UT – An unstable air mass has moved into the fire area overnight bringing the threat of thunderstorms and gusty winds to the fire area. A Red Flag Warning has been issued by the National Weather Service today meaning that weather conditions are right for extreme fire behavior. Winds are expected to be light and variable through most of the day, exclusive of thunder cell activity.

Firefighters made good progress on the southern flank of the Twitchell Canyon Fire yesterday. A dozer line was inserted from existing fireline toward Baldwin Ridge. Six Type I Hot Shot crews are working direct on the fireline to halt fire spread toward occupied areas along North Creek. Heavy-lift helicopters worked most of the day dropping upwards of 2,000 gallons of water per drop, cooling the fire front so firefighters can work. Heavy air tankers dropped retardant on Baldwin Ridge to halt fire spread.

Pockets of fire continued to burn yesterday inside the fire line. Non-threatening fire activity popped up inside the fire area on the east side near Signal Peak, and crews continue to monitor fire behavior on the east side.

Today the air operations will move from the Richfield Airport to the Beaver Airport to be closer to the area of operation. Seven helicopters will be working out of the Beaver Airport.

Some *forest roads in the area have been temporarily closed* to provide for firefighter and public safety as fire suppression operations continue.

The following roads are closed to provide for public and firefighter safety:

- Forest Road 119 Indian Creek Road at the west Forest boundary
- North Wildcat Creek Road (Forest Road 435) at the intersection with the Frontage Road
- Mud Spring Road also known as Brush Hollow Road (Forest Road 597) at the intersection with the Frontage Road
- The Frontage Road east of Interstate 15 at the Sulphurdale Exit
- The Frontage Road south of Interstate 70 at the Cove Fort Exit
- Shingle Creek Road (Forest Road 114) south of intersection with Highway 4/Clear Creek Road
- Forest Road 1026 and Forest Road 1027 south of Interstate 70 at Ranch Exit 7
- Forest Road 113 south of Interstate 70 at Fremont Indian State Park Exit 17
- Forest Road 113 at Upper Kimberly junction with Max Reid ATV Trail
- North Fork of North Creek (Forest Road 591) north of intersection with Forest Road 589 (Tanner Hollow)

Castle Rock Campground remains under evacuation

For more information, maps, and pictures on this and other fires, please visit www.utahfireinfo.gov or www.inciweb.org.

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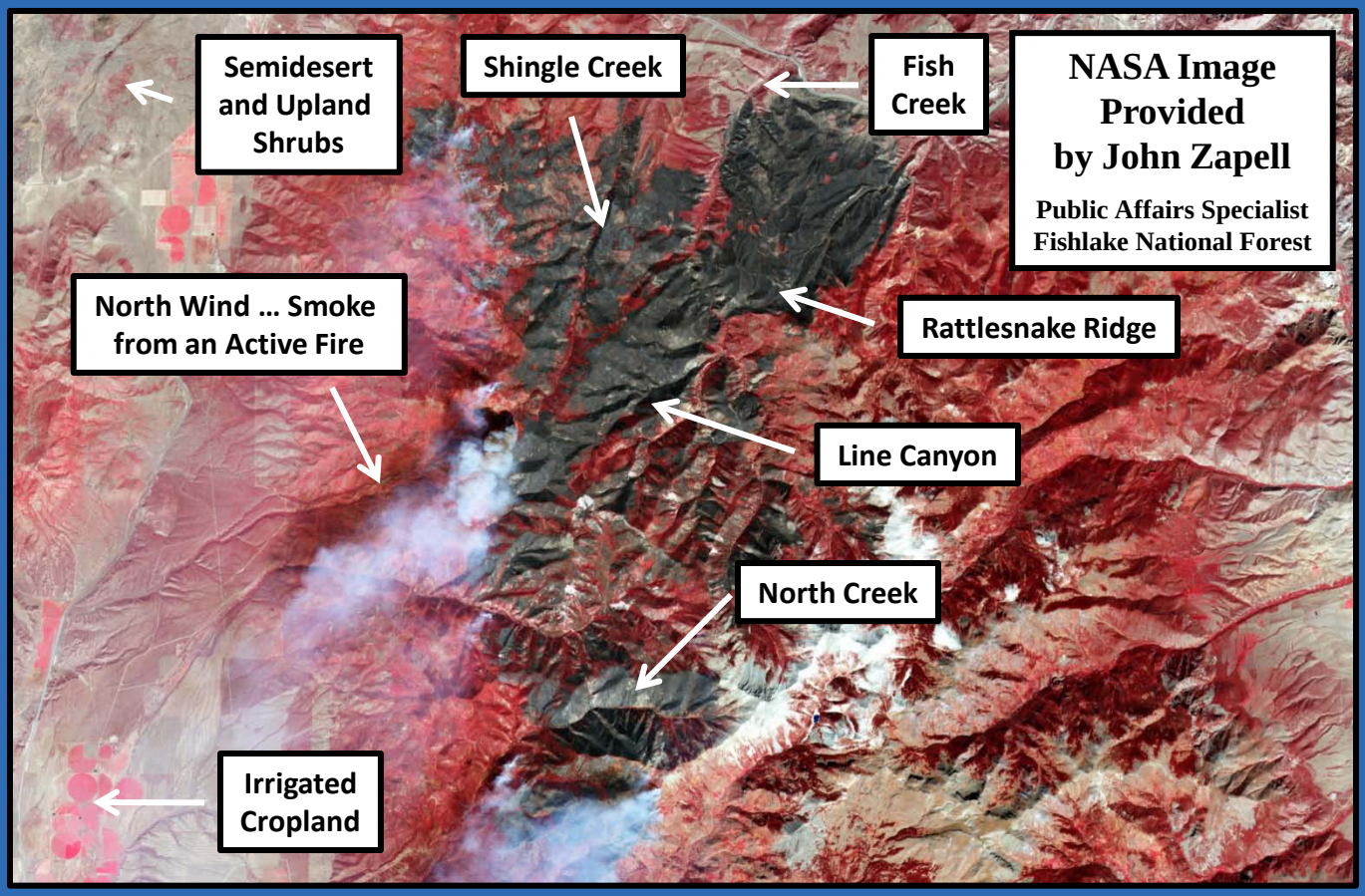
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-01-2010

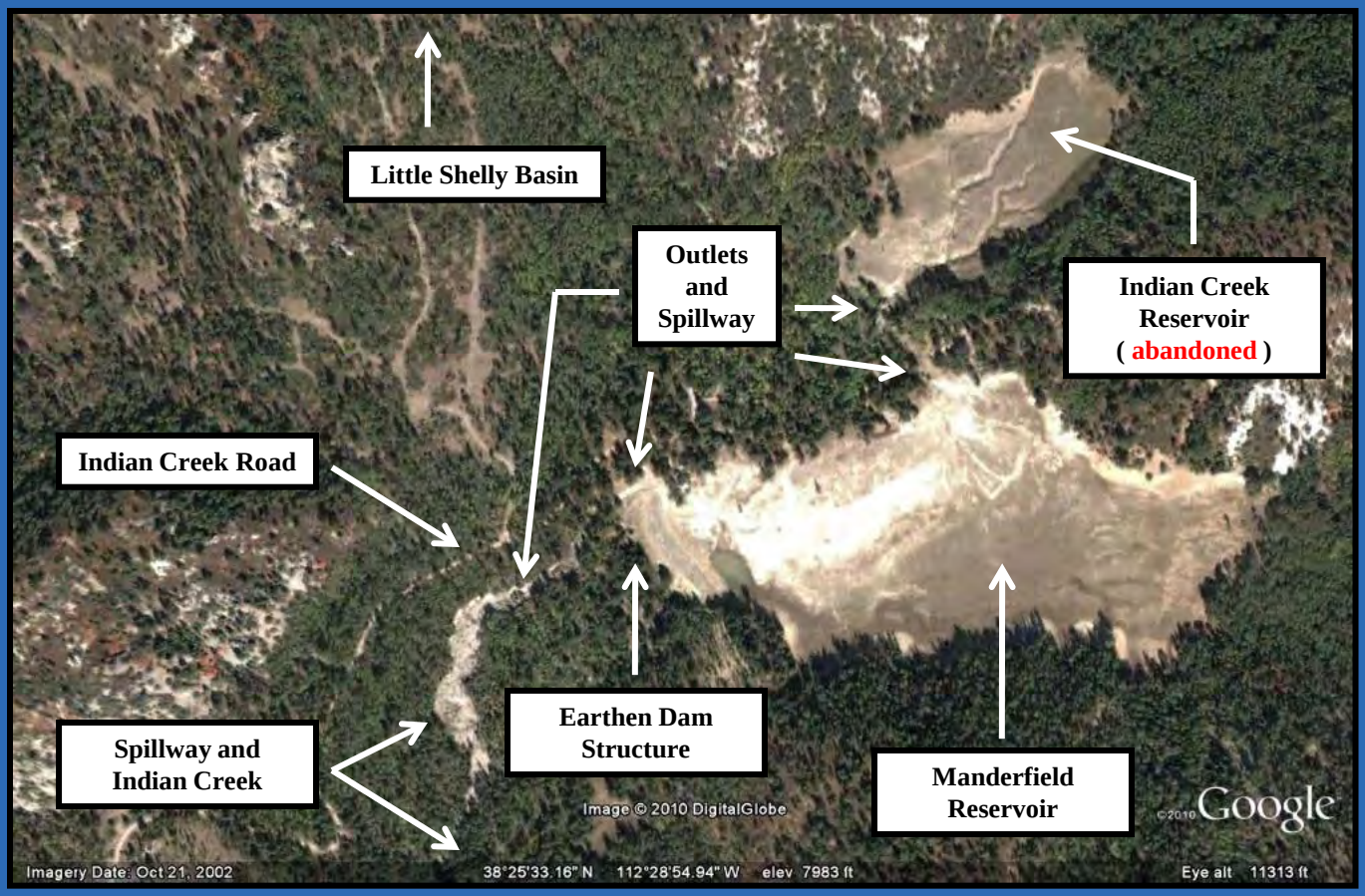


A lightning strike on July 20th, 2010, started the Twitchell Canyon Fire in Utah. More than 2 months later, the fire continued to burn and had consumed 44,000 acres of the Fishlake National Forest. Weather conditions have continued to be conducive to burning with low humidity, high winds and thunderstorm activity -- all of which increase the hazard of the fire. Over 500 fire fighters were working to establish fire breaks and to fight the flames, which were 30 % contained on October 1st according to the InciWeb / Incident Information System. Active fire fronts were being attacked with large aircraft and helicopters dropping fire retardant.

This image was acquired by the ASTER instrument on NASA's / Terra Satellite during the morning of September 29th, 2010. This false - color image uses near infrared light to make vegetation appear red in this treatment. Bare land appears in shades of tan and pale grey, burned-areas are charcoal toned and water appears blue. False - color imagery such as this is particularly good at showing the extent and severity of wildfires: the deep grey tones show where fires were especially intense.

Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-02-2010



Opportunity / Values-at-Risk

What is the functionality of the abandoned Indian Creek Reservoir … can this site be used as a temporary catch basin for surface runoff water and assorted debris ?

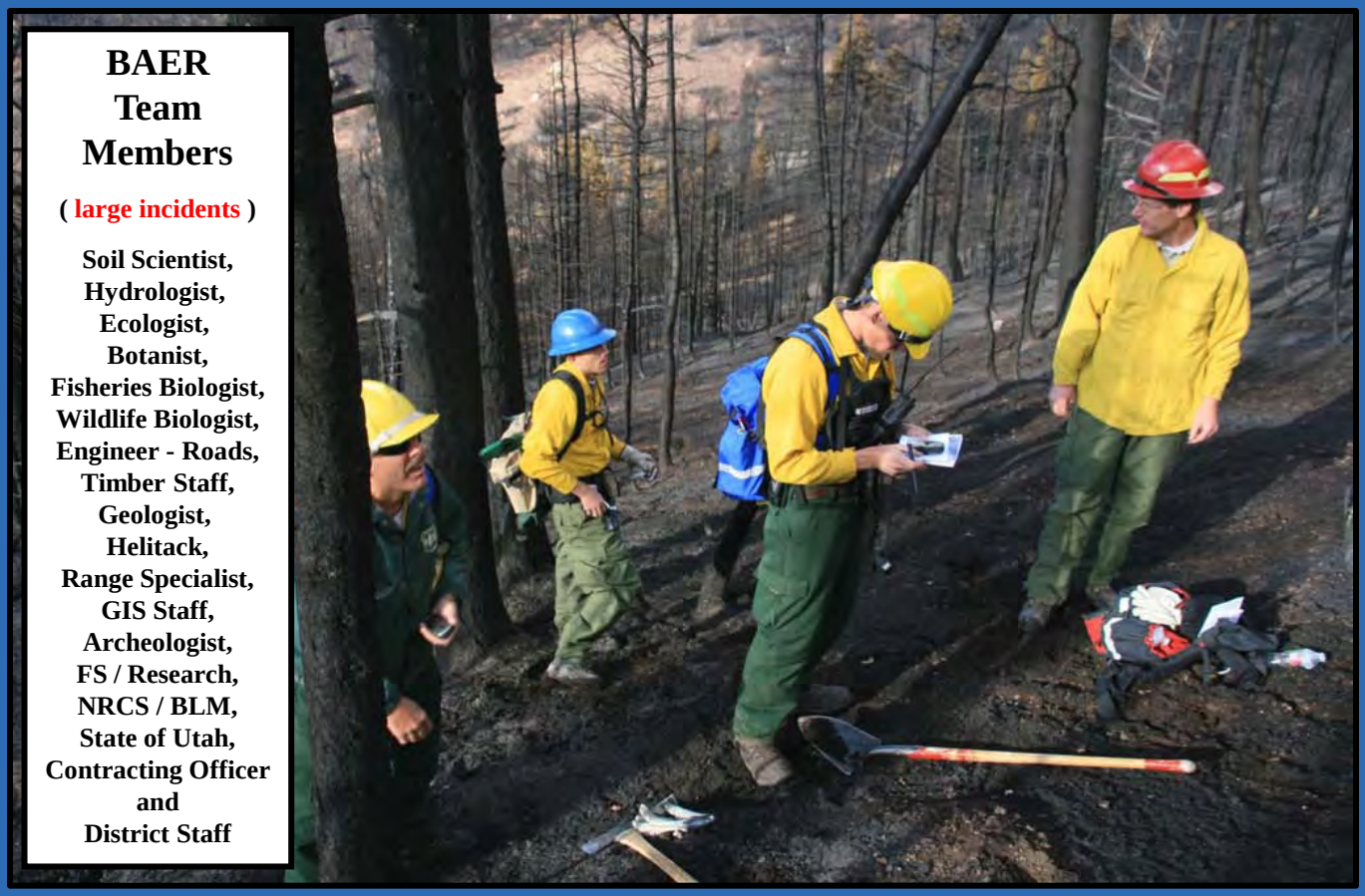
Does the Indian Creek site need to have its outlet or spillway cleaned and / or repaired to prevent unplanned or uncontrolled flows of water from flushing down into Indian Creek – damaging the existing road, its meadow areas and the Class 3 / Fisheries ?

If the Indian Creek site overtops … how will that affect the quantity and quality of water contained in the nearby Manderfield Reservoir ?

Much of the upper Indian Creek subwatershed has been impacted by Moderate to High / Severity Burns … will broadcast seeding, aerial mulching and using straw wattles to trap sediment near the Manderfield site protect the reservoir ?

Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-04-2010



Forest Service / BAER Team

For every incident of wildfire that exceeds 500 acres in size, the Forest Service assembles a group of Resource Specialist's to evaluate the impacts of the burn; these individuals are collectively known as the Burned-Area Emergency Response (**BAER**) Team. The Fishlake National Forest / BAER Team has the specific responsibility of 1) assessing on-the-ground conditions , 2) identifying emergency situations caused by the fire disturbance, 3) locating potential flood source sites occurring within the perimeter of the burn and 4) recommending land, channel, road and trail along with ecosystem management based treatments. The objective of implementing emergency treatments is to ... initiate " prompt action " for the immediate stabilization of fire-damaged terrain.

Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-04-2010

FACT SHEET

NIMO
NATIONAL INCIDENT MANAGEMENT ORGANIZATION

Monday, October 4th, 2010 - 10:00 a.m.

FOR IMMEDIATE RELEASE -

FOR MORE INFORMATION PLEASE CONTACT:

John Calabrese - Incident Information Officer (435) 438-0919
Incident Command Post is located at North I-70 Interchange, Beaver, UT
E-mail: twitchell.cyn@gmail.com

Start date: 7/20/10 11:20	Cause: Lightning	Estimated Size: 45,126 acres	% Contained: 65	# Of Firefighters: 579
Injuries to date 31	Estimated Containment: TBD	Closures: Campgrounds, roads and trails closures around the fire area are implemented	# of 20-person hand crews: 11	# Of helicopters: 3 - Heavy-lift 1 – Medium-lift 2 – Light-lift Total Helicopters: 6

Twitchell Canyon Fire Update

Beaver, UT – Operations continue in Division D, the south end of the fire nearest to North Creek subdivisions. Six hotshot crews, assisted with air support are working to build direct handline against the fire's edge. Containment lines on this division are expected to be finished in the next one to two days if weather conditions remain favorable. A structure protection group continues to work in the North Creek area as a contingency force. No new injuries were reported on Sunday.

Light rain fell on many parts of the fire yesterday, raising relative humidity and lowering temperatures and making direct line construction very effective. Higher elevations in the Tushar Mountains received light snow in the early morning hours. Rain showers are likely today through Tuesday.

Gage's National Incident Management Organzation (NIMO) Team took command of the fire at 6:00 a.m. this morning. The Incident Command Post (ICP) has moved and is now established on the north end of Beaver to be closer to ongoing operations. The helibase operations will run from Beaver Airport and airtanker support will continue as needed from Cedar City.

Shingle Creek Road 114 to Forest Road 583 leading to Paiute Trail 205, and Mud Flat road, are now open. Roads leading south from Paiute Trail 205 and Mud Flat Road are still closed due to ongoing fire operations. Shingle Creek road south from the Forest Road 583 intersection remains closed.

Temporary road closures are still in effect to provide for public and firefighter safety as follows:

- Forest Road 119 Indian Creek Road at the west Forest boundary
- North Wildcat Creek Road (Forest Road 435) at the intersection with the Frontage Road
- The Frontage Road east of Interstate 15 at the Sulfurdale Exit
- The Frontage Road south of Interstate 70 at the Cove Fort Exit
- Shingle Creek Road (Forest Road 114) south of intersection with Forest Road 583.
- Forest Road 1026 and Forest Road 1027 south of Interstate 70 at Ranch Exit 7
- North Fork of North Creek (Forest Road 591) north of intersection with Forest Road 589 (Tanner Hollow)

For more information, maps, and pictures on this and other fires, please visit www.utahfireinfo.gov or www.inciweb.org.

Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-06-2010

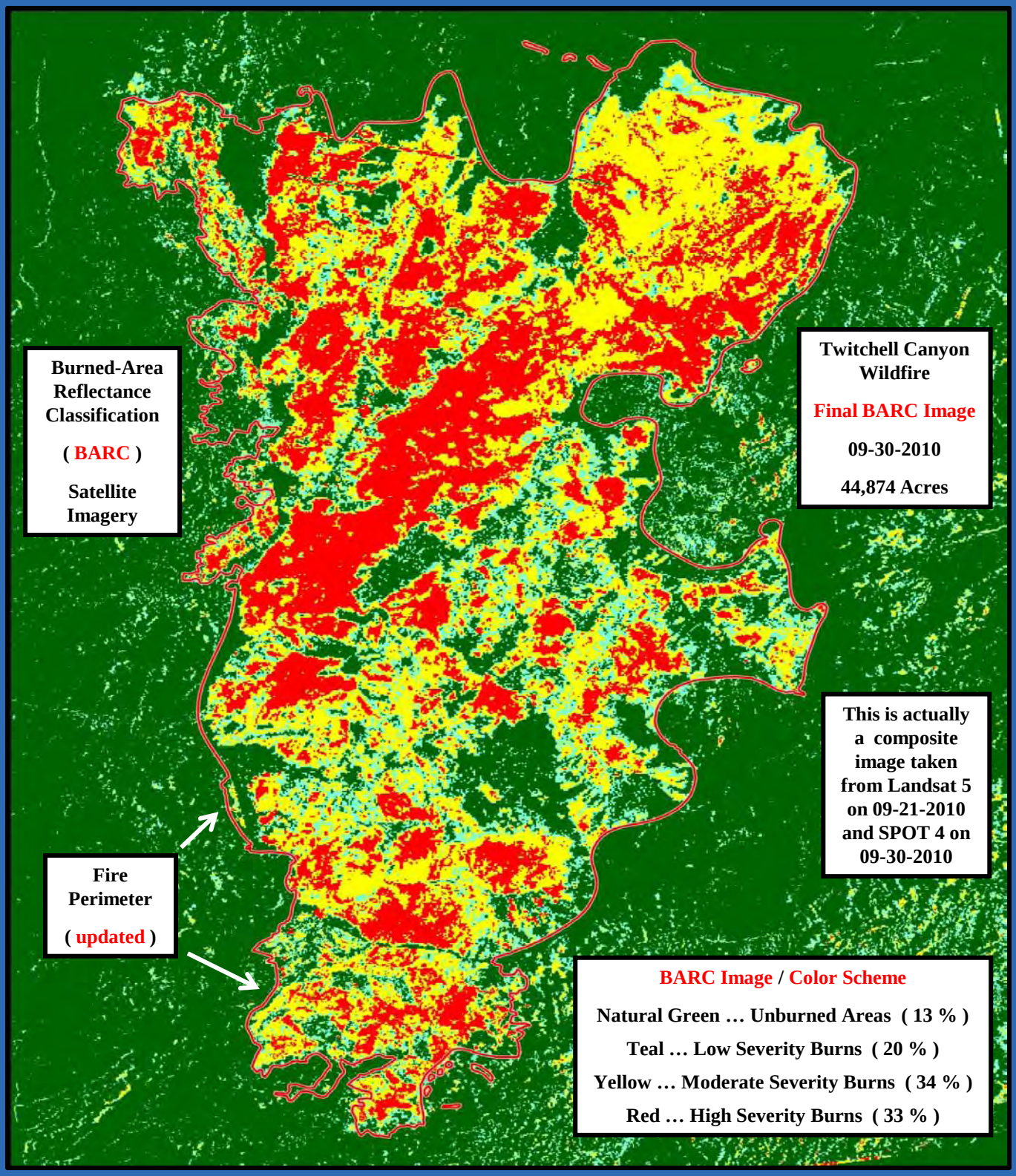
BAER Team Meeting – Richfield, UT

Adam Solt – Hydrologist
Rich Jaros – Soil Scientist
Bob Campbell – Ecologist
Steve Flinders – Wildlife
Dave Tait – Botanist
Gary Bezzant – State of Utah
Mike Smith – Soil Scientist
Doug Robison – Assistant Environmental Coordinator
Mark Madsen – Botanist

Brooke Shakespeare – Hydrologist
Amy Barker – District Ranger
Pete Haraden – Hydrologist
Dan Child – Engineering
Reggie Swenson – Range
Jenneka Knight – GIS
Robert Lopez – Fire
Tyler Monroe – Fire
Jim Whelan – Fisheries

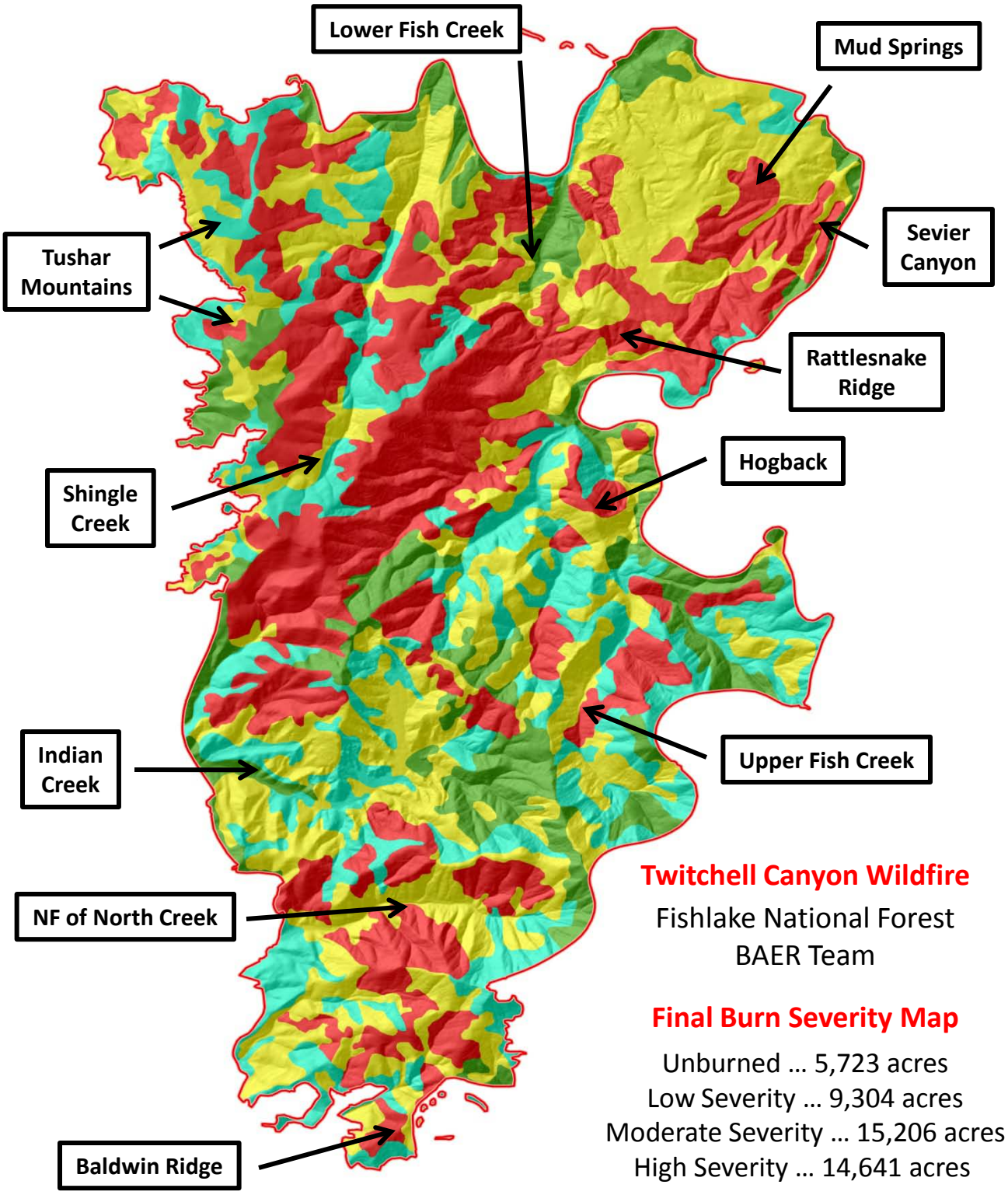
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-08-2010



Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-08-2010



Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-09-2010

BOISE NATIONAL FOREST
GARDEN VALLEY HELITACK
MODULAR COST SHEET 2010

Project name		Date	
Project number		Code	

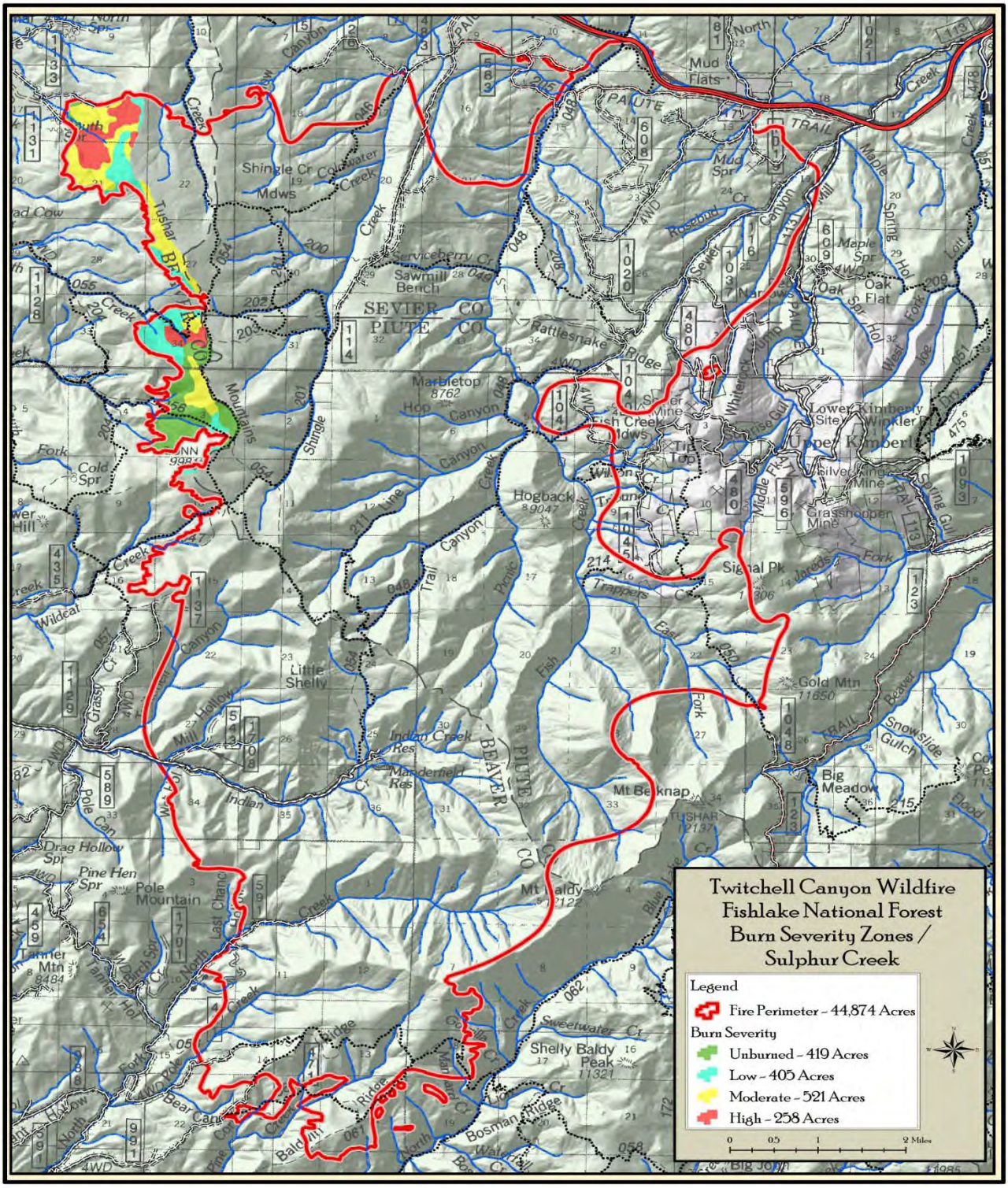
Personnel Names	HOURLY RATE GOVERNMENT COST				Total
GS-9 MOXHAM	38.75				
GS-7 KENNY	33.89				
GS-6 WILL	30.77				
GS-5 LINEBACK	23.72				
GS-5 DUFURRENA	25.75				
GS-5 VANHOOZER	15.86				
GS-5 AGIDIUS	15.86				
GS-3 JOLLEY	12.63				
GS-4 MILLER	20.67				
				SUB TOTAL	

REMARKS AVAILABILITY (AV) ONLY CHARGED AFTER 10/10 WITH A CONTRACT EXTENSION.	HELICOPTER (FT) $1064.00 per hr	
	HELICOPTER (AV) $2352 per day	
	FUEL TRUCK $1.40 per mile	
	PILOT ES	
	DRIVER ES	
Type III / Helicopter **(Bell 407)**	HELITENDER 9160 $0.72 per mile	
	CHASE TRUCK 6502 $0.58 per mile	
	CHASE TRUCK 4298 $0.67 per mile	
	R.O.N. CHARGE	
	SUB TOTAL	
PREPARED BY	TOTAL	

The Fishlake National Forest / BAER Team used the Garden Valley / Helicopter with its Support Crew during several Reconnaissance Flights starting Friday / 10-8th through Sunday / 10-10th.

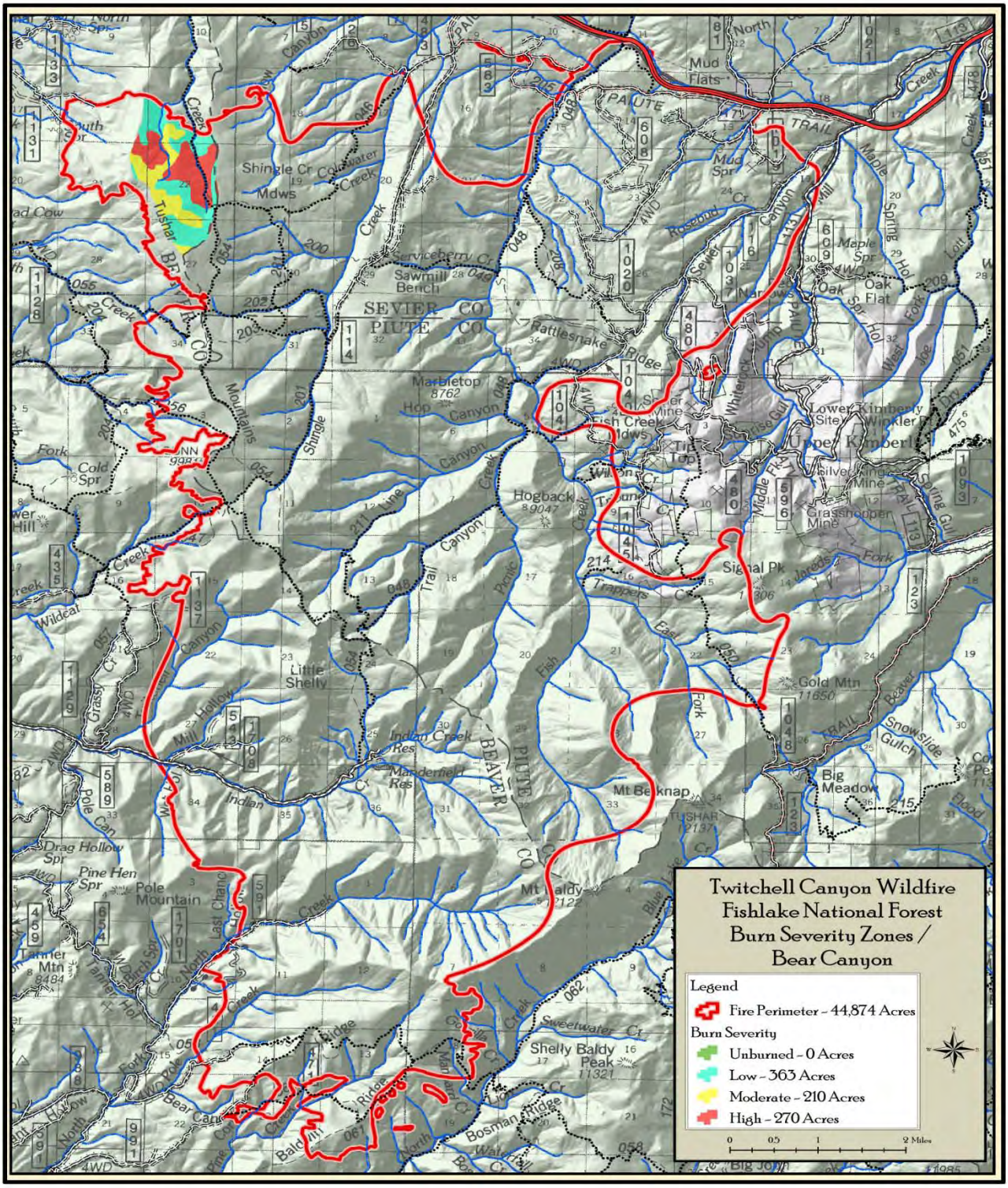
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-10-2010



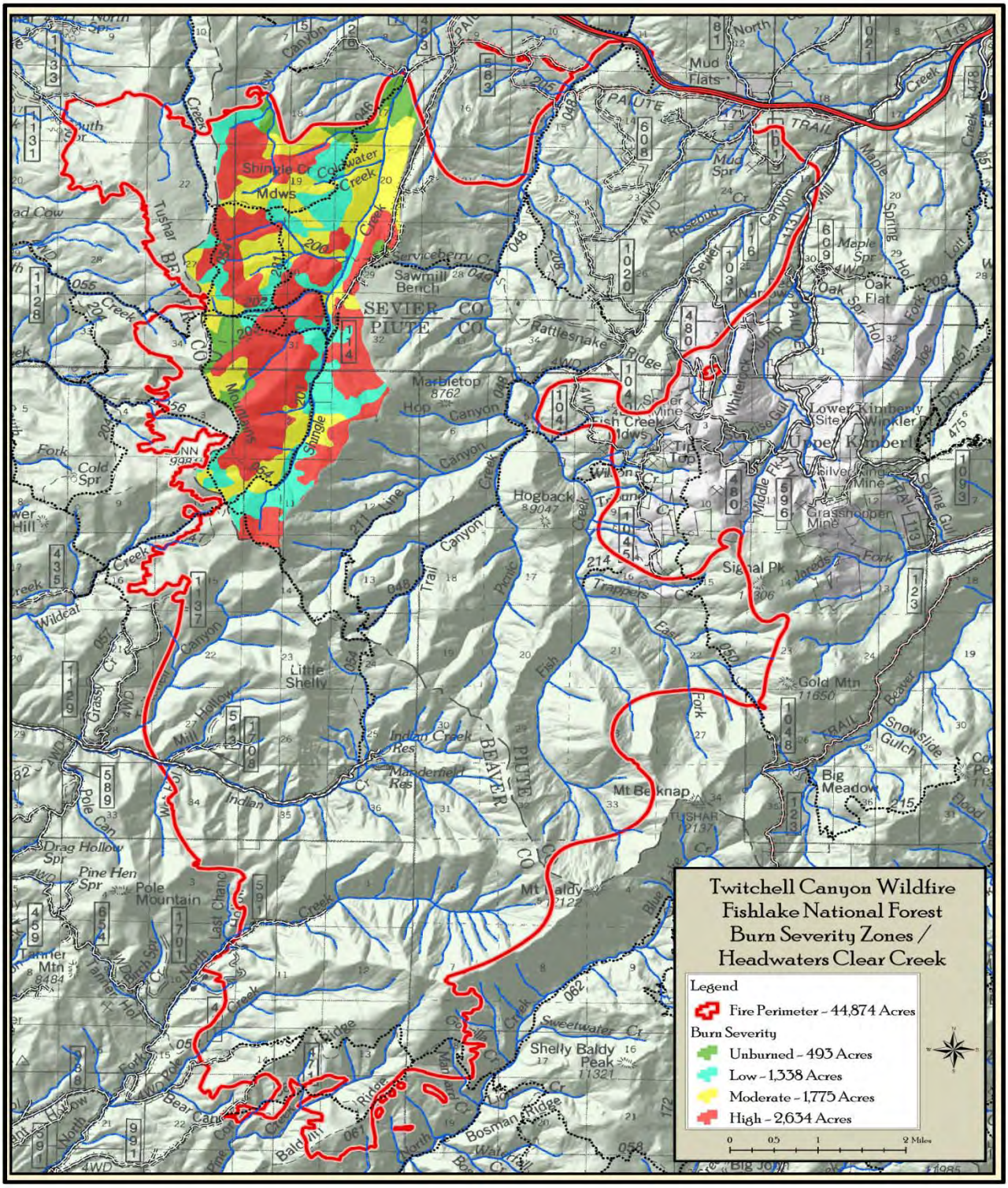
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-10-2010



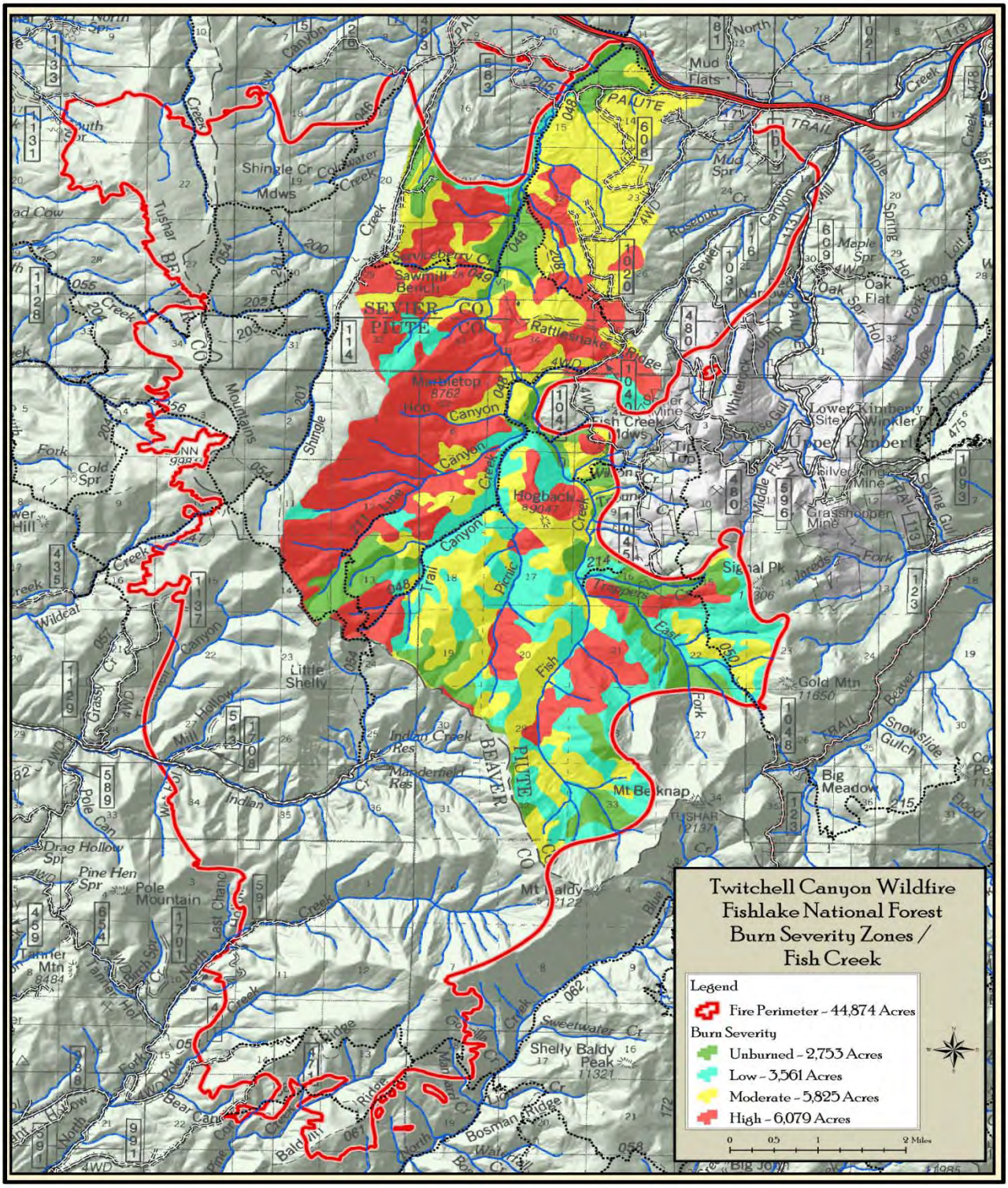
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-10-2010



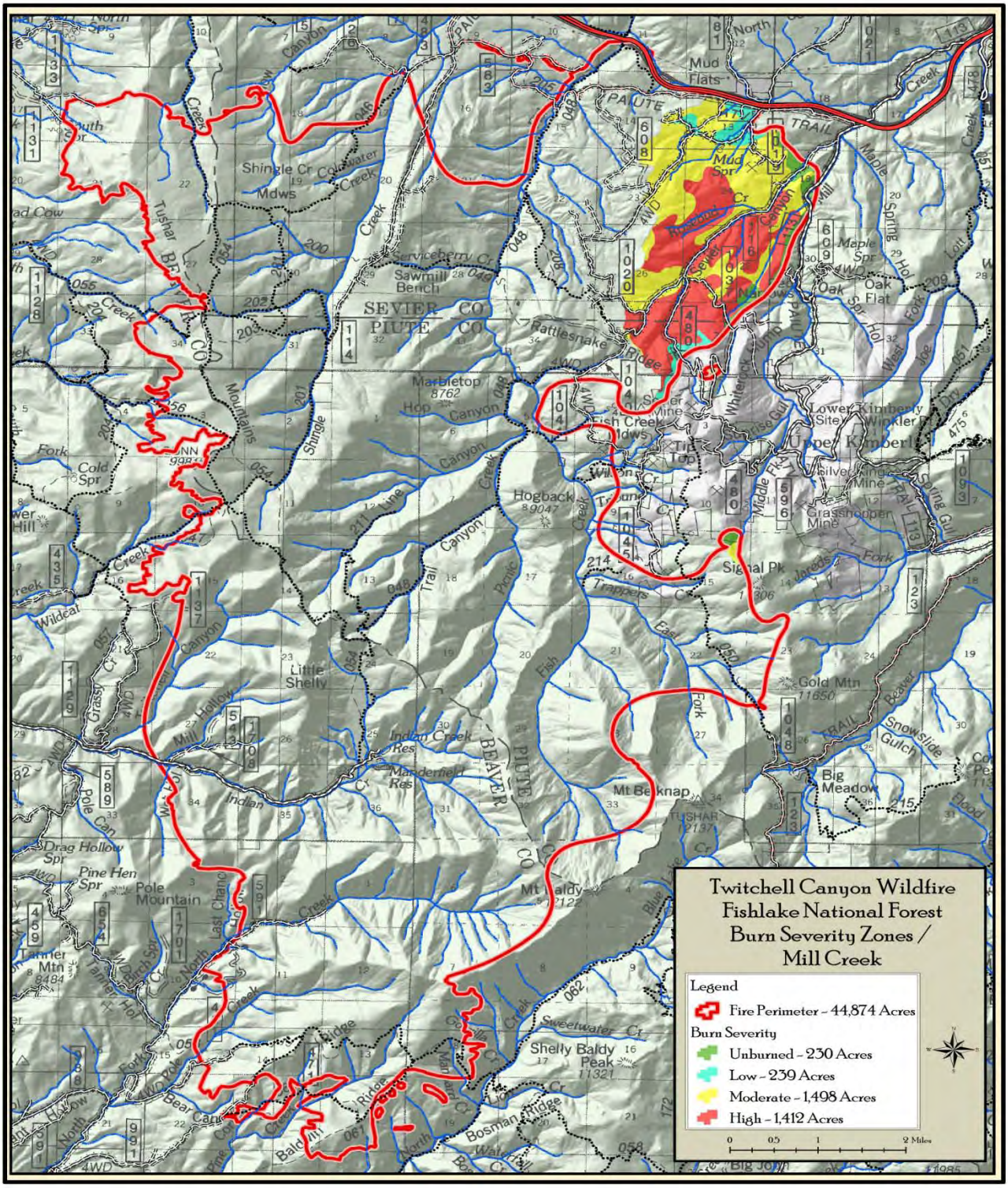
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-10-2010



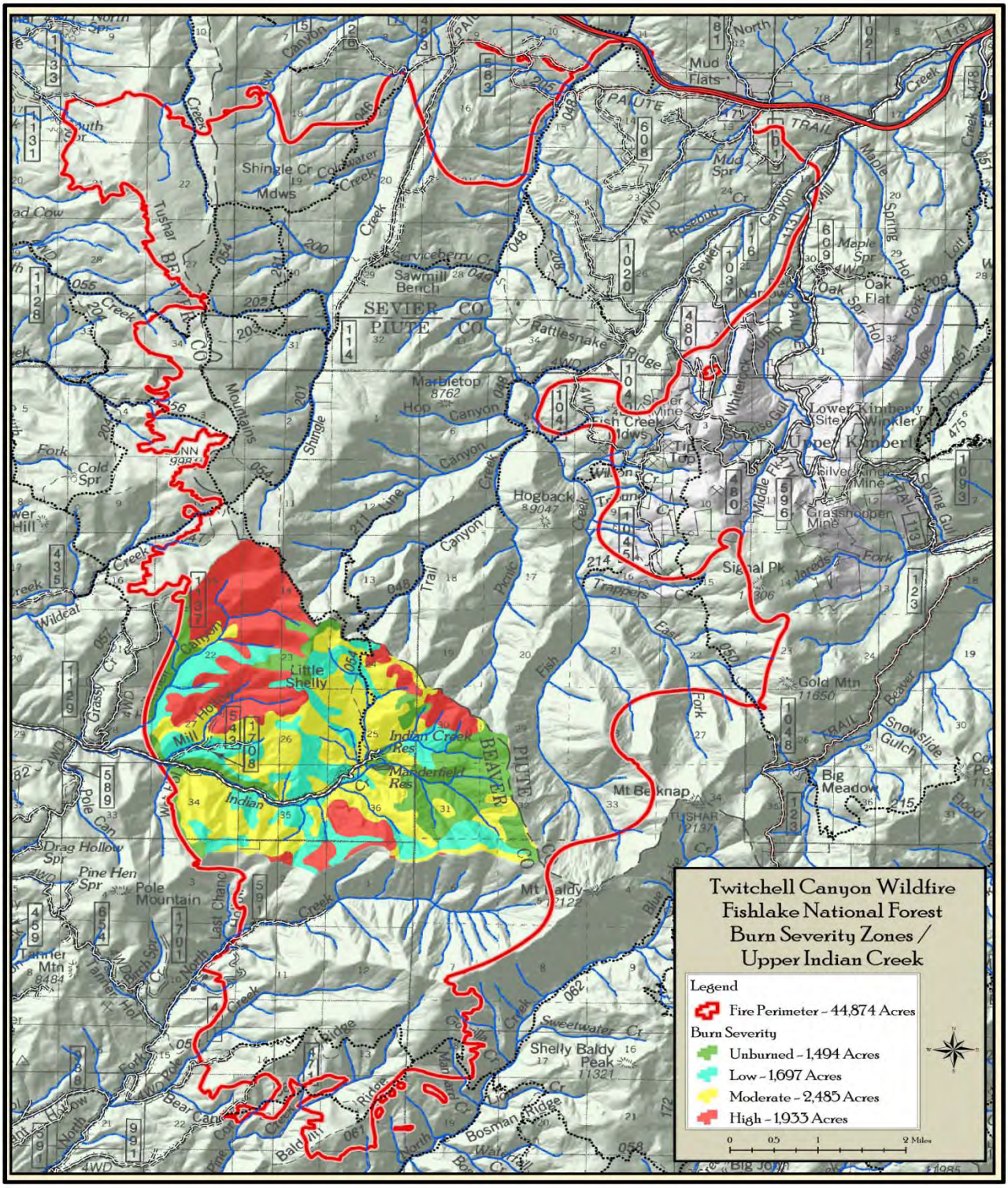
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-10-2010



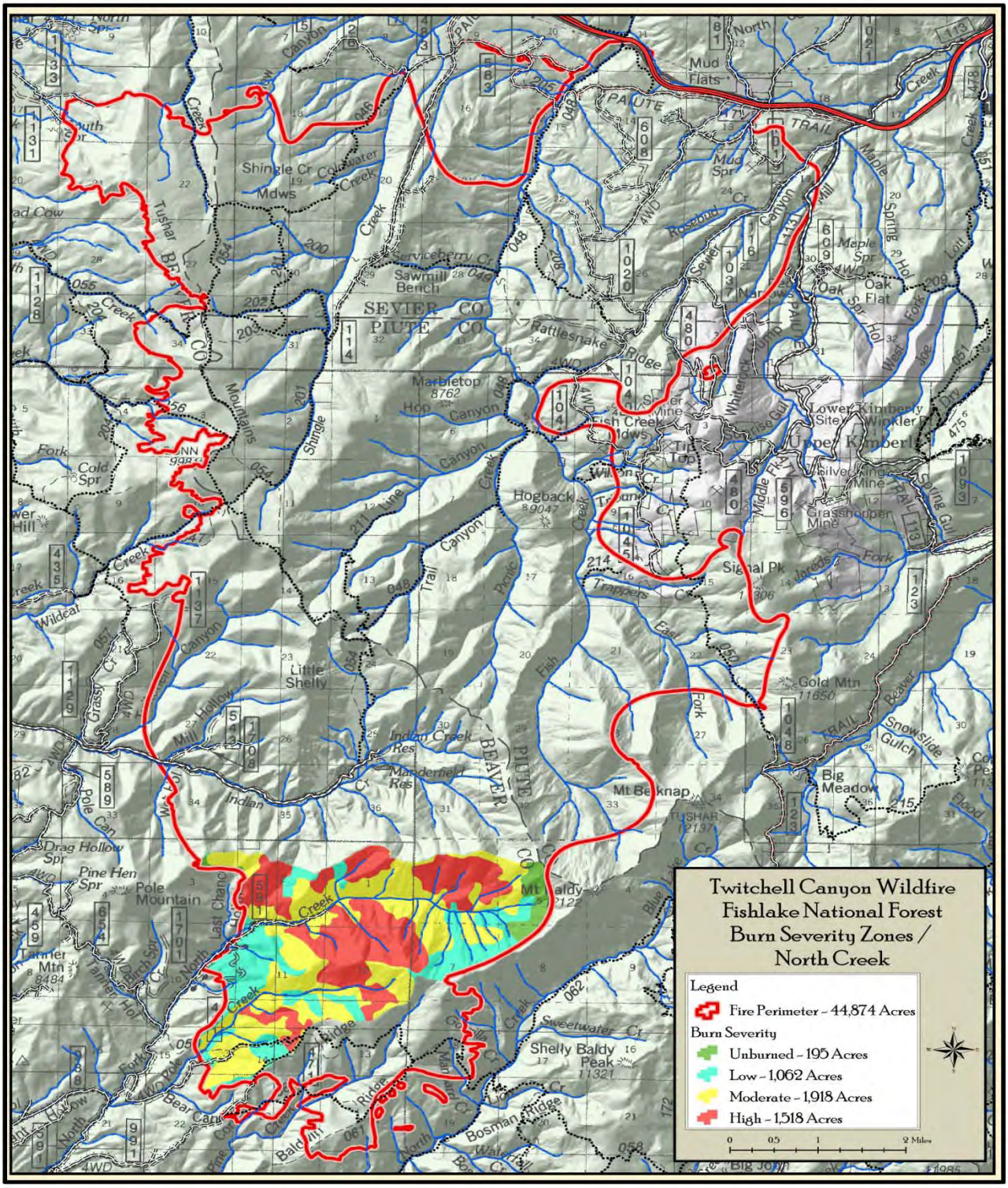
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-10-2010



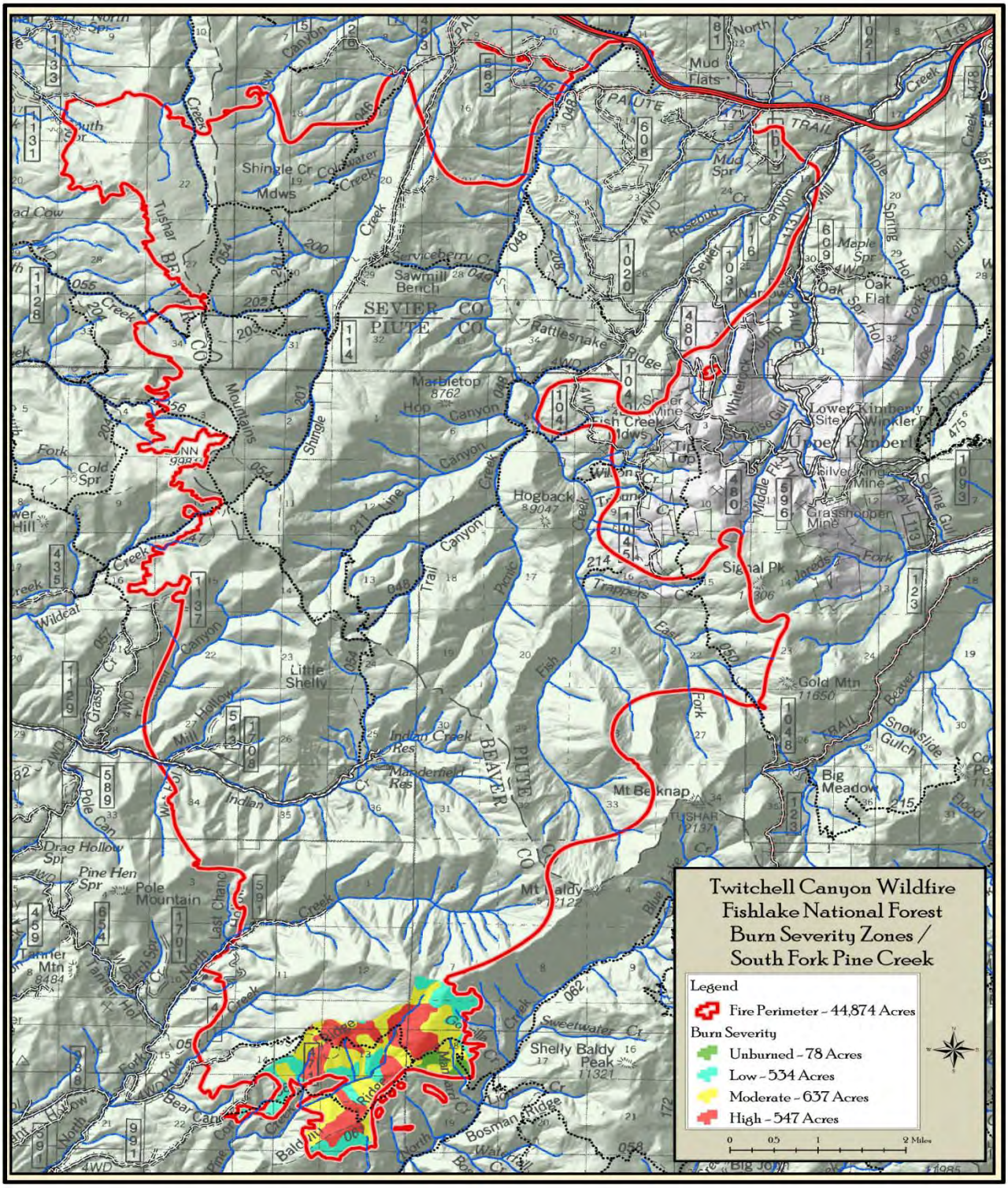
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-10-2010



Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q / 10-10-2010



Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q … Additional Photographs 1

Fire Strategy … Monitor, Confine and Contain

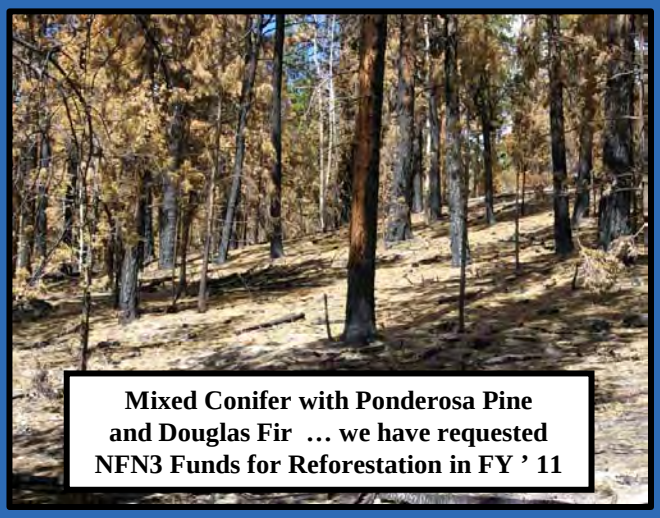
Bell 407 / Helicopter

BAER Team / Assessment Started on 09-13-2010

Severe Burn … Potential Flood Source Site

Aspen Regeneration following a Ground Disturbance

Pre-Burn Conditions … Mountain Brush, Mixed Conifer and Seral Aspen were located on Moderately Steep to Steep Mountainsides



Mixed Conifer with Ponderosa Pine and Douglas Fir … we have requested NFN3 Funds for Reforestation in FY ' 11

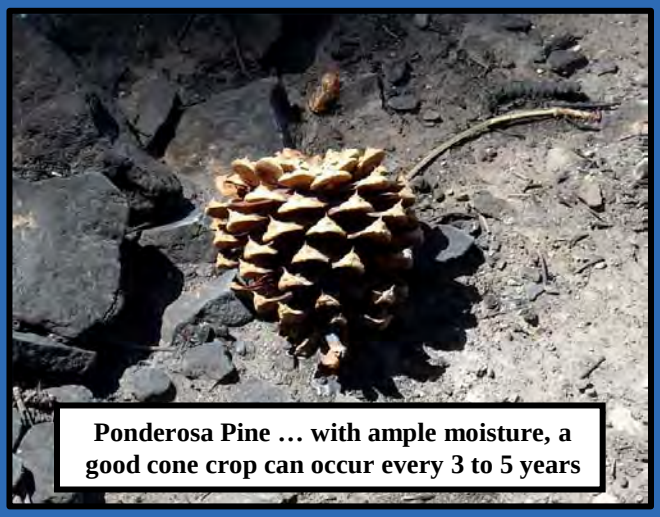
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q … Additional Photographs 2

Upper Fish Creek has been Damaged by Moderate and Severe Burns ... Floods and Debris Flows will Adversely Affect this Stream and its Fish Populations

The BARC Image from 09-13-2010 indicated 1648 acres of Severe Burns on a Wildfire that was only 25 % Contained

This drainage is showing the Initial Signs of Soil Stabilization



Ponderosa Pine … with ample moisture, a good cone crop can occur every 3 to 5 years

Little Shelly … Most of the Fires Observed in this area were of Moderate Burn Severity

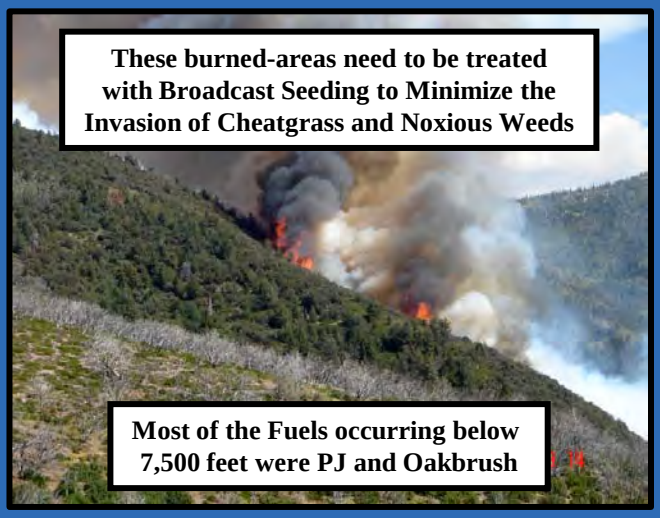
(note) … there will be some (limited) opportunity for Aspen Regeneration within the Charred Stands of Mixed Conifer

Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q … Additional Photographs 3

According to the Incident Command Summary (ICS - 209) … as of 09-15-2010, our Wildfire had Grown to about 20,862 Acres in Total Size

Example … of Long Range Spotting caused by High Wind Gusts – this Disturbance Measures < 5 Acres in Size



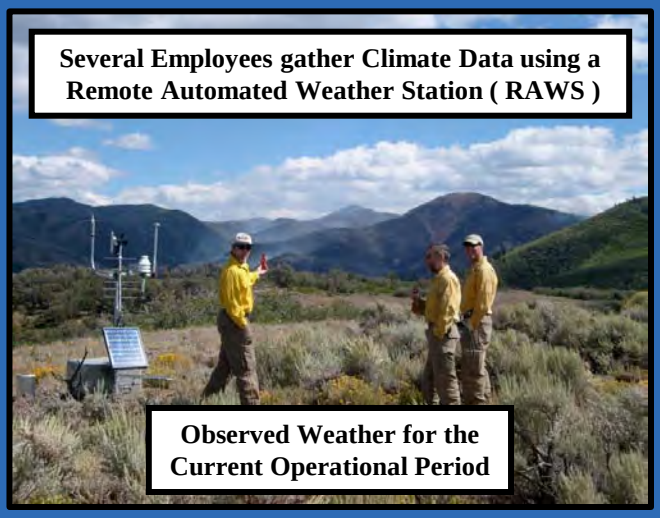
These burned-areas need to be treated with Broadcast Seeding to Minimize the Invasion of Cheatgrass and Noxious Weeds

Most of the Fuels occurring below 7,500 feet were PJ and Oakbrush

This Hand Line should be Re-Seeded and Water-Barred using Suppression (P - Code) dollars – or, FY ' 11 / NFN3 funds

Transition Zone … Mixed Conifer with Aspen – most of this Aspen grew in a Thicket due to Limited Precipitation and Low / Water Retention Properties

September 14th, 2010 … Fire and Smoke are Threatening I – 70, Fremont Indian State Park, Private Lands and the Kimberly Mining District



Several Employees gather Climate Data using a Remote Automated Weather Station (RAWS)

Observed Weather for the Current Operational Period

Fishlake National Forest

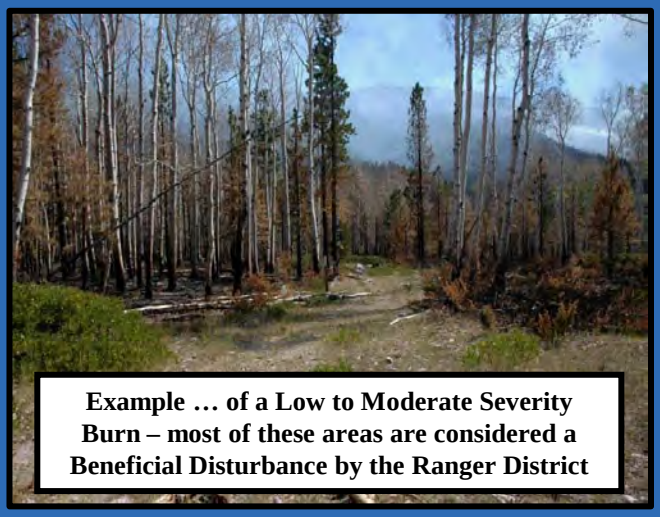
Twitchell Canyon Fire – P4FL8Q … Additional Photographs 4

Water-Repellent / Ground Conditions usually persist for a period of about 1 to 5 years following a Severe Burn

Type 1 / Helicopter
Erickson Air–Crane / S-64

Payload … 2650 Gallons of Retardant

Emerging Aspen … some of the new Suckers are already Measuring 1 foot In Height about 6 weeks after the Burn



Example … of a Low to Moderate Severity Burn – most of these areas are considered a Beneficial Disturbance by the Ranger District

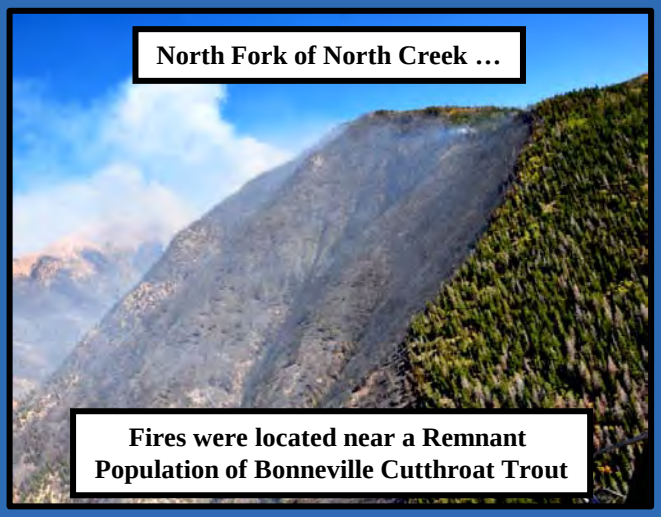
Fire Behavior … Creeping and Smoldering throughout the Burn – which is Consistent with our Stated / Resource Objectives

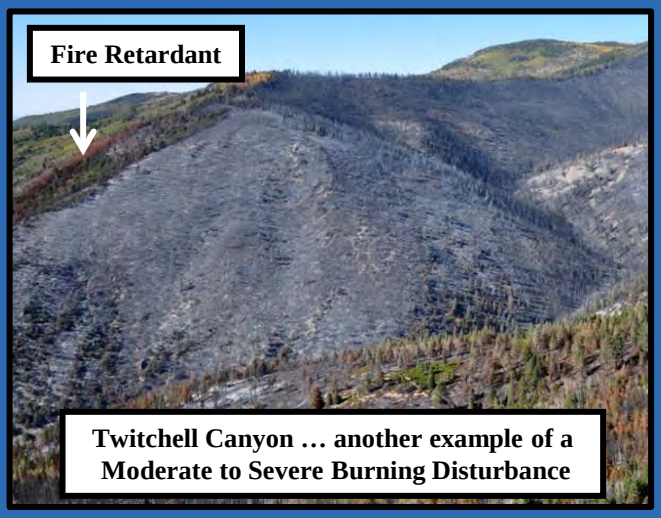
NFN3 Funds will be requested for Wildfire – Rehabilitation and Restoration Projects … includes, Riparian, Fences, Roads etc.

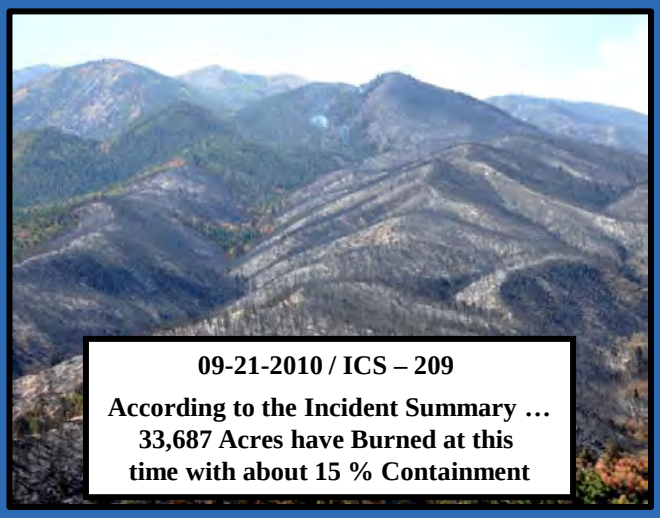
BAER Funds are used for Emergency Stabilization Treatments in Year # 1

Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q … Additional Photographs 5

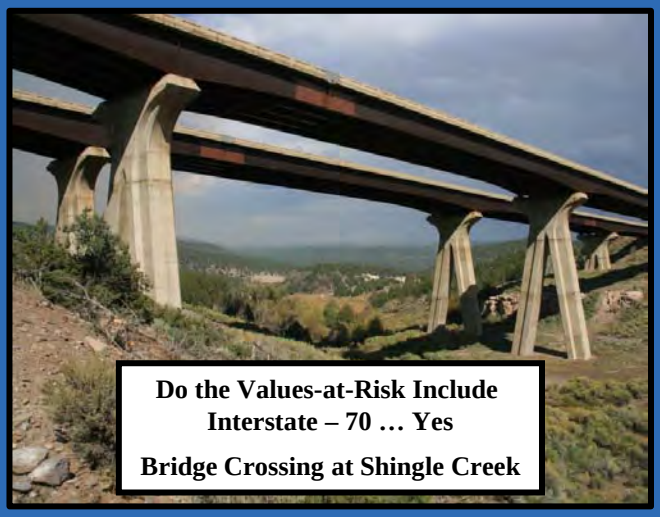






Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q … Additional Photographs 6



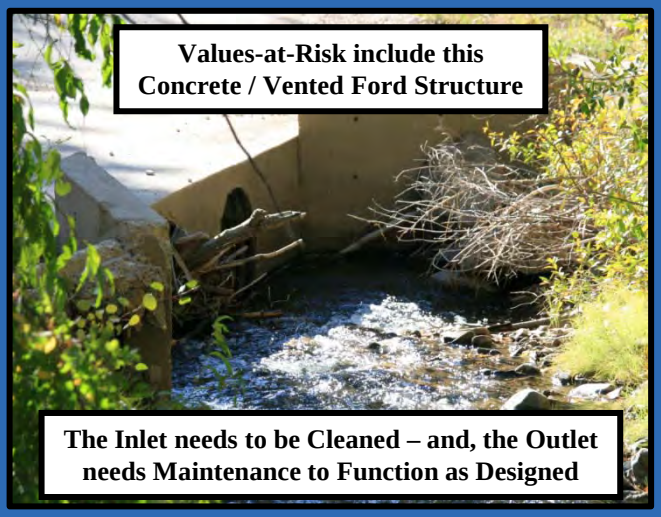
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q … Additional Photographs 7

This burn occurred in close proximity to Manderfield Reservoir … straw wattles will be used to trap ash and sediment -- protecting the quality of its water

Indian Creek

Several Large Plantations of Ponderosa Pine were Damaged in Indian Creek, at Mill Hollow and along North Creek

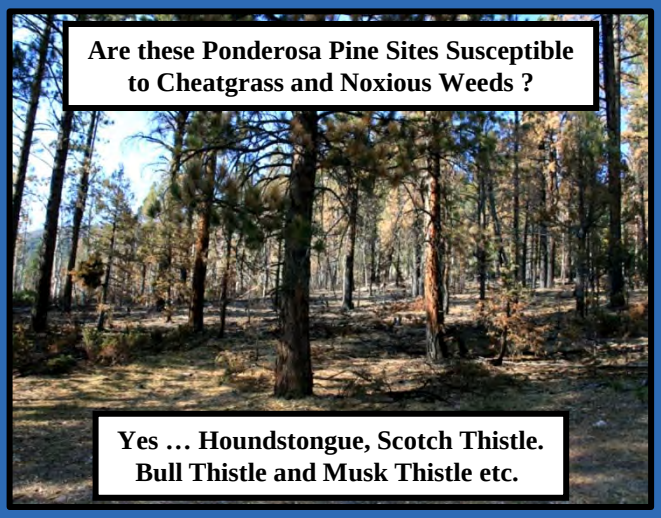


Values-at-Risk include this Concrete / Vented Ford Structure

The Inlet needs to be Cleaned – and, the Outlet needs Maintenance to Function as Designed

Upper Shingle Creek … Lots of Severely Burned Terrain

Hydrophobic Conditions and Flooding Hazards will Persist on these Slopes for Several Years



Are these Ponderosa Pine Sites Susceptible to Cheatgrass and Noxious Weeds ?

Yes … Houndstongue, Scotch Thistle. Bull Thistle and Musk Thistle etc.

Unburned Areas and Low Severity Fires …

Act as a Buffer Zone Trapping Assorted Debris and Slowing Runoff from Flood Source Sites

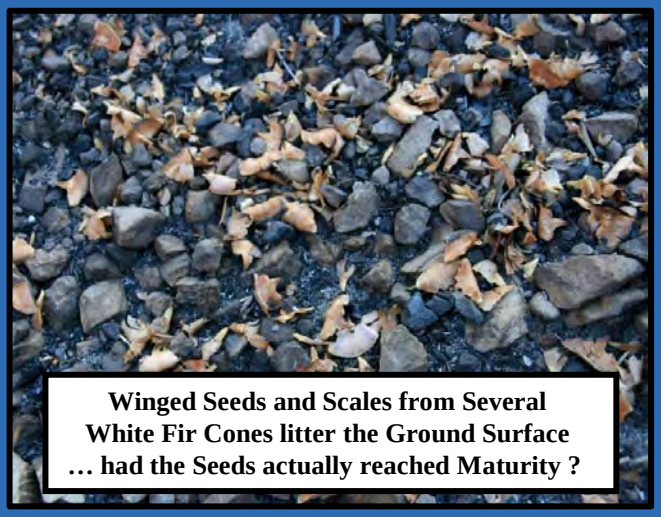
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q … Additional Photographs 8

Rattlesnake Ridge … another Landscape affected by a Moderate to High Severity Burn

Information Update / 09-30-2010

The estimated size of the Twitchell Canyon Fire is now at 44,874 Acres



Winged Seeds and Scales from Several White Fir Cones litter the Ground Surface … had the Seeds actually reached Maturity ?

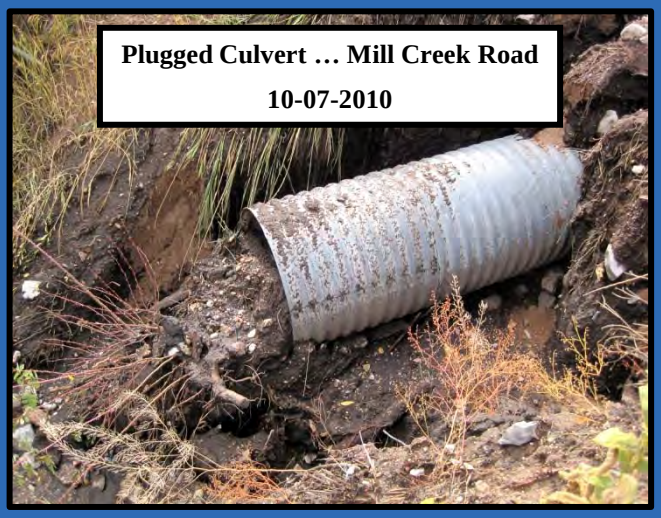
High Elevation Sites … Pre-Burn Conditions were Seral Aspen, Stable Aspen & Spruce / Fir

About 10 Miles of Road Needs to be Re-Conditioned within the Burned-Area … the cost was estimated at $ 25,000

We requested $ 17,500 in NFN3 Funds during FY ’ 11 to Remove Hazard Trees from Roads and Trails during Year # 1

Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q … Additional Photographs 9



Plugged Culvert … Mill Creek Road

10-07-2010

Clear Creek is filled with sediment and ash after the Kimberly SNOTEL Site receives 1.4 inches of rain over a period of 48 hours at 9300 feet

10-06-2010

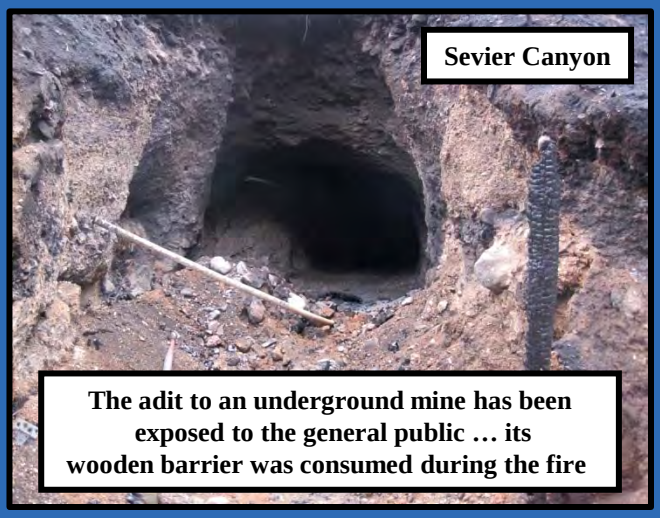
Shingle Creek … Fish Barrier & Ash-Laden Silt

Rattlesnake Ridge … this Location may be suitable for Implementing Broadcast Seeding Treatments using a Type III / Helicopter

BAER Team Survey … Road Conditions

Looking for Hazard Trees, Culvert Size and Condition, Drainage Structures, Bridge Crossings, Existing Waterbars etc.

North Creek

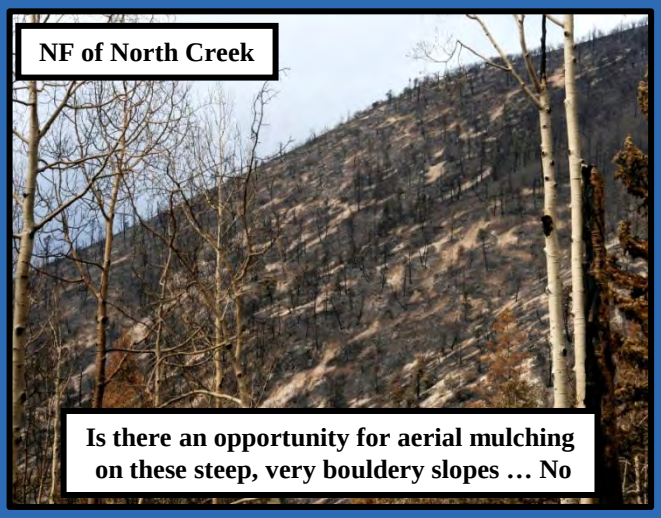


Sevier Canyon

The adit to an underground mine has been exposed to the general public … its wooden barrier was consumed during the fire

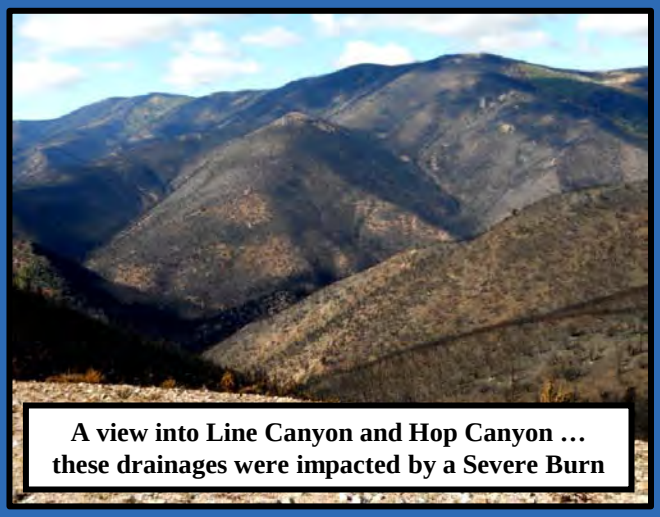
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q … Additional Photographs 10



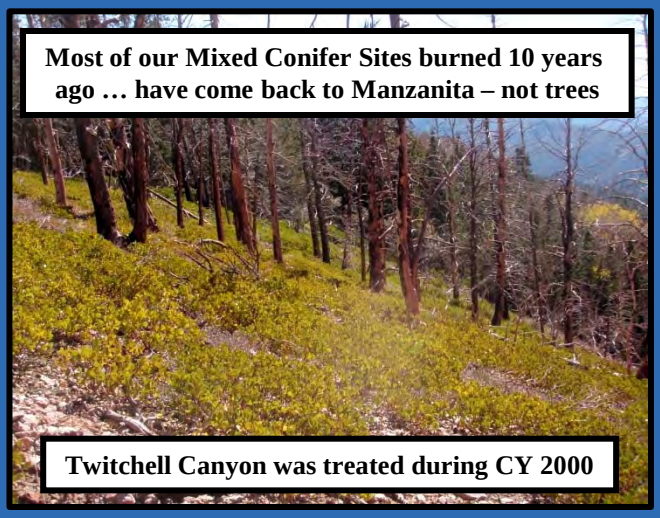
Fishlake National Forest

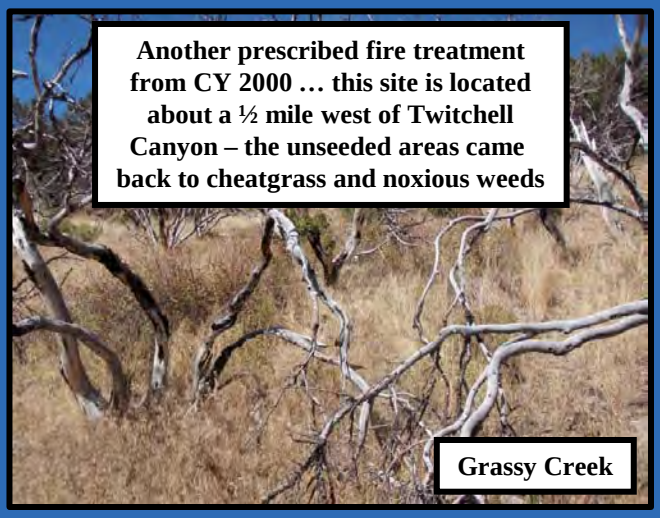
Twitchell Canyon Fire – P4FL8Q … Additional Photographs 11



Fishlake National Forest

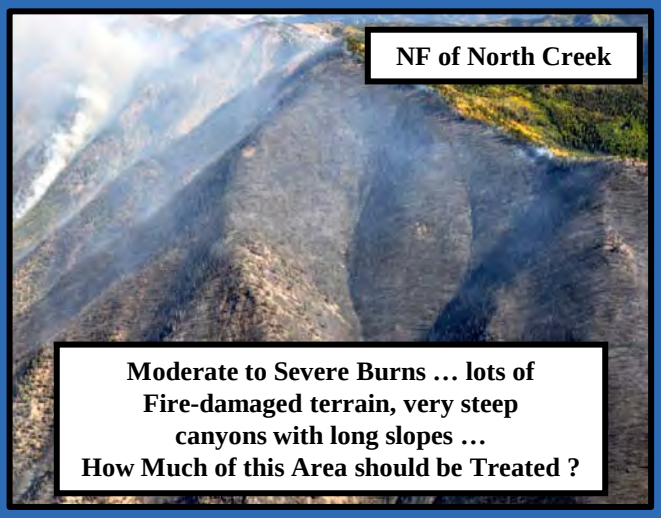
Twitchell Canyon Fire – P4FL8Q … Additional Photographs 12

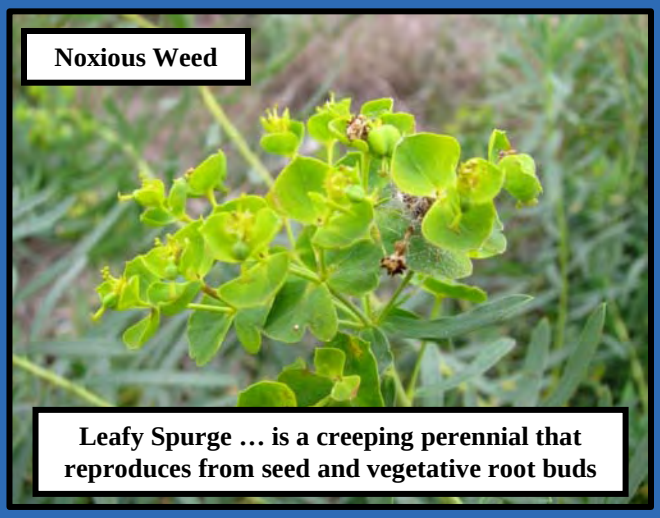


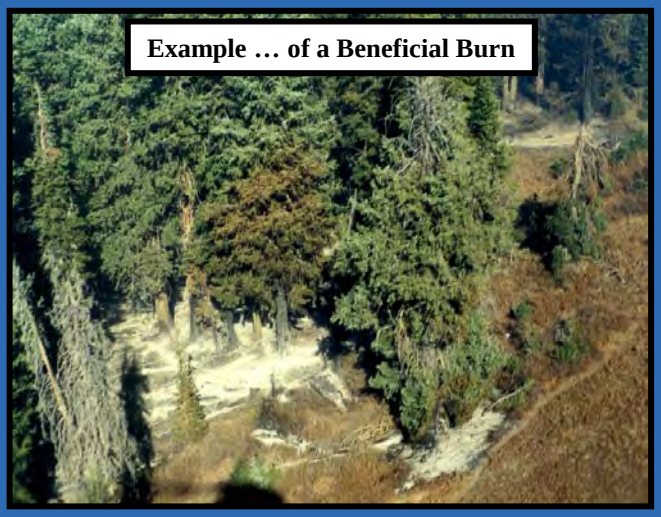


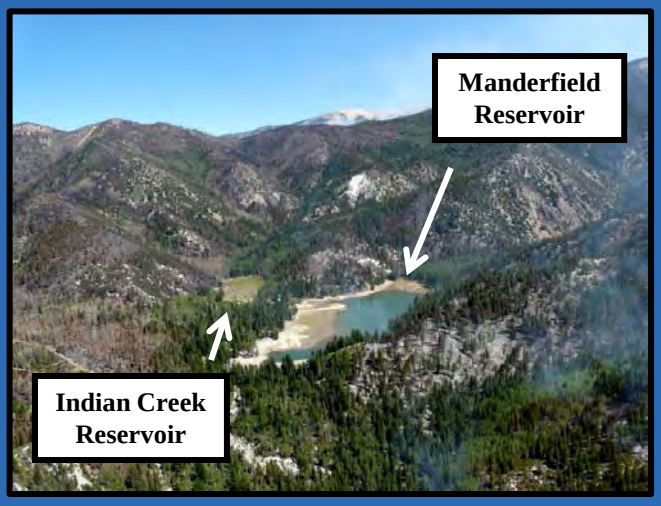
Fishlake National Forest

Twitchell Canyon Fire – P4FL8Q … Additional Photographs 13

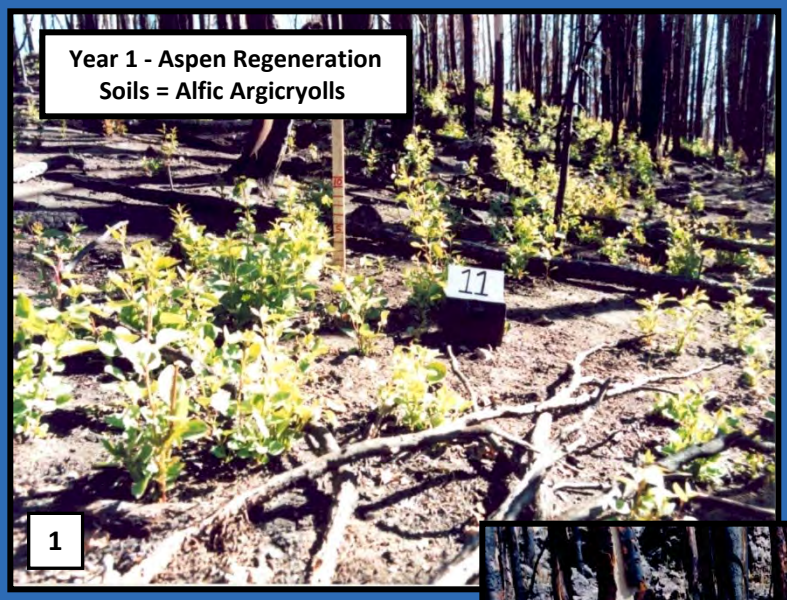








Oldroyd Fire of 2000 – Lessons Learned



1. Lessons Learned in 2001 …

The Fishlake NF / BAER Team recommended no treatments on many of our high mountain landscapes affected by the Oldroyd Fire during CY 2000 – allowing for aspen regeneration to occur and stabilize the site. Upland big game animals were quickly attracted to these burned-areas; all of the new aspen suckers were consumed in a matter of weeks by deer, elk and domestic livestock. This PhotoPoint (# 11) was taken on **07-10-2001**.

2. Project 0408-FIRE00-05-Oldroyd … our Seasonal Wildlife Crew established 20 different PhotoPoints within the Oldroyd Fire and monitored these sites to record the impacts of deer and elk within the burn. Their study lasted for a period of 3 years. Once again, this is a picture of PhotoPoint # 11 taken on **09-06-2001**. As you can see, all of the emerging aspen has been utilized as forage by the animals and livestock.

3. Another visit to PhotoPoint # 11 during the summer of 2002 shows … the area is converting to a plant community of perennial grasses and forbs; our opportunity for aspen regeneration is gone. In this instance, permanent impairment and unacceptable long-term change of habitat has occurred on Monroe Mountain. In order to prevent this from happening on the Twitchell Canyon Fire, temporary fences should be considered (NFN3 Funds) to protect our aspen resources along migration corridors.

(Oldroyd Monitoring Report)

Fishlake National Forest

Johnson Fire of 2002 … Lessons Learned

It is expected that most of the Johnson Fire will come to behave much like the Splatter Canyon Fire - in that, a large portion of the disturbance will eventually become covered with aspen. And why not ? Both the soil properties and site characteristics are nearly identical in these 2 areas. The soils within the burns were classified as being Argicryolls, Haplocryolls and Haplocryalfs. Mean annual precipitation is about 26 to 28 inches – and, each site receives 40 to 70 freeze - free days / year.

When everything was said and done … the amount of forage actually utilized by upland big game animals on the Johnson Fire was much less than what we had observed at the Oldroyd Fire of CY 2000 on Monroe Mountain. It is expected about 70 % of the burned-area will eventually revert to an aspen dominated landscape once again. The remaining sites never had the potential to support aspen due to extremely stony ground conditions, limited water retention properties and acidic pH conditions occurring within the topsoil horizons.

09-22-2010

FSM 2523 … BAER / the Emergency Stabilization of Burned-Areas Located on NFS Lands following Wildfires

The current policy and direction for our BAER Program changed dramatically during August of 2010. Presently, all BAER Teams must complete a Risk Assessment Matrix (or several assessments) with their Initial / BAER Report. Simply stated, the new matrix helps the BAER Team determine when Emergency Treatments are considered necessary and appropriate on NFS Lands. Included in this document is a brief review of the current objective, our policy, its definitions and some of the changes related to … a recently modified assessment process.

BAER Objective … to identify imminent post - wildfire threats to human life, safety and property along with, critical natural or cultural resources – to recognize the consequences … and, take immediate actions to manage all unacceptable risks

This material is being provided to our District Staff and Forest Employees to examine … it is intended to help folks understand the new terms and definitions being used by the 2010 / BAER Program.

1 – BAER / Assessment Process … 4 Basic Steps

1) Identification of the Values-at-Risk
2) Understanding of the Various Threats
3) Risk Evaluation – Determination of the Emergency
4) Treatment Prescription – Stabilization of the Burn during Year # 1

2 -- BAER / Risk Evaluation

Each critical value is evaluated using a Risk Assessment Matrix.

Risk is defined as … a combination of 1) Probability of Damage or Loss grouped with 2) a Magnitude of the Consequences

3 – Probability of Resource Damage or Loss

Use the following as a framework to estimate the relative probability that damage or loss would occur within a period of 1 to 3 years

Very Likely	a nearly certain occurrence	(> 90 %)
Likely	likely occurrence	(> 50 % to < 90 %)
Possible	possible occurrence	(> 10 % to < 50 %)
Unlikely	unlikely occurrence	(< 10 %)

4 – Magnitude of the Consequences

Major	involves … a loss of life or serious injury to humans; substantial property damage; irreversible and adverse affects to critical natural resources or cultural sites
Moderate	involves … injury or illness to humans; a moderate amount of property damage; harm to critical natural resources or cultural sites -- resulting in considerable or long-term impairment
Minor	property damage is limited in economic scope and / or value to just a few investments; damage to natural resources or cultural sites often results in minimal, recoverable or localized effects

5 – Risk Levels … is it a BAER Emergency ?

- **HIGH AND VERY HIGH RISK** … these are unacceptable risk levels – emergency treatments should be considered and implemented
- **INTERMEDIATE RISK** ... this could be unacceptable " if " human life or safety is the critical value – emergency treatments may be necessary
- **LOW AND VERY LOW RISK** ... these are not unacceptable risk levels -- emergency treatments are rarely justified

BAER Risk Evaluation / Example # 1

- ➔ Severely burned terrain is located on very steep slopes
- ➔ Occurs in close proximity to the Indian Creek Road and its Class 3 / Fisheries
- ➔ This area is susceptible to plant invasion by Scotch Thistle, Houndstongue and Cheatgrass … previously, these species did not exist on this landscape
- ➔ Soils were derived from volcanic tuff … these sandy sites are very susceptible to detachment and transport by water – meaning, possible mudslides

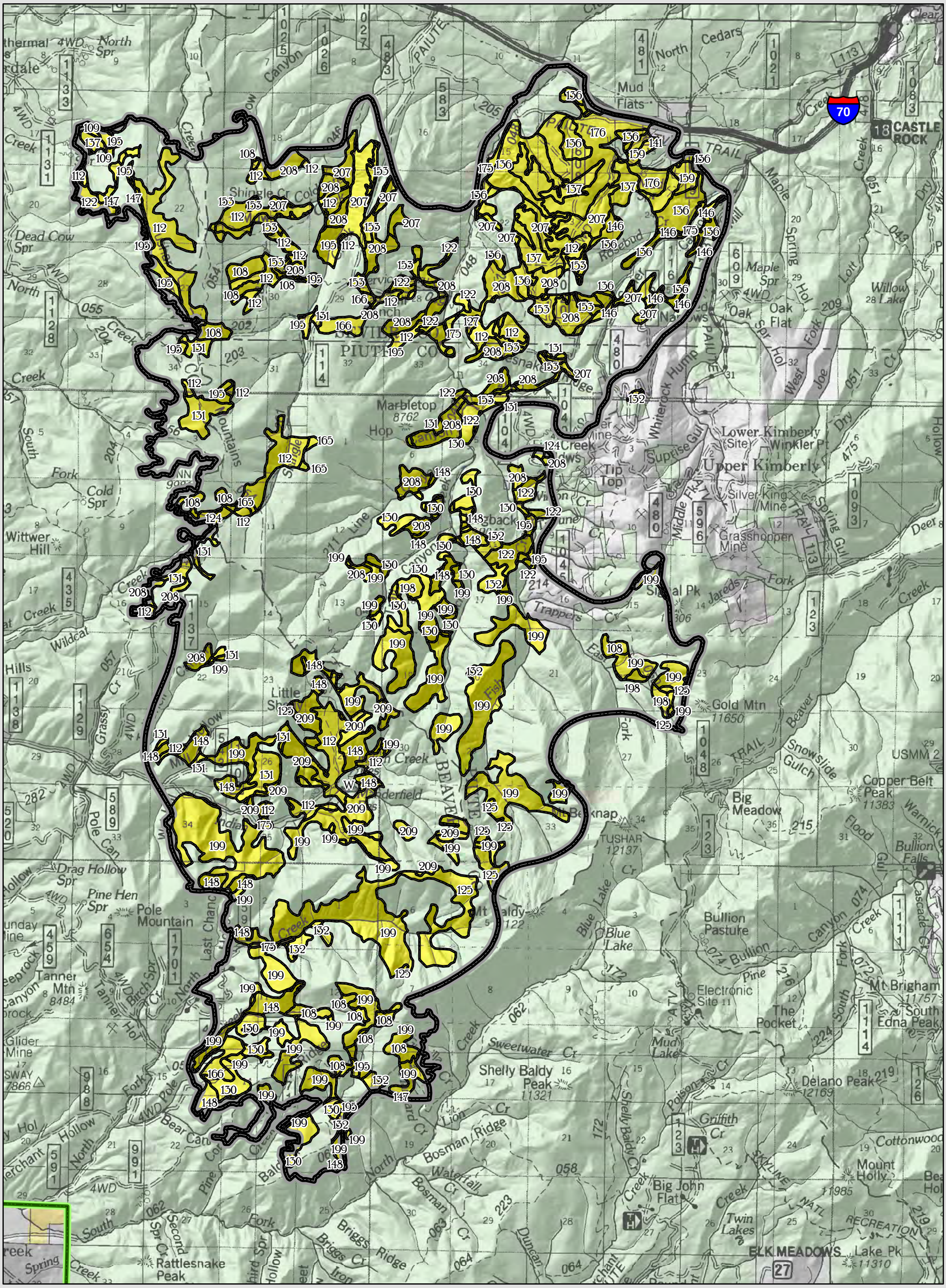
Probability of Resource Damage or Loss on NFS Lands	Magnitude of the Consequences		
	Major	Moderate	Minor
	*** BAER / Risk Assessment Matrix *** Mill Hollow … Potential Flood Hazard (noxious weeds / accelerated rates of soil erosion)		
Very Likely	Very High	Very High	Low
Likely	Very High	High	Low
Possible	High	Intermediate	Low
Unlikely	Intermediate	Low	Very Low

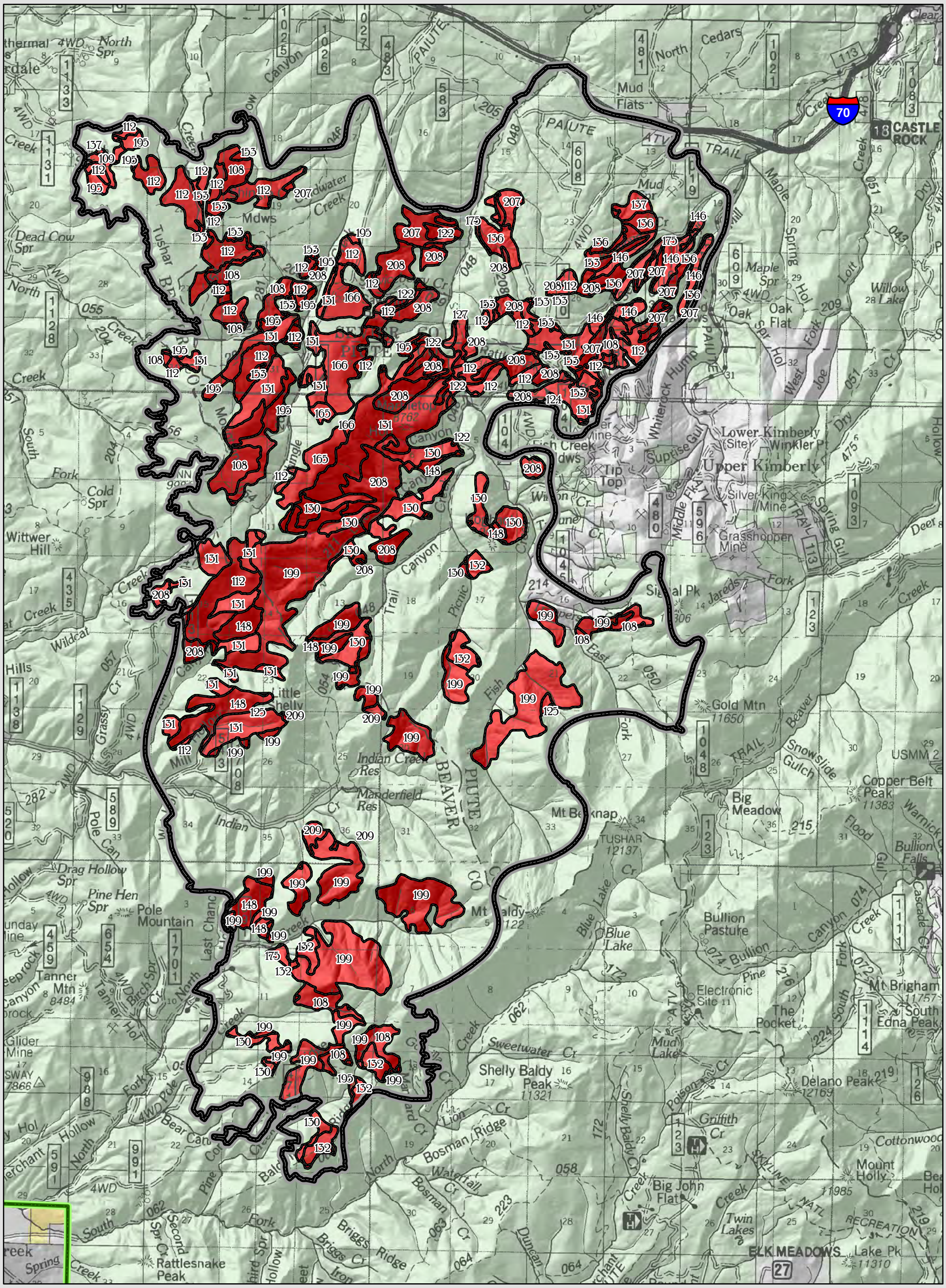
BAER Treatments … broadcast seeding and aerial mulching – these actions are intended to stabilize highly erosive soils and minimize unwanted plants such as Cheatgrass, Scotch Thistle & Houndstongue; the seed mix will be designed for landscapes having 22 + inches of annual precipitation; this area will be monitored for flood events and noxious weeds

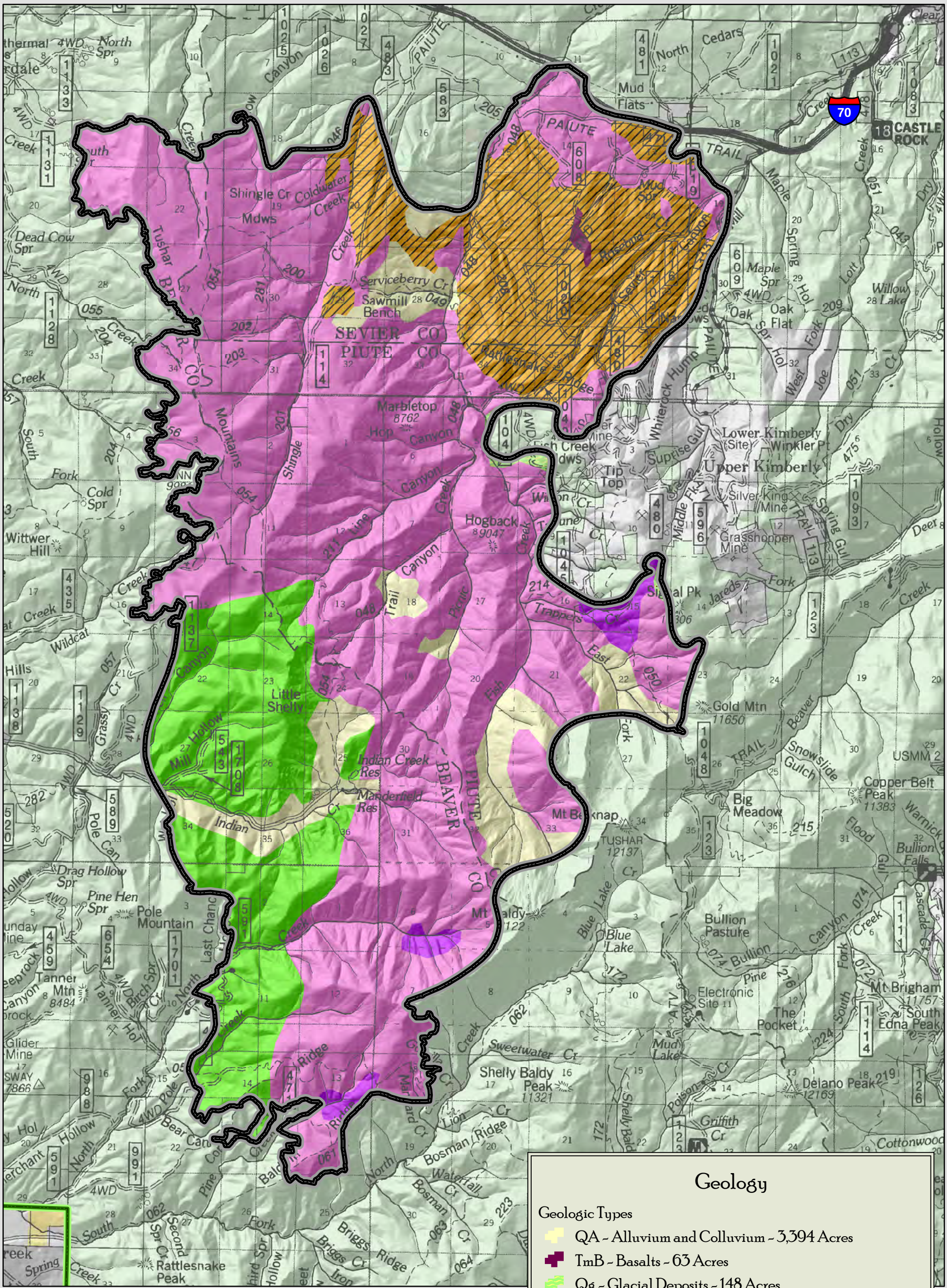
Twitchell Canyon Wildfire … BAER / Risk Evaluations

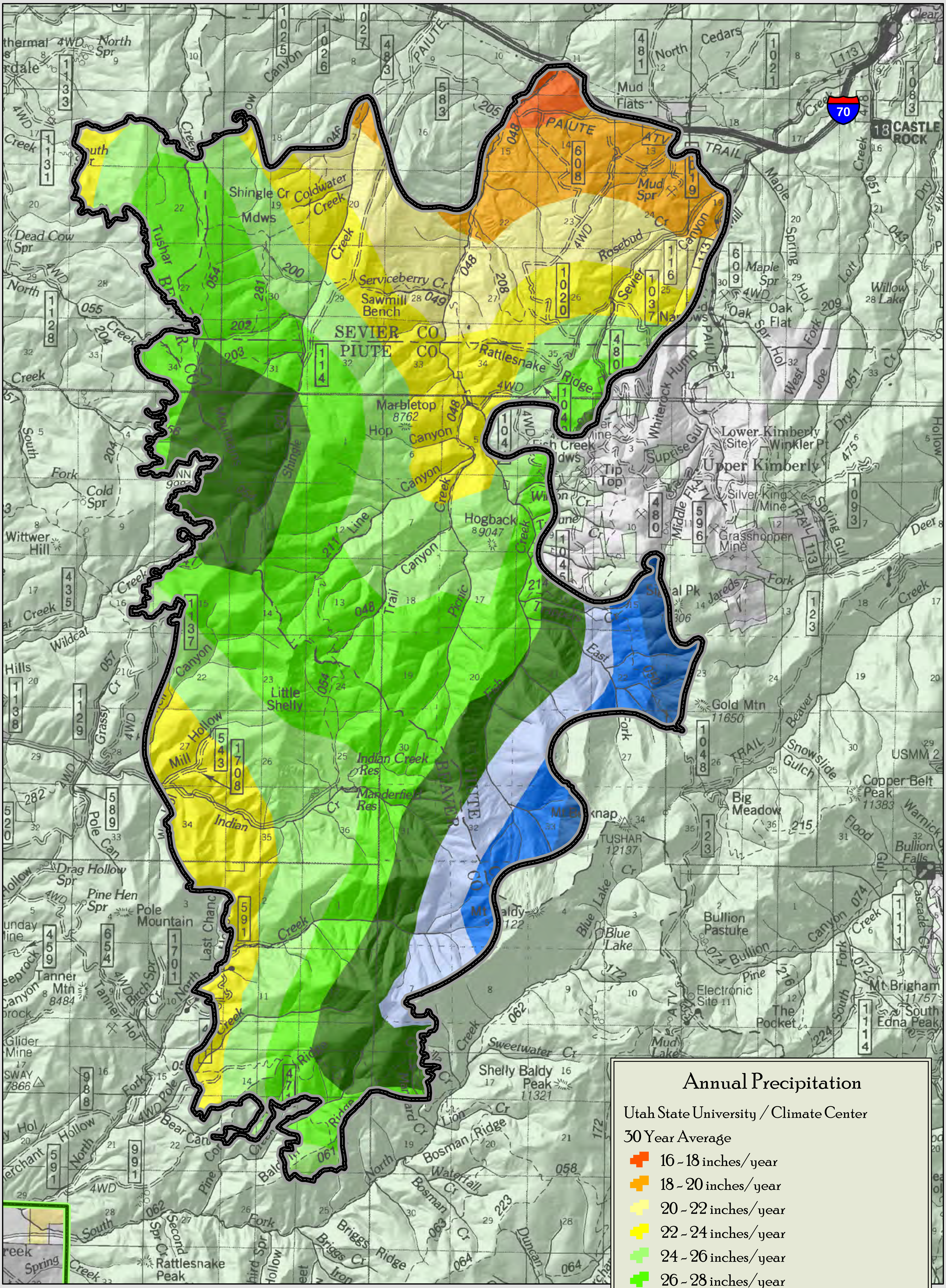
Summary Table and Ratings

Critical Values	Probabilities	Magnitudes	Risk Ratings
*** Human Life and Safety ***			
Private / State Property	Possible	Minor	Low
Roads – Flooding	Very Likely	Moderate	Very High
Mine Adits	Likely	Major	Very High
Hazard Trees	Possible	Major	High
*** Property ***			
Forest Roads	Very Likely	Moderate	Very High
State Highway	Unlikely	Moderate	Low
Forest Trails	Likely	Moderate	High
Downstream Diversions	Unlikely	Minor	Very Low
Agricultural Water	Possible	Moderate	Intermediate
Downstream Improvements	Possible	Moderate	Intermediate
Geothermal Plant	Unlikely	Moderate	Low
Manderfield Reservoir	Possible	Moderate	Intermediate *
*** Natural Resources ***			
Wild & Scenic River	Unlikely	Minor	Very Low
North Creek – Irrigation	Likely	Minor	Low
Geothermal	Unlikely	Moderate	Low
Soil Productivity	Very Likely	Major	Very High
Hydrologic Function	Very Likely	Moderate	Very High
LE – Plant Communities	Likely	Moderate	High
HE – Plant Communities	Possible	Moderate	Intermediate
*** Cultural Resources ***			
Listed Sites	Unlikely	Minor	Very Low


Twitchell Canyon Wildfire
Fishlake National Forest
Soil Types / Moderate Burn Severity
0 1 2 4 Miles
1:75,000 Scale
N
S
E
W
Soil Types / Moderate Burn Severity
Soil Types
Moderate Burn Severity ~ 15,206 Acres
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary


Twitchell Canyon Wildfire
Fishlake National Forest
Soil Types / High Burn Severity
0 1 2 4 Miles
1:75,000 Scale
N
S
E
W
Soil Types / High Burn Severity
Soil Types
High Burn Severity ~ 14,641 Acres
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary


Twitchell Canyon Wildfire
Fishlake National Forest
Geology
0
1
2
4 Miles
1:75,000 Scale
N
S
E
W
Geology
Geologic Types
QA ~ Alluvium and Colluvium ~ 3,394 Acres
TmB ~ Basalts ~ 63 Acres
Qg ~ Glacial Deposits ~ 148 Acres
Tjt ~ Joe Lott Tuff ~ 6,557 Acres
Tmv ~ Miocene Volcanic Rocks, Undivided ~ 27,651 Acres
T5 ~ Sevier River Volcanics ~ 6,447 Acres
Ti ~ Tertiary Intrusive Rocks ~ 614 Acres
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary



Twitchell Canyon Wildfire
Fishlake National Forest
Annual Precipitation

0 1 2 4 Miles

1:75,000 Scale

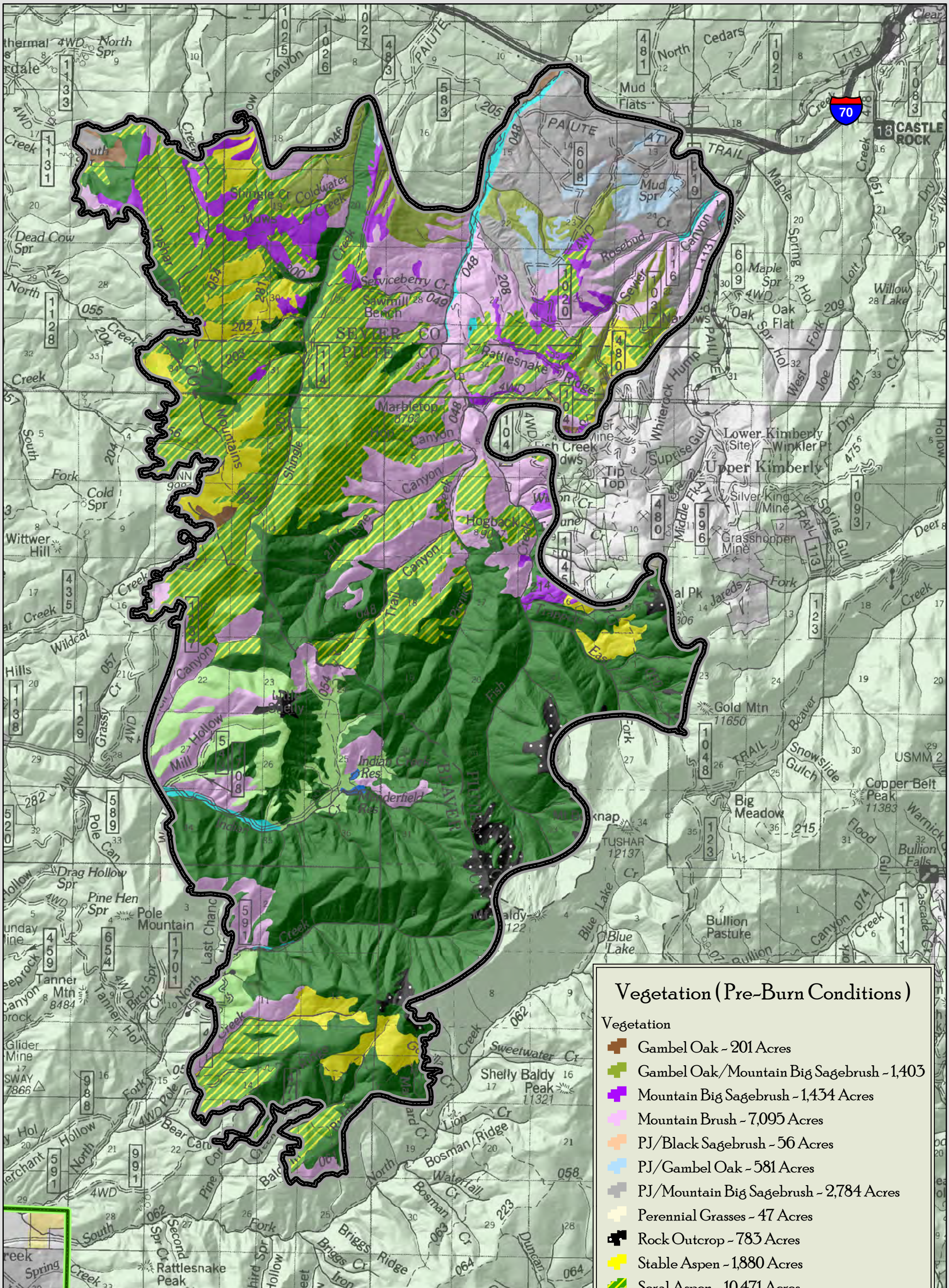
N W E S

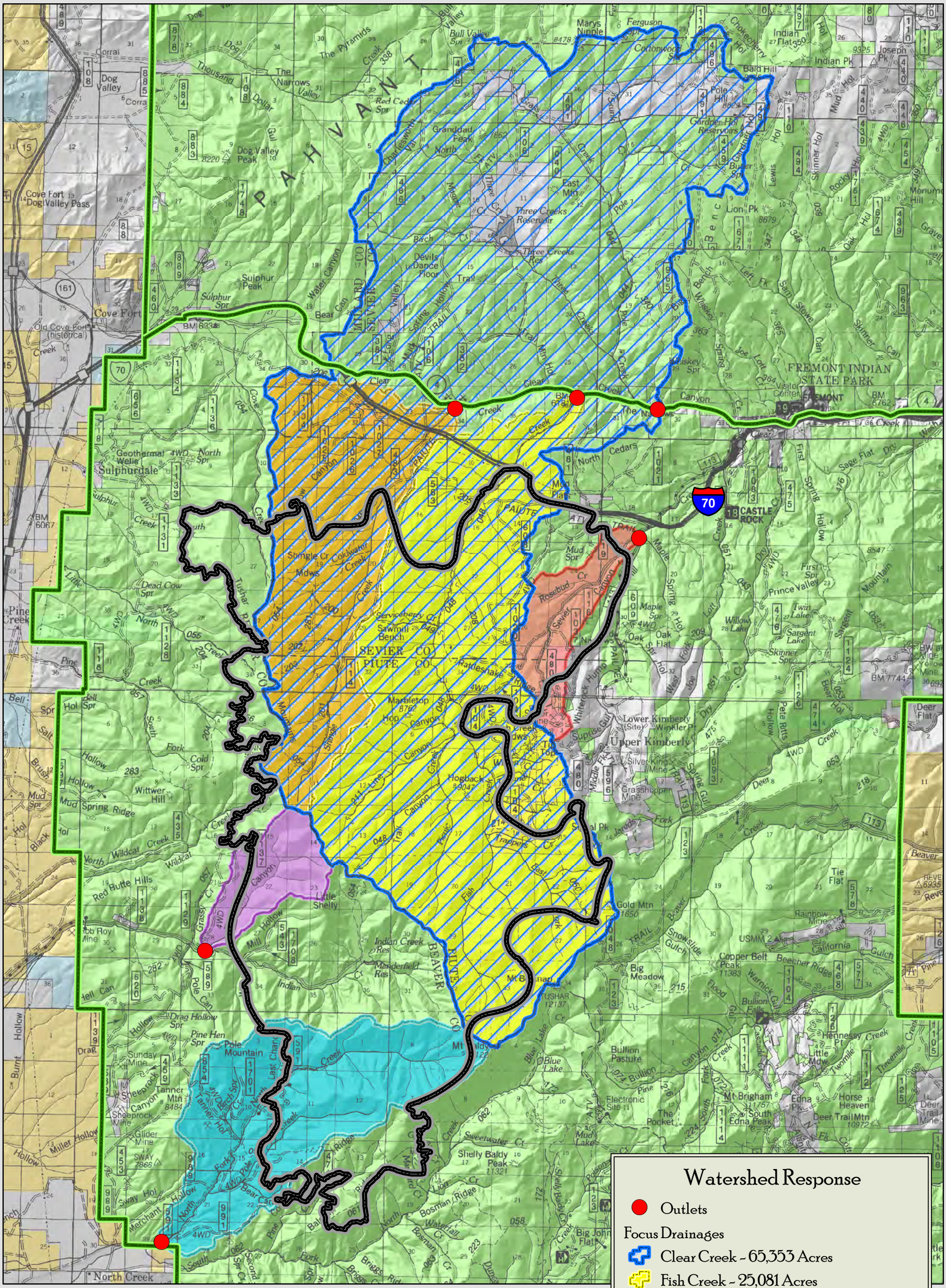
Annual Precipitation

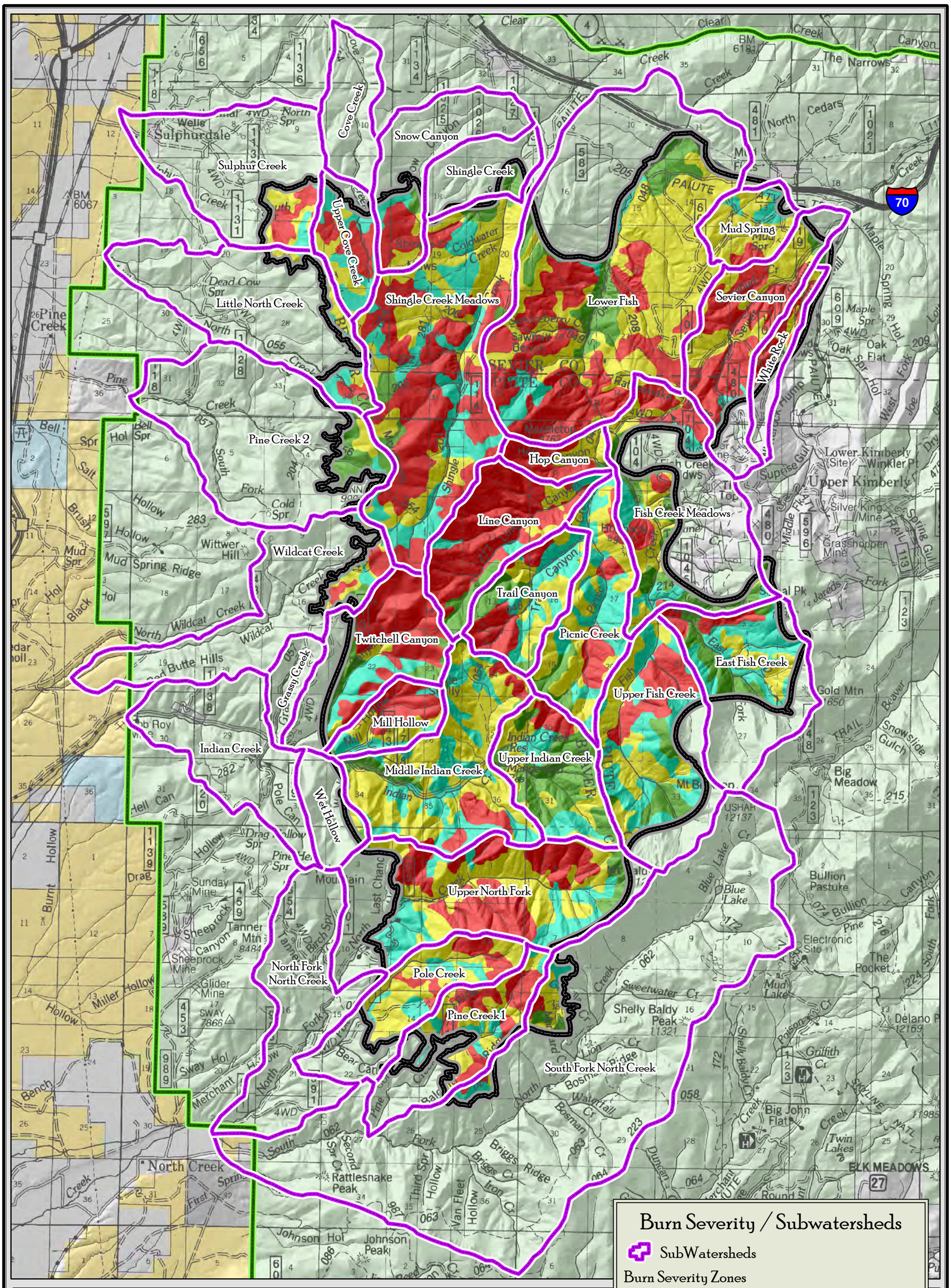
Utah State University / Climate Center

30 Year Average

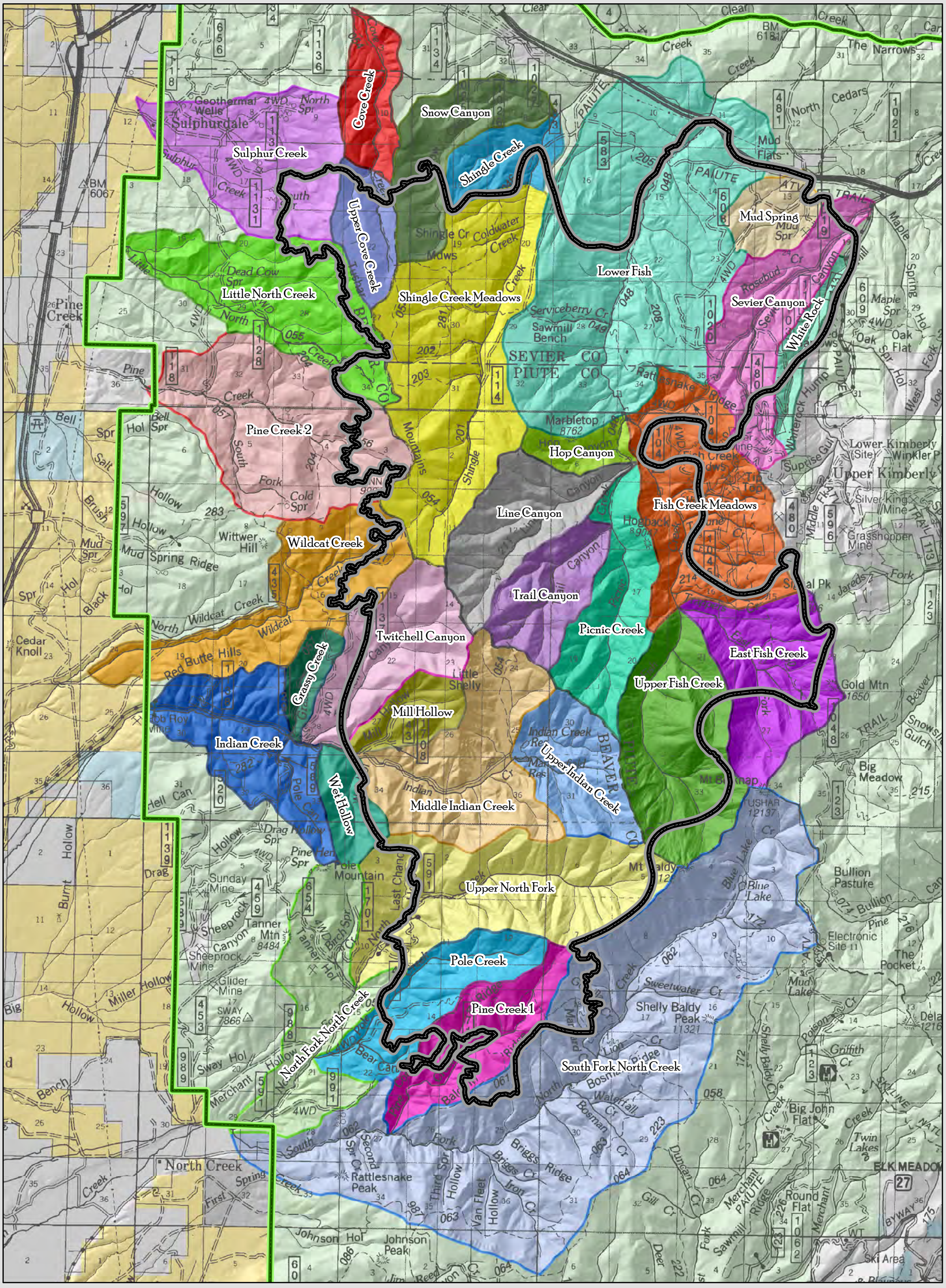
- 16 - 18 inches/year
- 18 - 20 inches/year
- 20 - 22 inches/year
- 22 - 24 inches/year
- 24 - 26 inches/year
- 26 - 28 inches/year
- 28 - 30 inches/year
- 30 - 32 inches/year
- 32 - 34 inches/year
- 34 - 36 inches/year
- Twitchell Canyon Wildfire - 44,874 Acres
- Forest Boundary


Twitchell Canyon Wildfire
Fishlake National Forest
Vegetation (Pre-Burn Conditions)
0 1 2 4 Miles
1:75,000 Scale
N
S
E
W
Vegetation (Pre-Burn Conditions)
Vegetation
Gambel Oak ~ 201 Acres
Gambel Oak/Mountain Big Sagebrush ~ 1,403
Mountain Big Sagebrush ~ 1,434 Acres
Mountain Brush ~ 7,095 Acres
PJ/Black Sagebrush ~ 56 Acres
PJ/Gambel Oak ~ 581 Acres
PJ/Mountain Big Sagebrush ~ 2,784 Acres
Perennial Grasses ~ 47 Acres
Rock Outcrop ~ 783 Acres
Stable Aspen ~ 1,880 Acres
Seral Aspen ~ 10,471 Acres
Spruce/Fir ~ 16,024 Acres
Mixed Conifer ~ 1,766 Acres
Riparian ~ 325 Acres
Water ~ 24 Acres
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary


Twitchell Canyon Wildfire
Fishlake National Forest
Watershed Response
0 1 2 4 Miles
1:110,000 Scale
N
W
E
S
Watershed Response
Outlets
Focus Drainages
Clear Creek ~ 65,353 Acres
Fish Creek ~ 25,081 Acres
North Creek ~ 9,032 Acres
Sevier Creek ~ 2,348 Acres
Shingle Creek ~ 11,039 Acres
Twitchell Creek ~ 2,107 Acres
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary
PAHVANT
SEVIER CO
PIUTE CO
FREMONT INDIAN STATE PARK
CASTLE ROCK
Sulphurdale
Cove Fort
Upper Kimberly
Lower Kimberly
Three Creeks Reservoir
Gardner Hol Reservoirs
Marys Nipple
Ferguson Spr
Cottonwood Spr
Indian Flat
Joseph Pk
Indian Pk
Bald Hill
Pole Hill
Lion Pk
East Mtn
Grandad Peak
Dog Valley Peak
Sulphur Peak
Shingle Cr
Coldwater Creek
Sawmill Bench
Marbletop
Hogback
Shelly Baldy Peak
Gold Mtn
Big Meadow
Copper Belt Peak
Bullion Falls
Bullion Pasture
Mt Brigham
South Edna Peak
Horse Heaven
Deer Trail Mtn
Tie Flat
Prince Valley
Twin Lake
Sargent Lake
Willow Lake
Tanner Mtn
Pole Mountain
Little Shelly
Indian Creek Res
Manderfield Res
Blue Lake
Mud Lake
Big John Flat
North Creek



Twitchell Canyon Wildfire
Fishlake National Forest
Burn Severity / Subwatersheds



Twitchell Canyon Wildfire
Fishlake National Forest
Subwatersheds

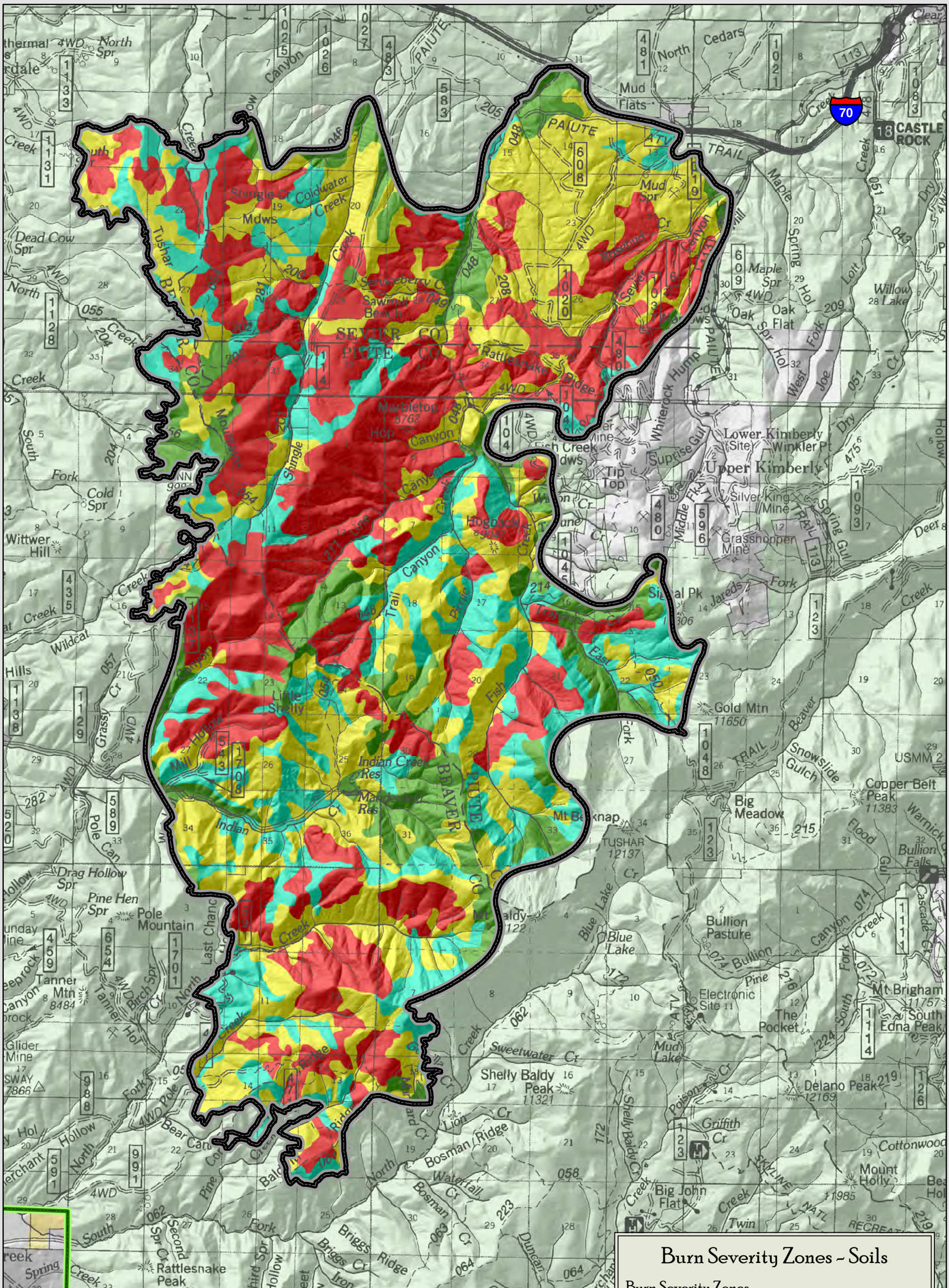
0 1 2 4 Miles

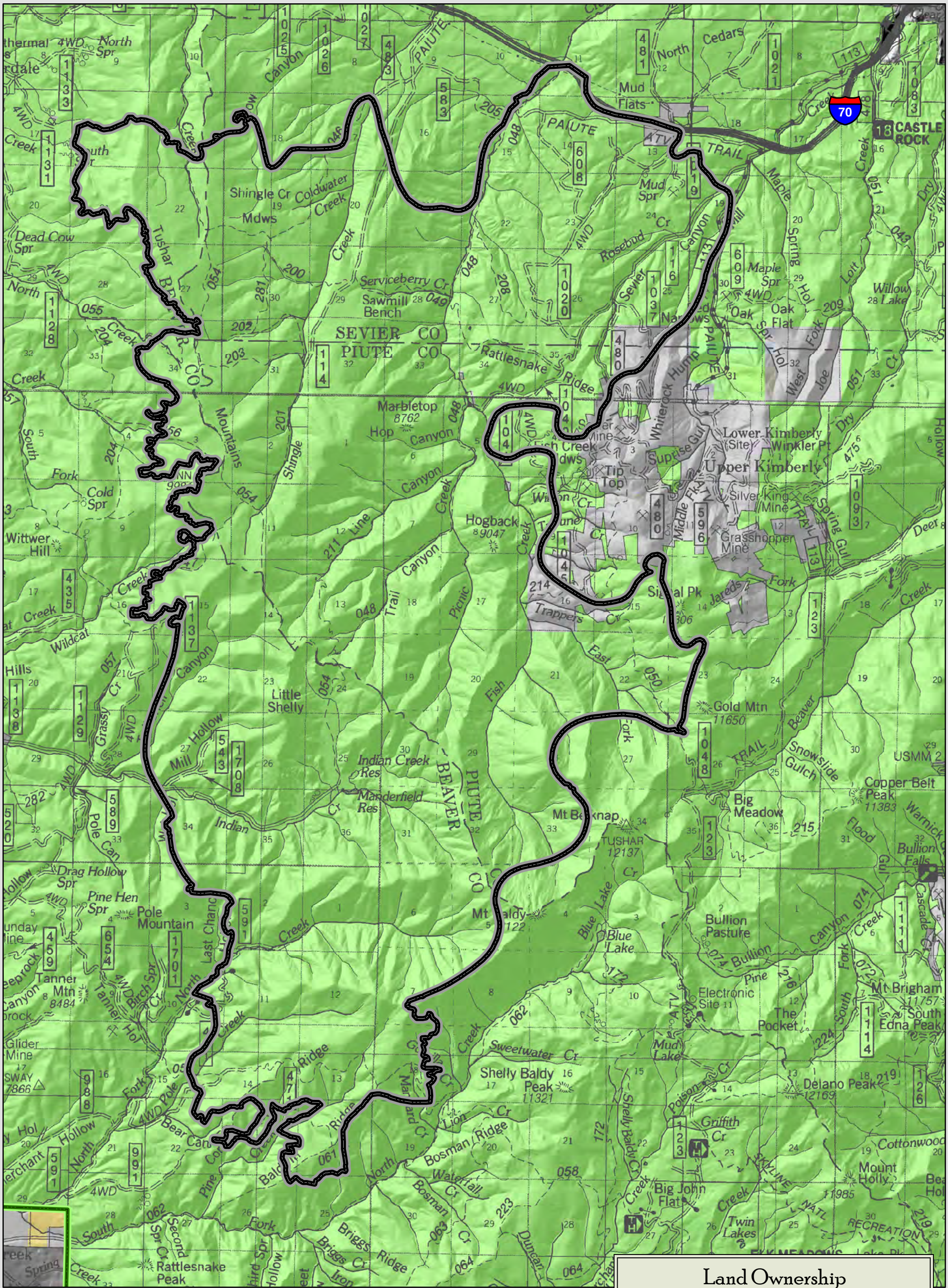
1:85,000 Scale

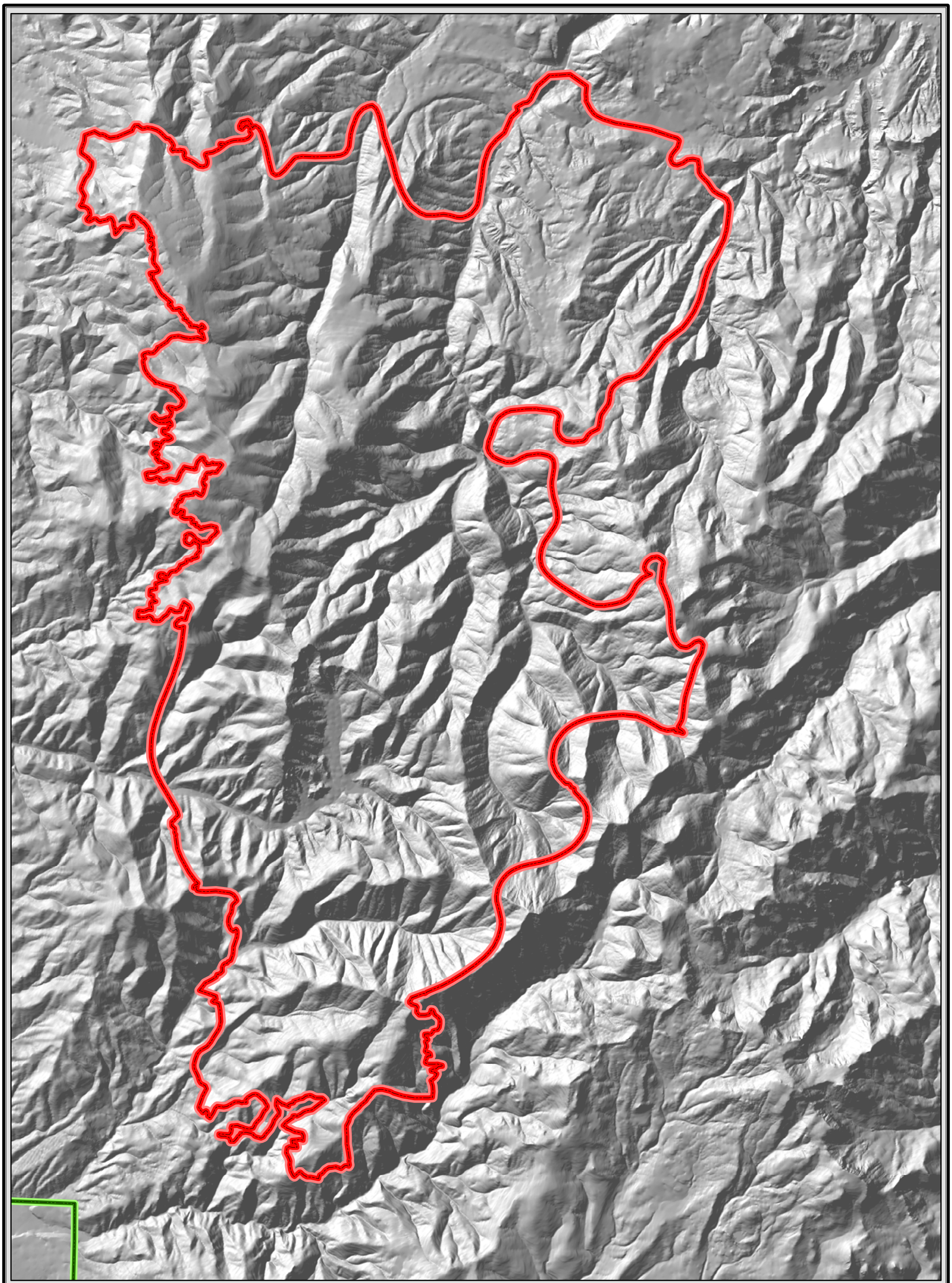
N
W E
S

Subwatersheds

- Twitchell Canyon Wildfire ~ 44,874 Acres
- Forest Boundary


Twitchell Canyon Wildfire
Fishlake National Forest
Burn Severity Zones
0 1 2 4 Miles
1:75,000 Scale
N
W
E
S
Burn Severity Zones ~ Soils
Burn Severity Zones
High ~ 14,641 Acres ~ 33%
Moderate ~ 15,206 Acres ~ 34%
Low ~ 9,304 Acres ~ 21%
Unburned ~ 5,723 Acres ~ 13%
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary


Twitchell Canyon Wildfire
Fishlake National Forest
Land Ownership
0
1
2
4 Miles
1:75,000 Scale
N
W
E
S
Land Ownership
Land Ownership
Forest Service ~ 44,376 Acres
Private ~ 498 Acres
BLM
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary
SEVIER CO
PIUTE CO
BEAVER CO
CASTLE ROCK
Mud Flats
Shingle Cr
Coldwater Creek
Mdws
Sawmill Bench
Serviceberry Cr
Rattlesnake Ridge
Marbletop 8762
Hogback 9047
Lower Kimberly
Upper Kimberly
Silver King Mine
Grasshopper Mine
Little Shelly
Indian Creek Res
Manderfield Res
Gold Mtn 11650
Big Meadow
Copper Belt Peak 11383
Mt Belknap
TUSHAR 12137
Bullion Pasture
Blue Lake
Electronic Site
The Pocket
Mt Brigham 11757
South Edna Peak
Delano Peak 12169
Shelly Baldy Peak 11321
Big John Flat
Twin Lakes
Mount Holly 11985
Pole Mountain
Tanner Mtn 8484
Rattlesnake Peak
Drag Hollow Spr
Pine Hen Spr
Wittwer Hill
Dead Cow Spr
Cold Spr
Willow Lake
Bullion Falls
Cottonwood
Mud Lake
Maple Spr
Oak Flat
Tip Top
Trappers Cr
Sweetwater Cr
Bosman Ridge
Waterfall Cr
Bear Canyon
Pine Canyon
Tushar Mountains
Shingle Canyon
Fish Creek
Picnic Trail
Trail Canyon
Rosebud Canyon
Sevier Canyon
Maple Spring Hol
Lott Fork
West Joe
Dry Hollow
Deer Creek
Wildcat Hills
Grassy Cr
Mill Hollow
Indian Canyon
Pole Canyon
Last Chance
Birch Spr
Hot Hollow
Second Spr Cr
Briggs Ridge
Duncan
Griffith Cr
Poison Cr
Shelly Baldy Cr
Lion Cr
Flood Gulch
Warnick Cr
Snowslide Gulch
Beaver Creek
East Fork
Jareds Fork
Spring Gulch
Suprise Gulch
Whiterock Hump
Middle Fk
Glider Mine
SWAY 7866
Merchant Hollow
Spring Creek
SKYLINE NATL RECREATION



Twitchell Canyon Wildfire
Fishlake National Forest
Shaded Relief

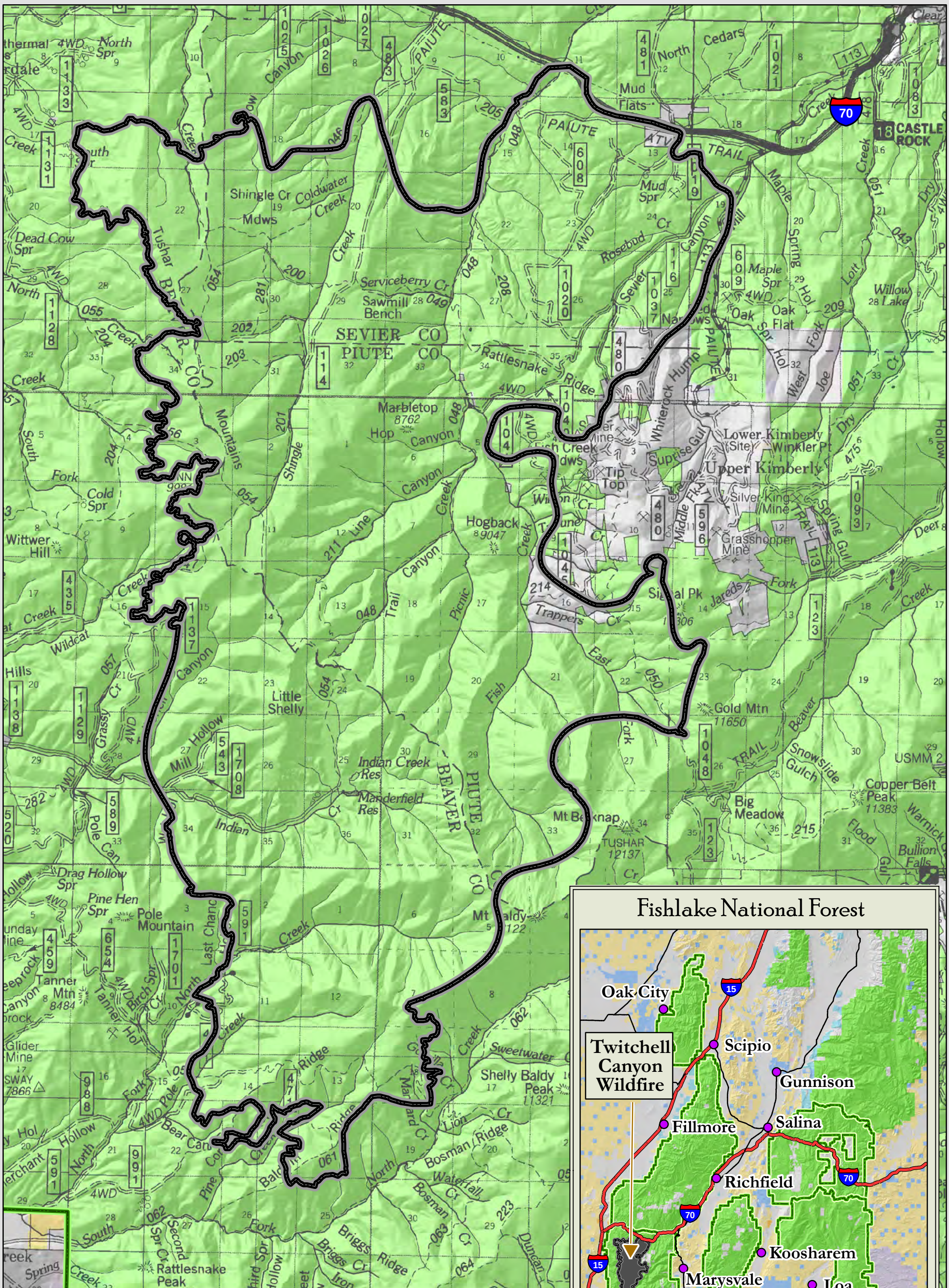
0 1 2 4 Miles

1:75,000 Scale

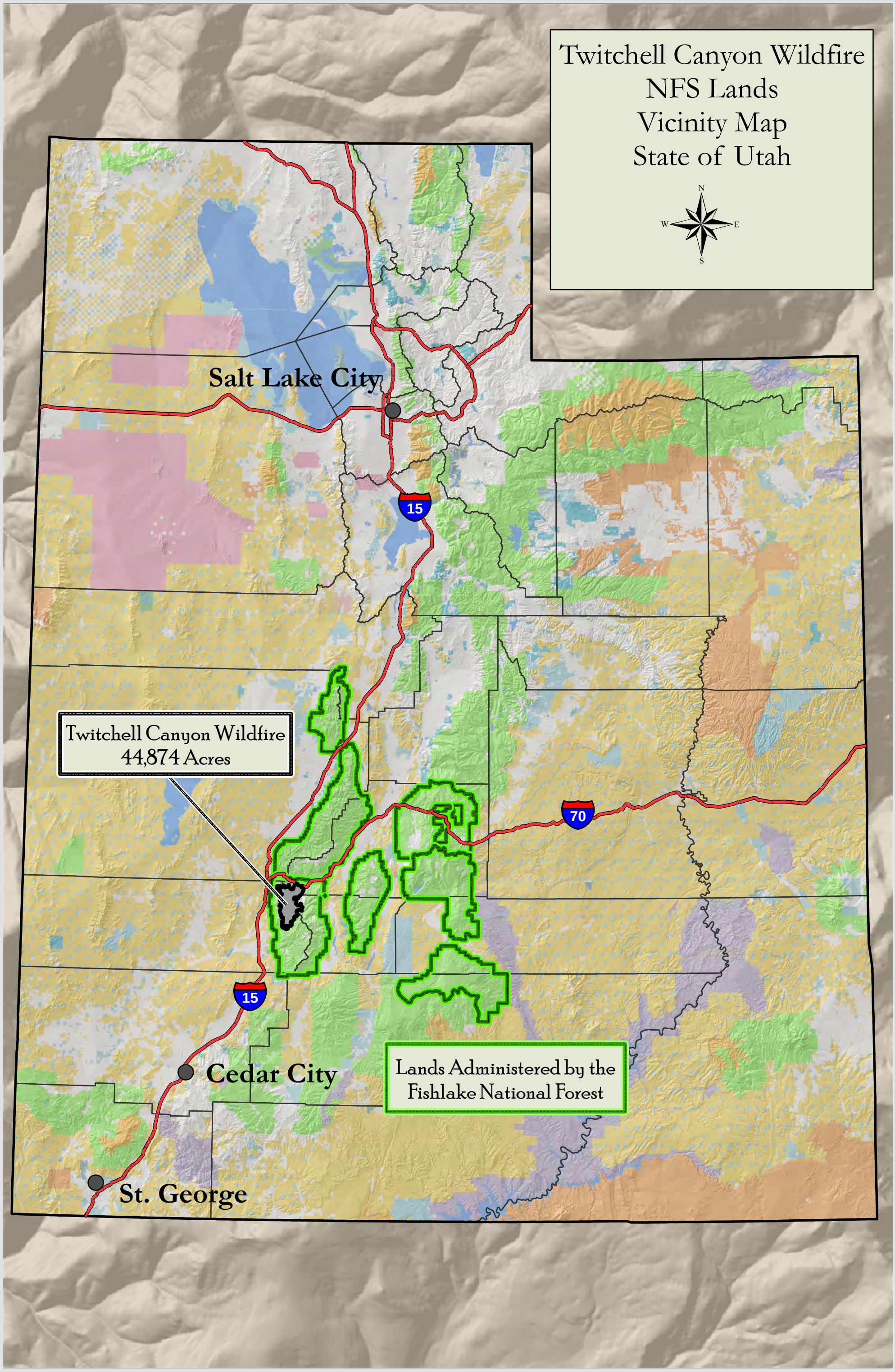
N
W E
S

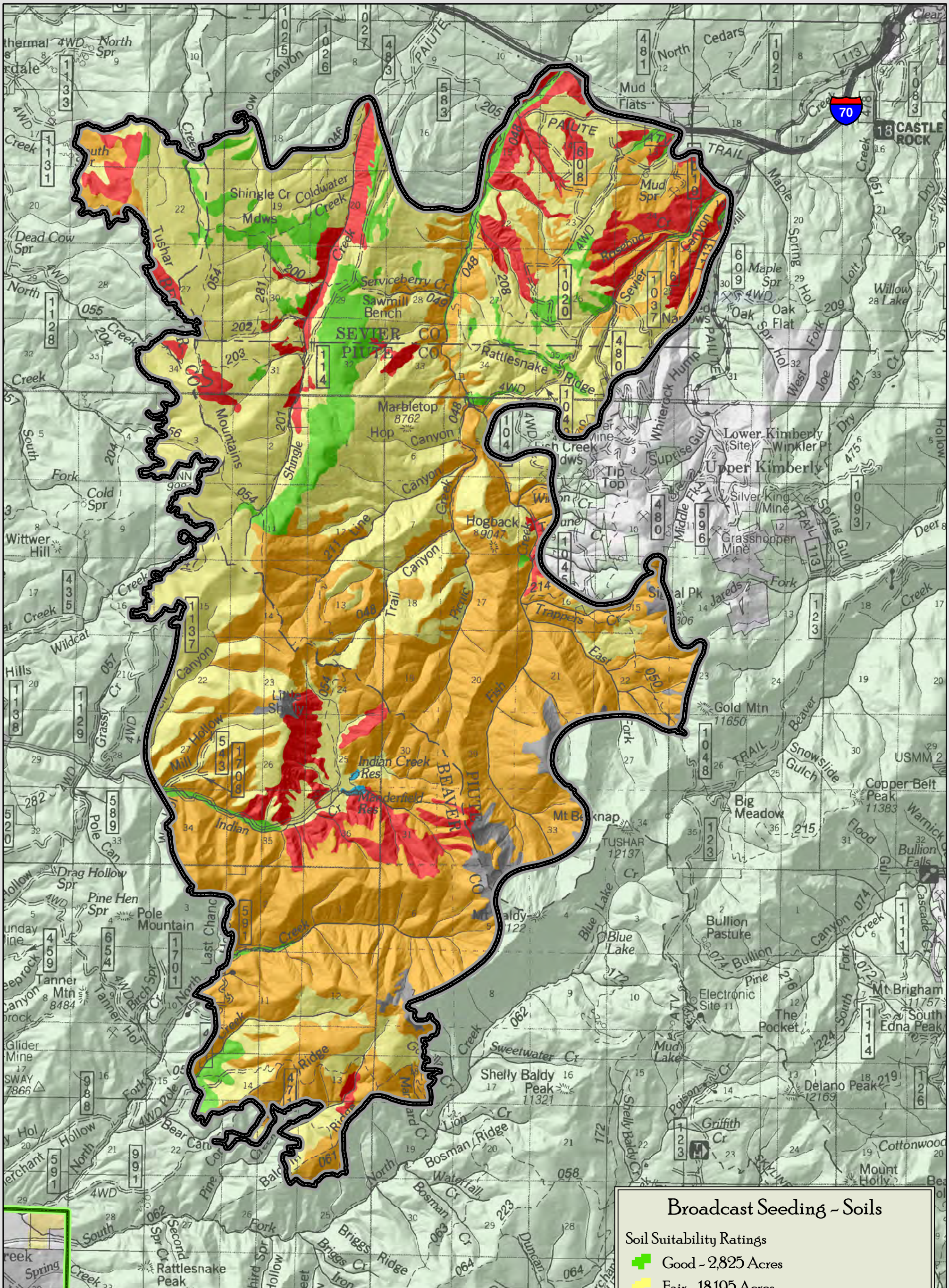
Shaded Relief

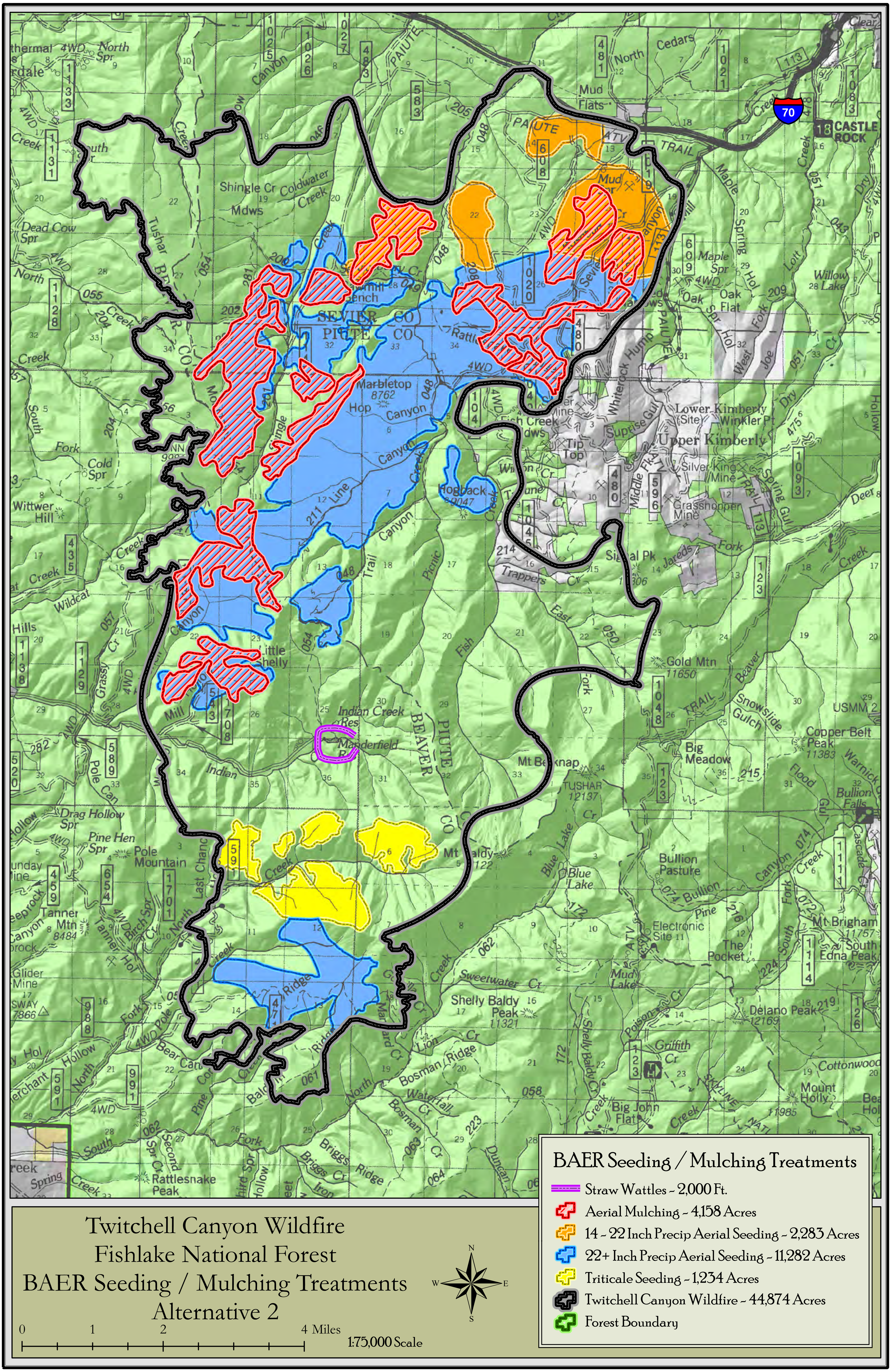
- Twitchell Canyon Wildfire ~ 44,874 Acres
- Forest Boundary

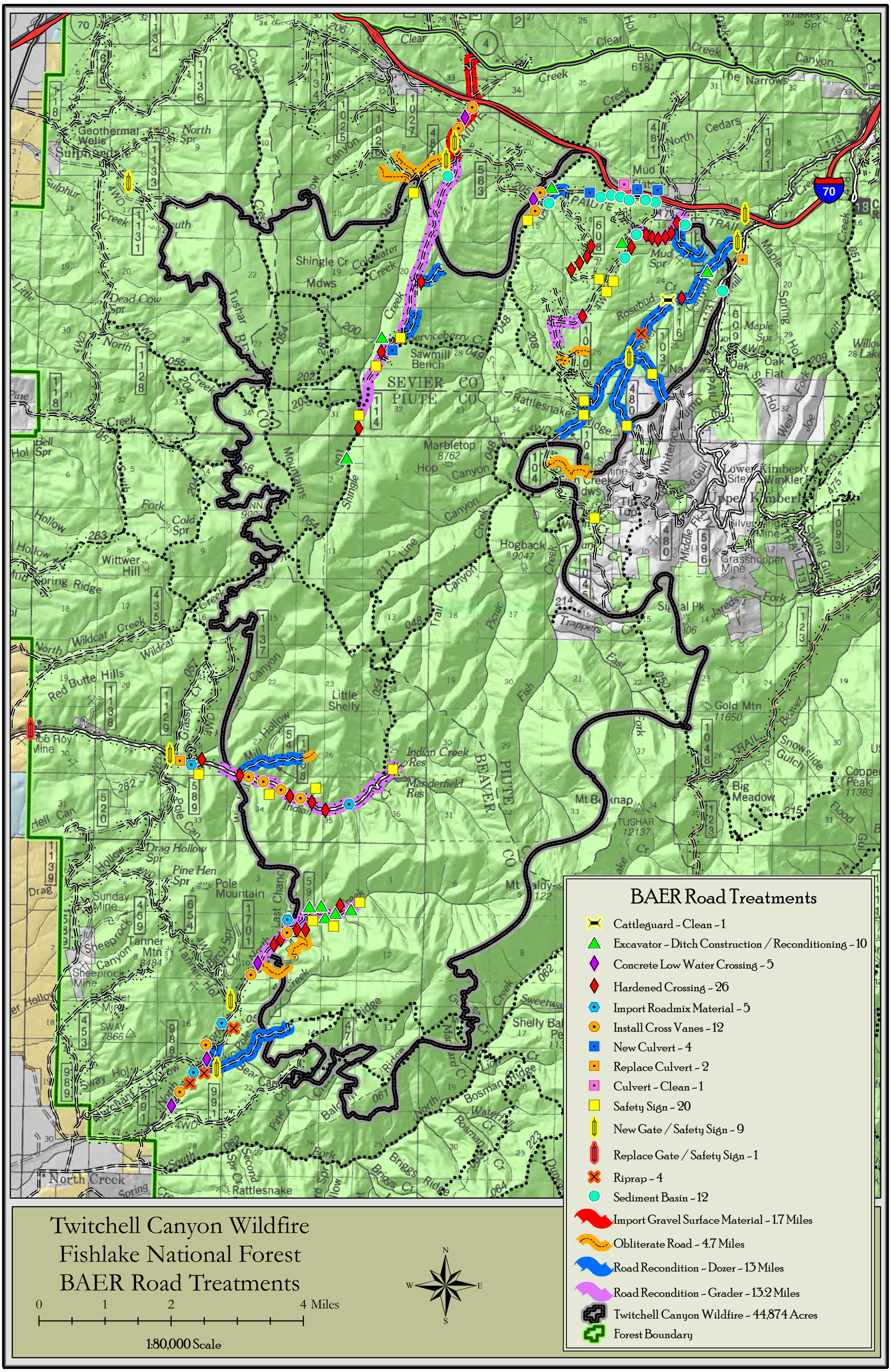


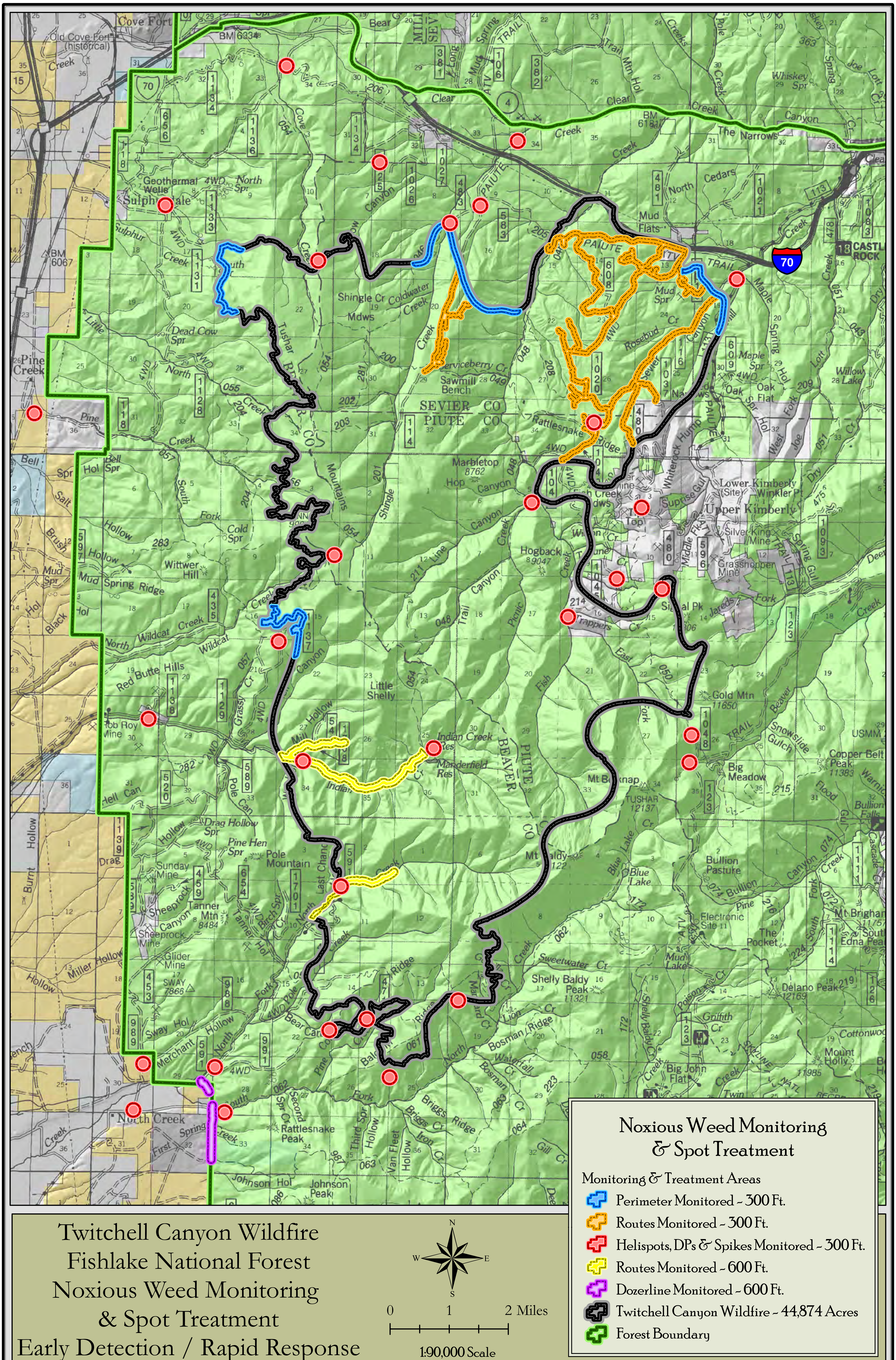
Twitchell Canyon Wildfire
44,874 Acres
Fishlake National Forest
Vicinity Map


Twitchell Canyon Wildfire
NFS Lands
Vicinity Map
State of Utah
N
W
E
S
Salt Lake City
15
Twitchell Canyon Wildfire
44,874 Acres
70
15
Cedar City
Lands Administered by the
Fishlake National Forest
St. George

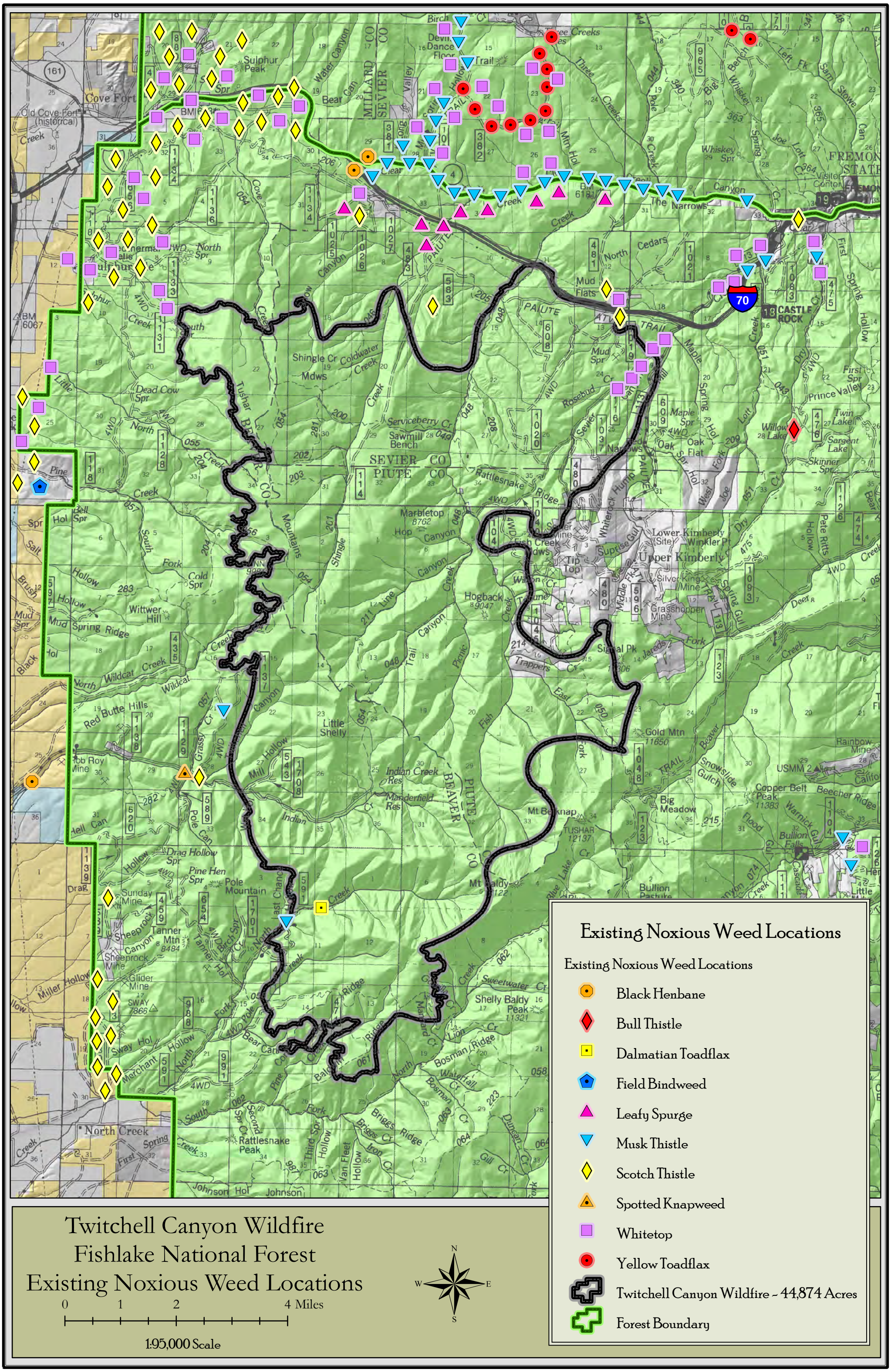

Twitchell Canyon Wildfire
Fishlake National Forest
Broadcast Seeding
0 1 2 4 Miles
1:75,000 Scale
N
W
E
S
Broadcast Seeding ~ Soils
Soil Suitability Ratings
Good ~ 2,825 Acres
Fair ~ 18,195 Acres
Poor ~ 18,723 Acres
Very Poor ~ 4,327 Acres
Unsuited ~ 780 Acres
Water ~ 24 Acres
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary

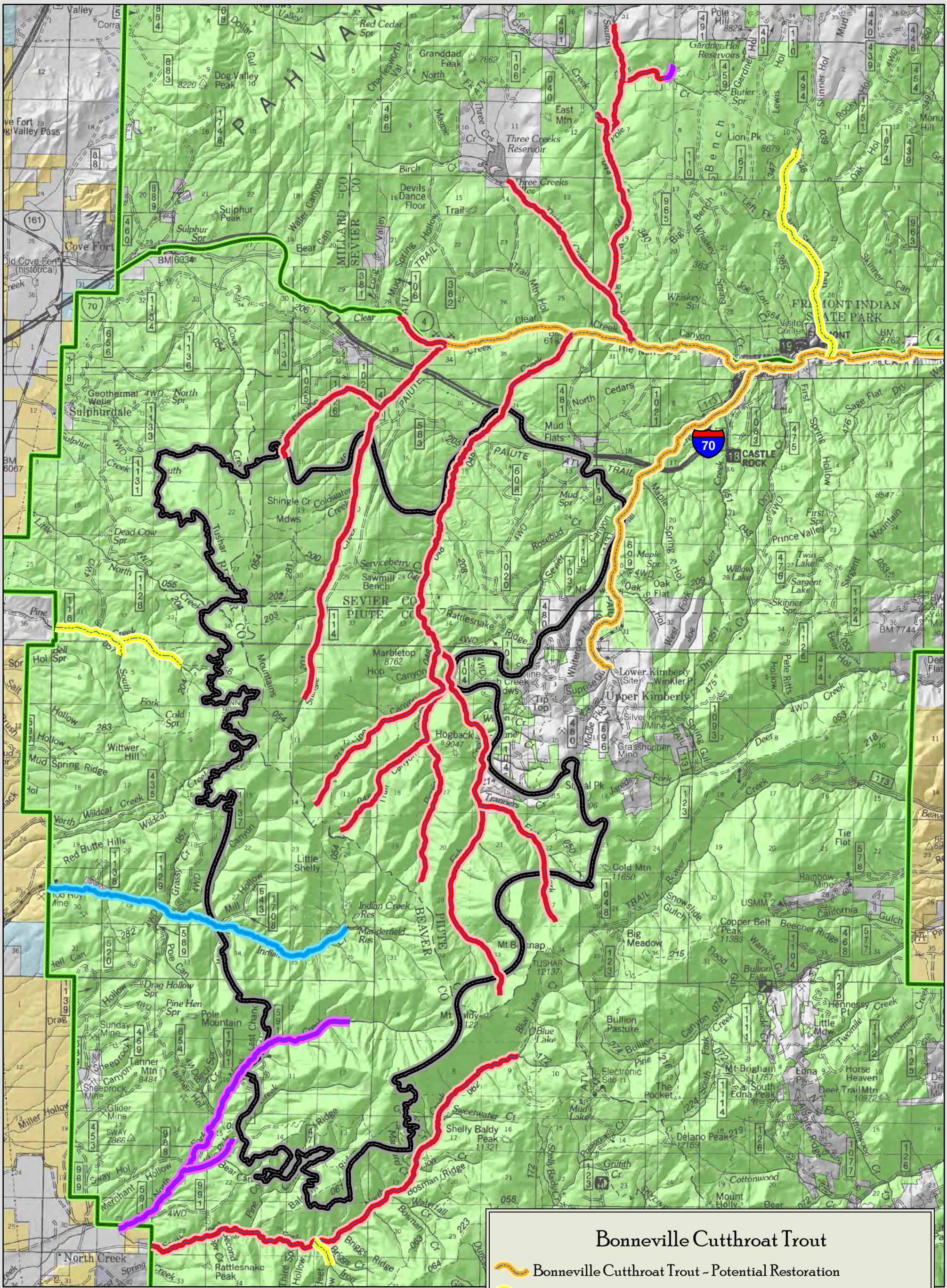

Twitchell Canyon Wildfire
Fishlake National Forest
BAER Seeding / Mulching Treatments
Alternative 2
0
1
2
4 Miles
1:75,000 Scale
N
W
E
S
BAER Seeding / Mulching Treatments
Straw Wattles ~ 2,000 Ft.
Aerial Mulching ~ 4,158 Acres
14 ~ 22 Inch Precip Aerial Seeding ~ 2,283 Acres
22+ Inch Precip Aerial Seeding ~ 11,282 Acres
Triticale Seeding ~ 1,234 Acres
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary

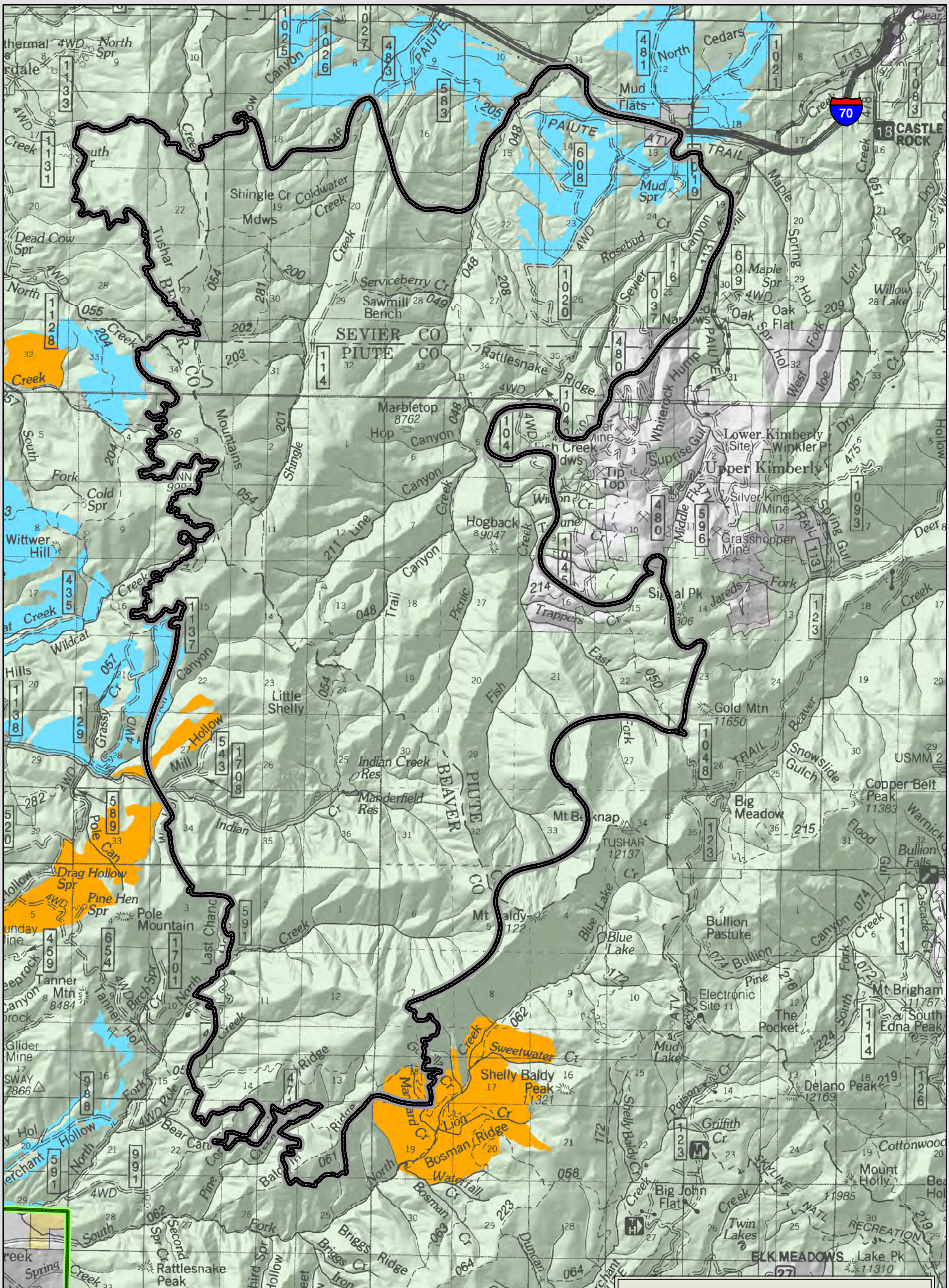

Twitchell Canyon Wildfire
Fishlake National Forest
BAER Road Treatments
0 1 2 4 Miles
1:80,000 Scale
N
W
E
S
BAER Road Treatments
Cattleguard ~ Clean ~ 1
Excavator ~ Ditch Construction / Reconditioning ~ 10
Concrete Low Water Crossing ~ 5
Hardened Crossing ~ 26
Import Roadmix Material ~ 5
Install Cross Vanes ~ 12
New Culvert ~ 4
Replace Culvert ~ 2
Culvert ~ Clean ~ 1
Safety Sign ~ 20
New Gate / Safety Sign ~ 9
Replace Gate / Safety Sign ~ 1
Riprap ~ 4
Sediment Basin ~ 12
Import Gravel Surface Material ~ 1.7 Miles
Obliterate Road ~ 4.7 Miles
Road Recondition ~ Dozer ~ 13 Miles
Road Recondition ~ Grader ~ 13.2 Miles
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary

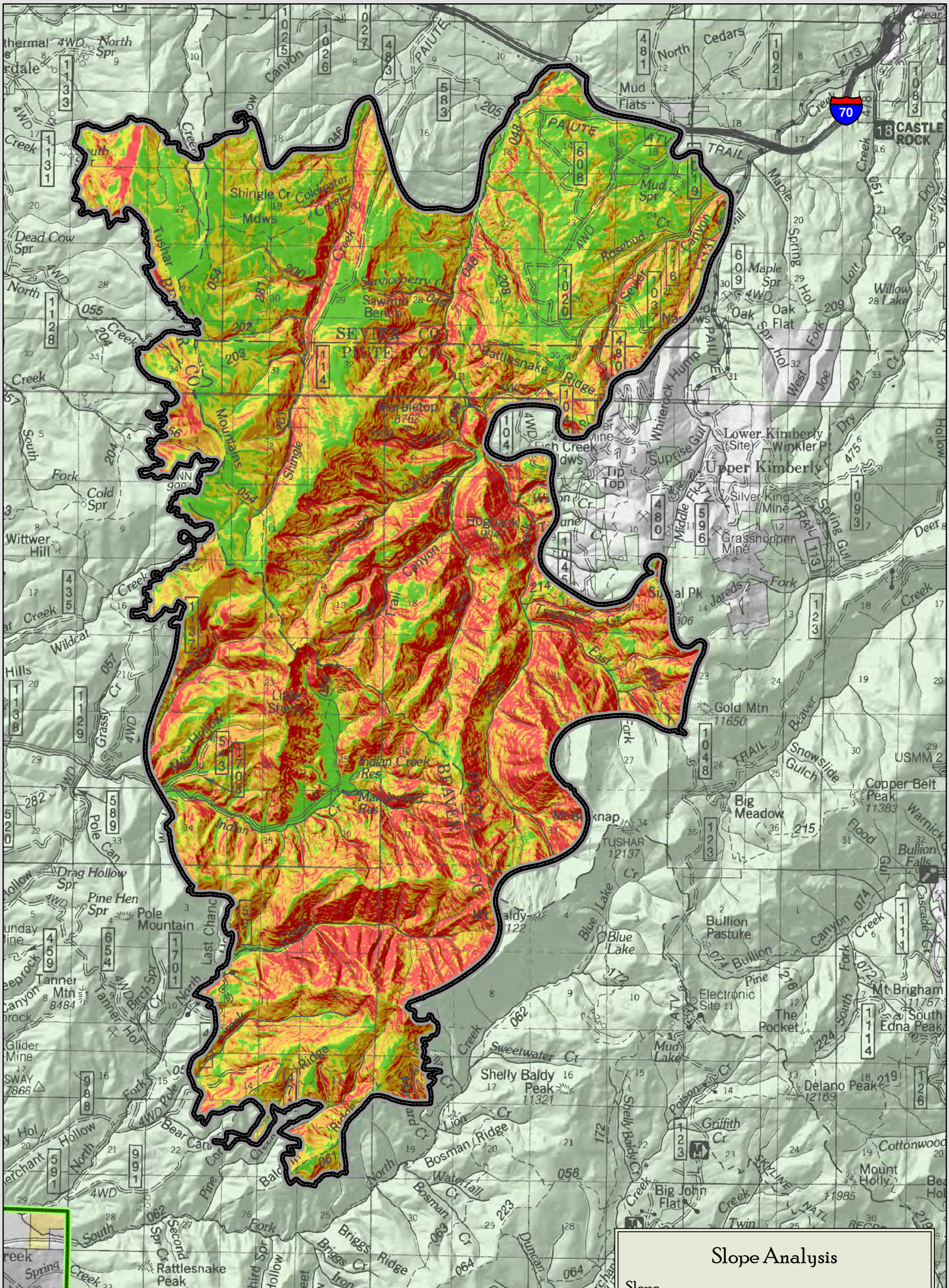


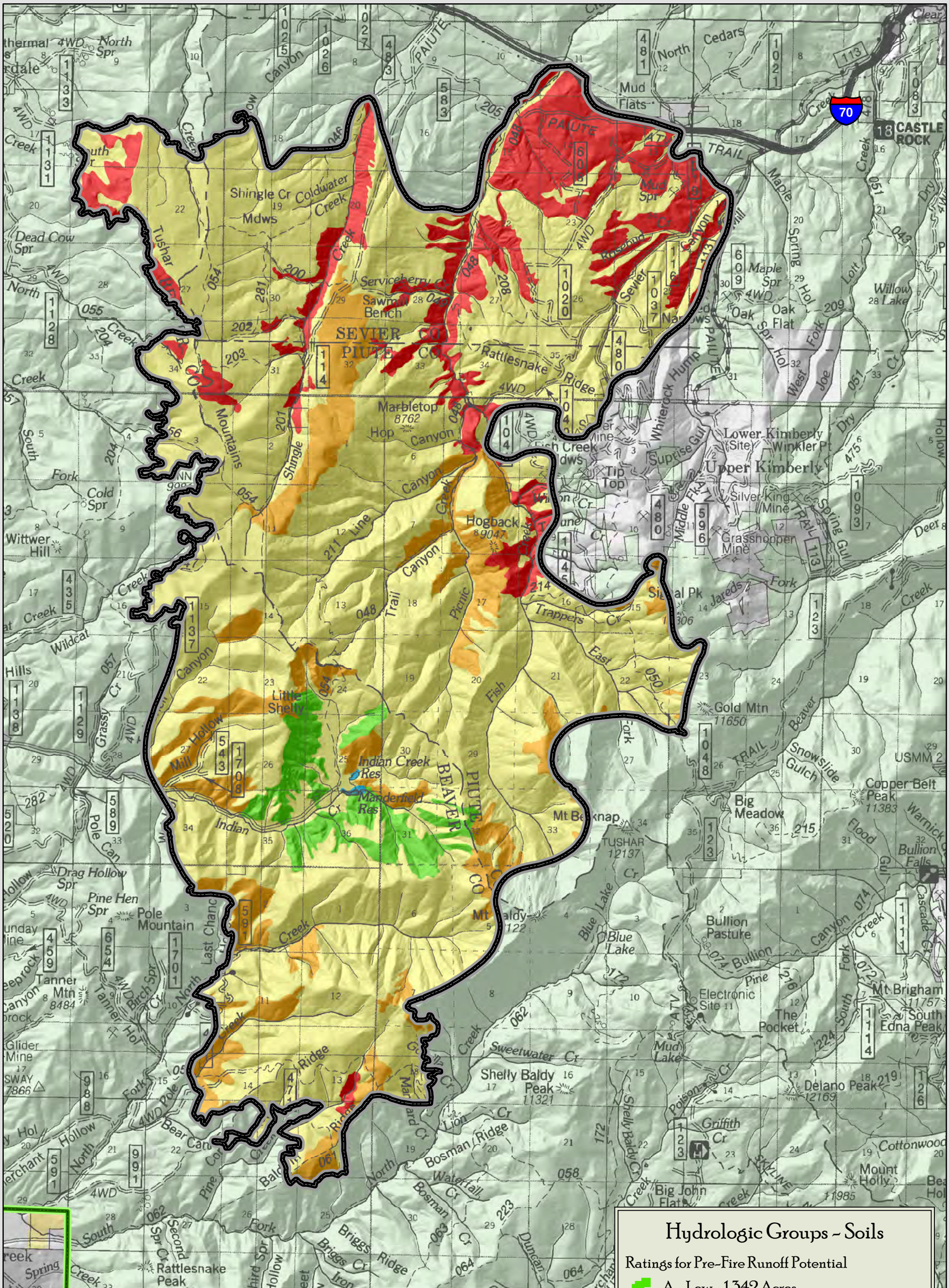
Twitchell Canyon Wildfire
Fishlake National Forest
Noxious Weed Monitoring
& Spot Treatment
Early Detection / Rapid Response

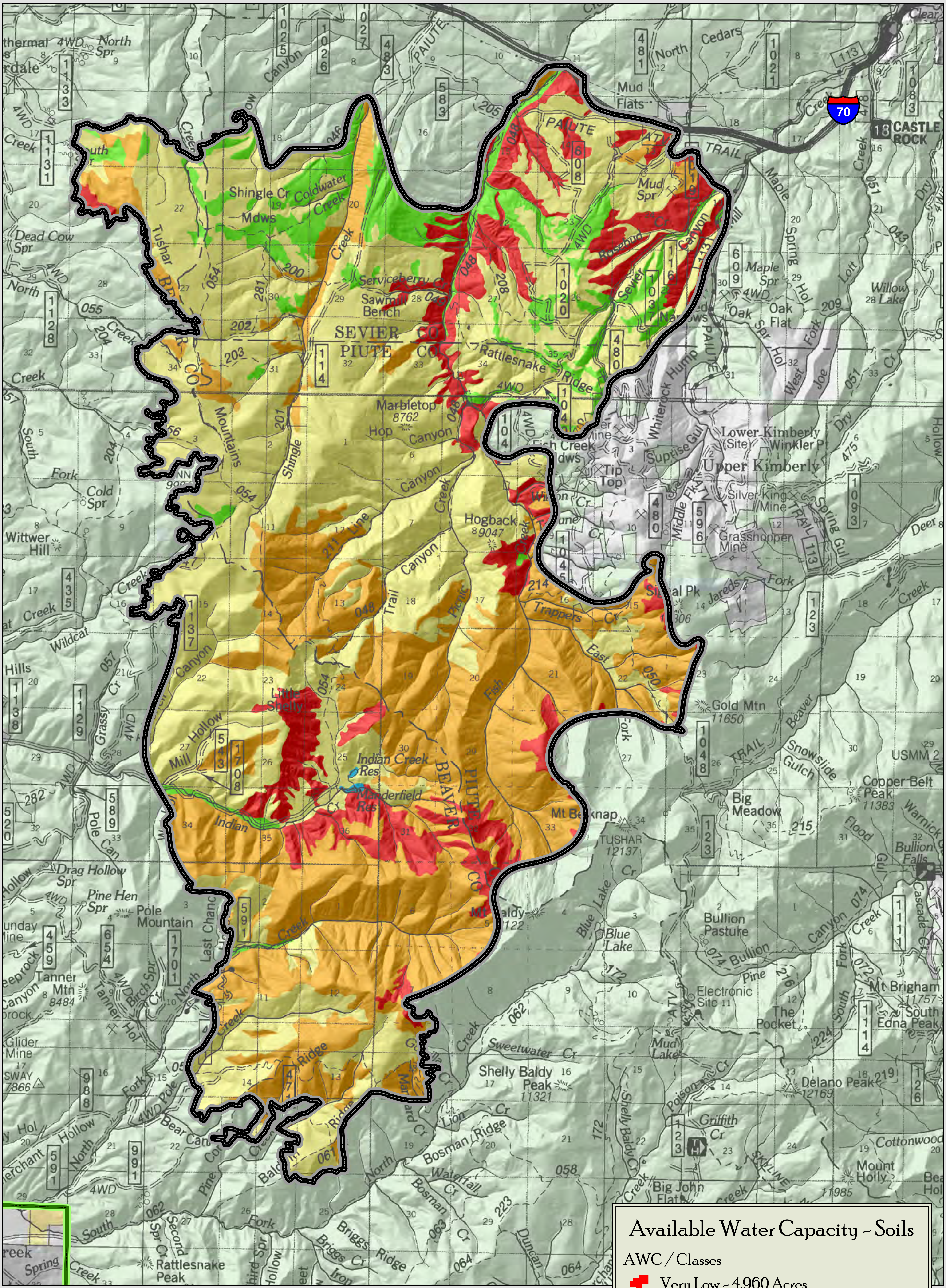

Twitchell Canyon Wildfire
Fishlake National Forest
Existing Noxious Weed Locations
0 1 2 4 Miles
1:95,000 Scale
N
S
E
W
Existing Noxious Weed Locations
Existing Noxious Weed Locations
Black Henbane
Bull Thistle
Dalmatian Toadflax
Field Bindweed
Leafy Spurge
Musk Thistle
Scotch Thistle
Spotted Knapweed
Whitetop
Yellow Toadflax
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary


Twitchell Canyon Wildfire
Fishlake National Forest
Bonneville Cutthroat Trout
0 1 2 4 Miles
1:105,000 Scale
N
W
E
S
Bonneville Cutthroat Trout
Bonneville Cutthroat Trout ~ Potential Restoration
Bonneville Cutthroat Trout ~ Previously Restored
Bonneville Cutthroat Trout ~ Remnant Population
Bonneville Cutthroat Trout ~ Restoration Approved and Initiated
Non-Native Trout
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary


Twitchell Canyon Wildfire
Fishlake National Forest
Previous Fire Disturbances
0 1 2 4 Miles
1:75,000 Scale
N
W
E
S
Previous Fire Disturbances
Fire Disturbances
Prescribed Fire
Unwanted Wildfires
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary
SEVIER CO
PIUTE CO
BEAVER CO
CASTLE ROCK
Mud Flats
Cedars
Mud Spr
Shingle Cr
Coldwater Creek
Mdws
Dead Cow Spr
Tushar Mountains
Serviceberry Cr
Sawmill Bench
Rattlesnake Ridge
Marbletop 8762
Hop Canyon
Hogback 9047
Lower Kimberly (Site)
Winkler Pt
Upper Kimberly
Silver King Mine
Grasshopper Mine
Tip Top
Whiterock Hump
Maple Spr
Oak Flat
Willow Lake
Wittwer Hill
Wildcat Hills
Little Shelly
Indian Creek Res
Marderfield Res
Gold Mtn 11650
Snowslide Gulch
Copper Belt Peak 11383
Big Meadow
Mt Belknap
TUSHAR 12137
Bullion Falls
Drag Hollow Spr
Pine Hen Spr
Pole Mountain
Mt Baldy 11122
Blue Lake
Bullion Pasture
Tanner Mtn 8484
Electronic Site
The Pocket
Mt Brigham 11757
South Edna Peak
Sweetwater Cr
Shelly Baldy Peak 11321
Mud Lake
Delano Peak 12169
Griffith Cr
Bosman Ridge
Waterfall
Big John Flat
Mount Holly 11985
Twin Lakes
ELK MEADOWS
Lake Pk 11310
Rattlesnake Peak
70
113


Twitchell Canyon Wildfire
Fishlake National Forest
Slope Analysis
0
1
2
4 Miles
1:75,000 Scale
N
W
E
S
Slope Analysis
Slope
< 25% ~ 9,277 Acres
25% ~ 40% ~ 10,407 Acres
40% ~ 60% ~ 15,082 Acres
> 60% ~ 10,108 Acres
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary


Twitchell Canyon Wildfire
Fishlake National Forest
Hydrologic Groups
0 1 2 4 Miles
1:75,000 Scale
N
W
E
S
Hydrologic Groups ~ Soils
Ratings for Pre-Fire Runoff Potential
A ~ Low ~ 1,342 Acres
B ~ Moderately Low ~ 33,243 Acres
C ~ Moderately High ~ 4,964 Acres
D ~ High ~ 5,301 Acres
Water ~ 24 Acres
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary



Twitchell Canyon Wildfire
Fishlake National Forest
Available Water Capacity

0 1 2 4 Miles

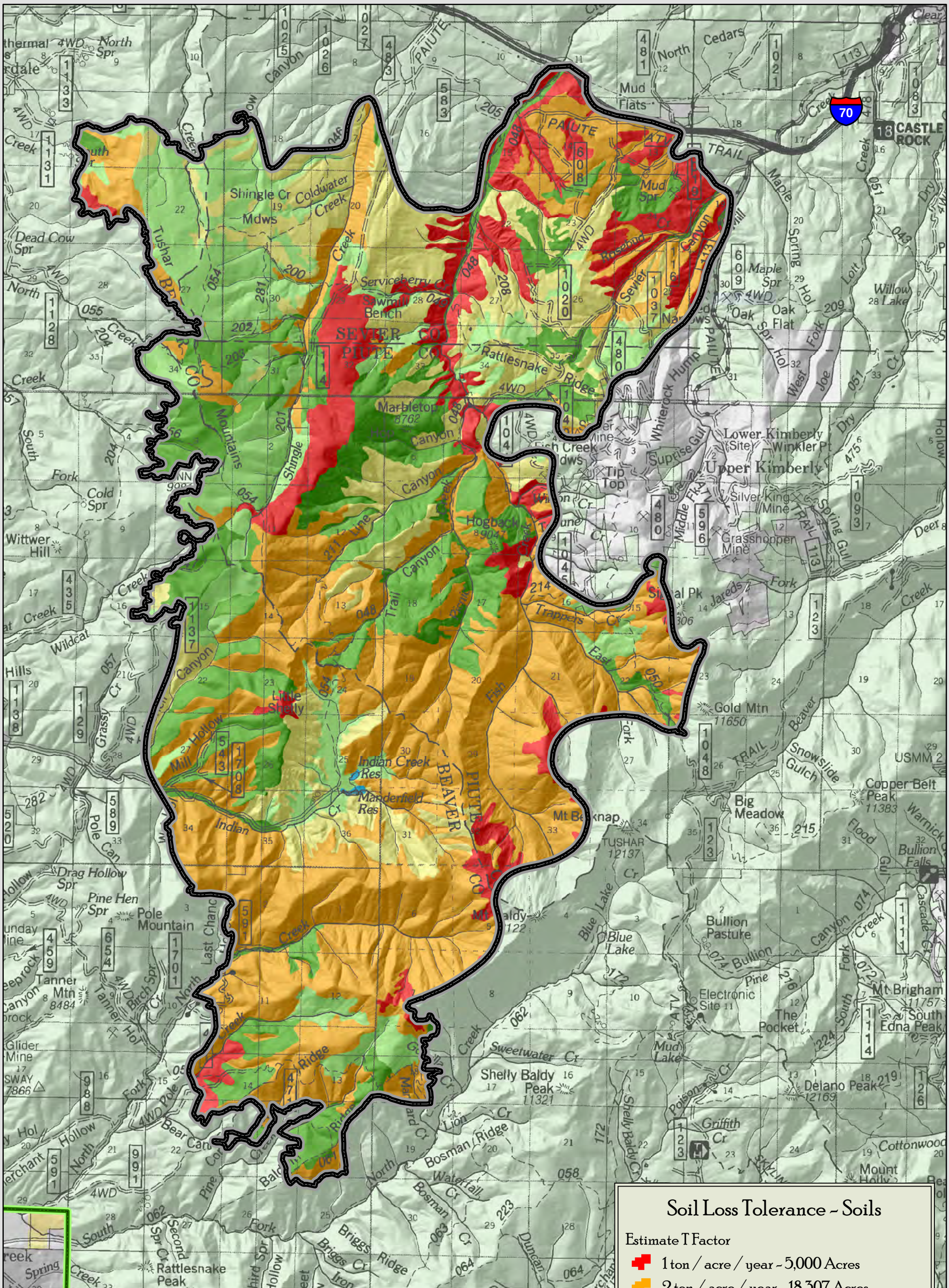
1:75,000 Scale

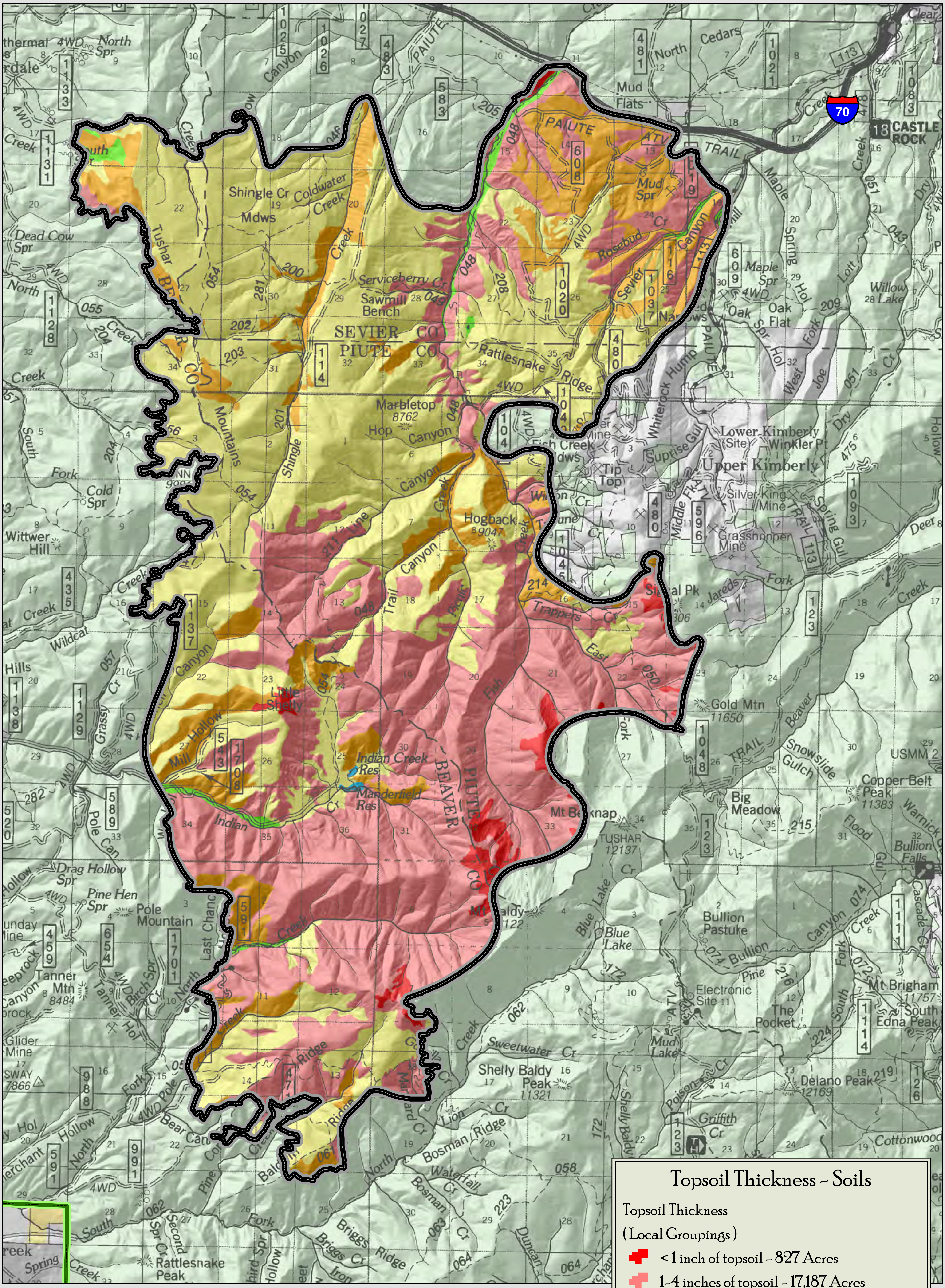
N S E W

Available Water Capacity - Soils

AWC / Classes

- Very Low - 4,960 Acres
- Low - 14,514 Acres
- Moderate - 22,233 Acres
- High - 3,143 Acres
- Water - 24 Acres
- Twitchell Canyon Wildfire - 44,874 Acres
- Forest Boundary

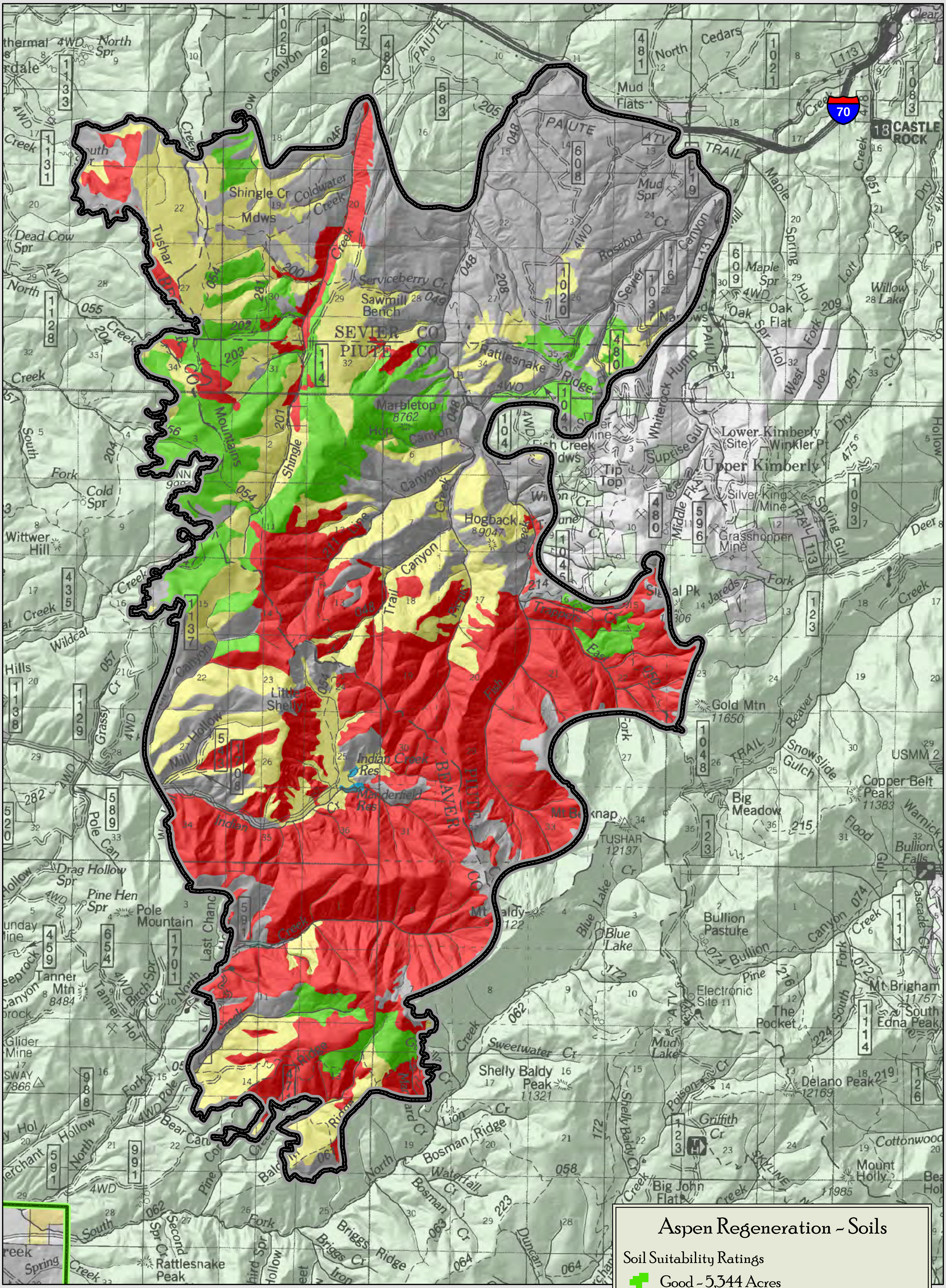

Twitchell Canyon Wildfire
Fishlake National Forest
Soil Loss Tolerance
0 1 2 4 Miles
1:75,000 Scale
N
W
E
S
Soil Loss Tolerance ~ Soils
Estimate T Factor
1 ton / acre / year ~ 5,000 Acres
2 ton / acre / year ~ 18,307 Acres
3 ton / acre / year ~ 7,013 Acres
4 ton / acre / year ~ 6,626 Acres
5 ton / acre / year ~ 7,904 Acres
Water ~ 24 Acres
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary
70
CASTLE ROCK
Mud Flats
North Cedars
Shingle Cr
Coldwater Creek
Mdws
Serviceberry Cr
Sawmill Bench
SEVIER CO
PIUTE CO
Rattlesnake Ridge
Marbletop
Hogback
Upper Kimberly
Lower Kimberly
Grasshopper Mine
Silver King Mine
Gold Mtn
Little Shelly
Indian Creek Res
Manderfield Res
Big Meadow
Copper Belt Peak
Bullion Pasture
Blue Lake
Electronic Site
The Pocket
Mt Brigham
South Edna Peak
Delano Peak
Shelly Baldy Peak
Sweetwater Cr
Mud Lake
Griffith Cr
Cottonwood
Mount Holly
Rattlesnake Peak
Pole Mountain
Tanner Mtn
Drag Hollow Spr
Pine Hen Spr
Wittwer Hill
Dead Cow Spr
Cold Spr
Wildcat Hills
Grassy Cr
Tushar Mtn
Bullion Falls
Willow Lake
Oak Flat
Maple Spr
Mud Spr
Trappers Cr
Bosman Ridge
Waterfall Cr
Briggs Ridge
Pole Canyon
Bear Canyon
Glider Mine
Sway 7866
Tushar 12137
Gold Mtn 11650
Copper Belt Peak 11383
Shelly Baldy Peak 11321
Delano Peak 12169
Mt Brigham 11757
South Edna Peak
Marbletop 8762
Hogback 8904
Tanner Mtn 8484



Twitchell Canyon Wildfire
Fishlake National Forest
Topsoil Thickness

0 1 2 4 Miles

1:75,000 Scale



Twitchell Canyon Wildfire
Fishlake National Forest
Aspen Regeneration

0 1 2 4 Miles

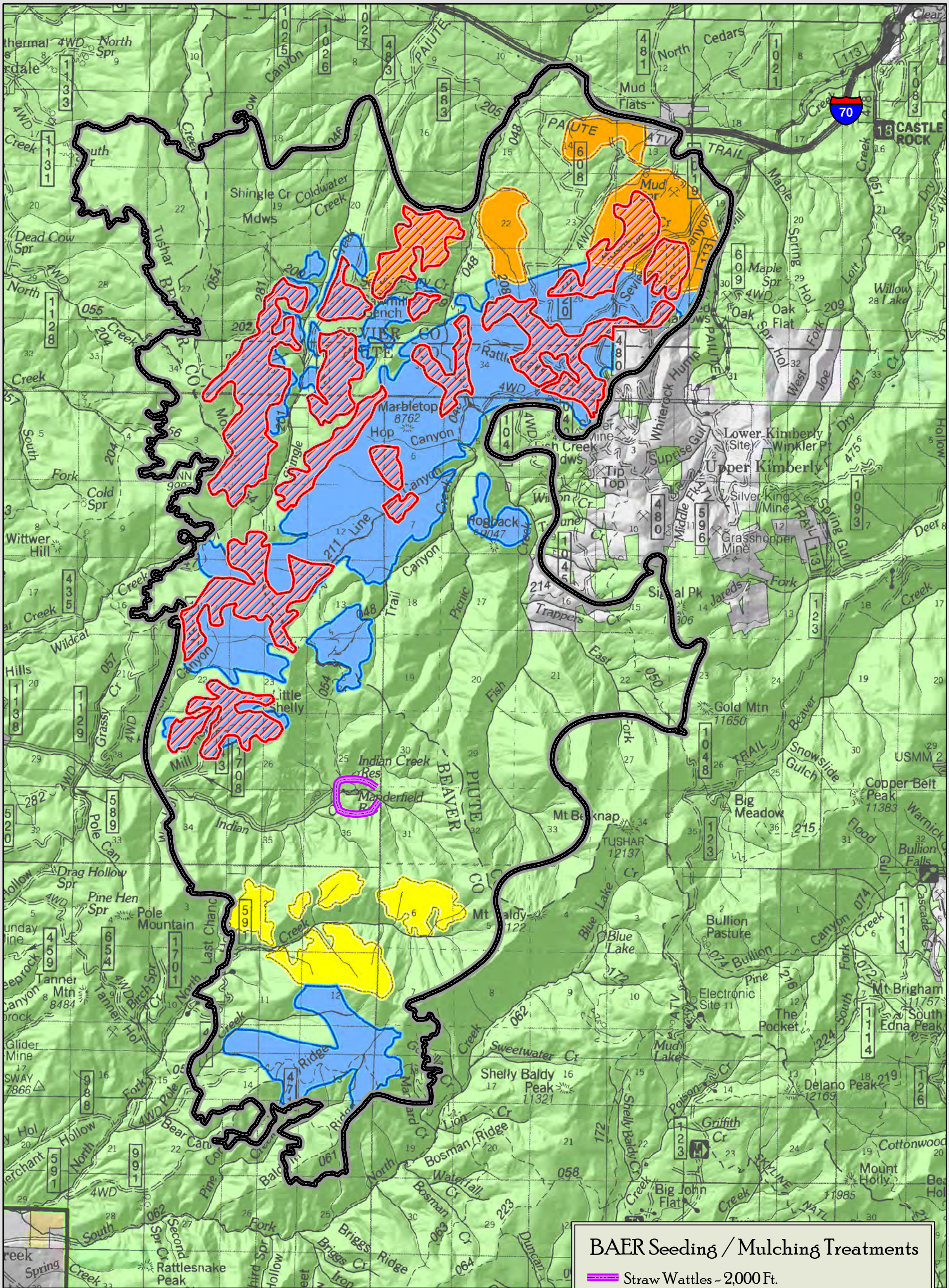
1:75,000 Scale

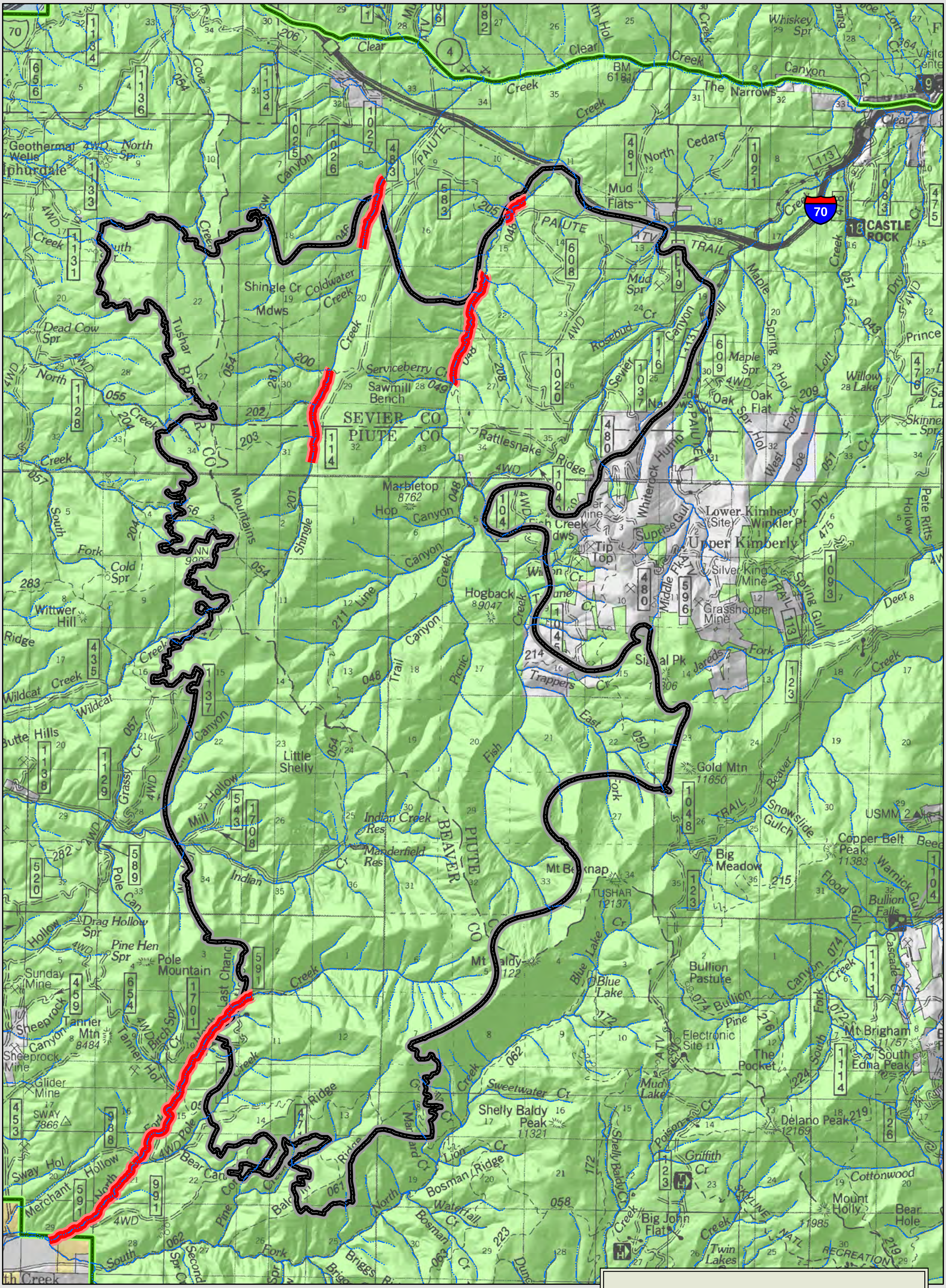
N W E S

Aspen Regeneration - Soils

Soil Suitability Ratings

- Good - 5,344 Acres
- Fair - 9,208 Acres
- Poor - 15,560 Acres
- Unsuited - 14,738 Acres
- Water - 24 Acres
- Twitchell Canyon Wildfire - 44,874 Acres
- Forest Boundary


Twitchell Canyon Wildfire
Fishlake National Forest
BAER Seeding / Mulching Treatments
Alternative 1
0 1 2 4 Miles
1:75,000 Scale
N
S
E
W
BAER Seeding / Mulching Treatments
Straw Wattles ~ 2,000 Ft.
Aerial Mulching ~ 5,085 Acres
14 ~ 22 Inch Precip Aerial Seeding ~ 2,283 Acres
22+ Inch Precip Aerial Seeding ~ 11,282 Acres
Triticale Seeding ~ 1,234 Acres
Twitchell Canyon Wildfire ~ 44,874 Acres
Forest Boundary



Twitchell Canyon Wildfire
Fishlake National Forest
Grade stabilizer Treatments

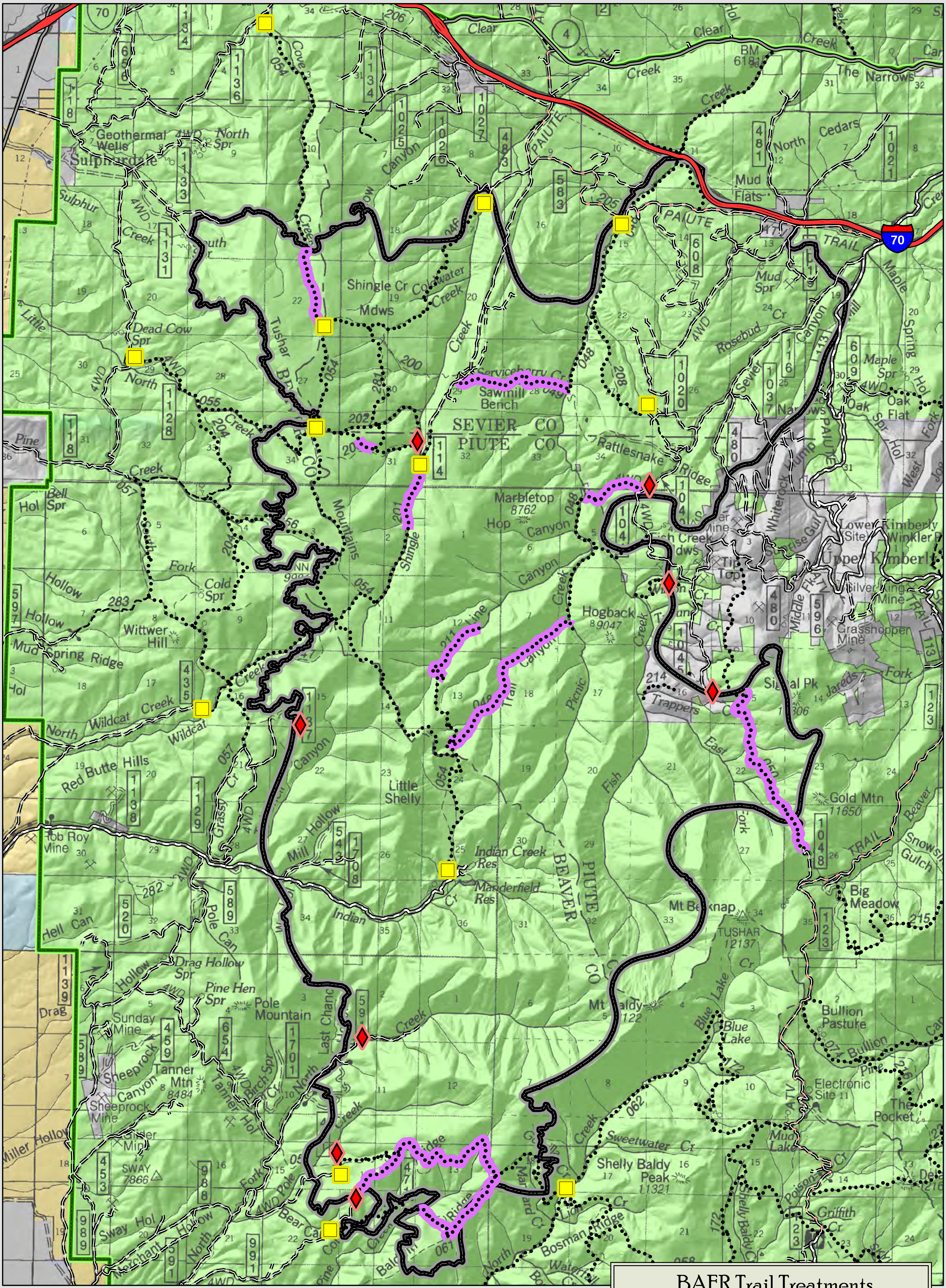
0 1 2 4 Miles

1:80,000 Scale

N S E W

Grade Stabilizer Treatments

- Treatment Areas
- Streams
- Twitchell Canyon Wildfire - 44,874 Acres
- Forest Boundary



Twitchell Canyon Wildfire
Fishlake National Forest
BAER Trail Treatments

0 1 2 4 Miles

1:75,000 Scale

N E S W

BAER Trail Treatments

- Safety Signs ~ 13
- Trail Head Barrier ~ 8
- Trail Stabilization ~ 16.4 Miles
- Twitchell Canyon Wildfire ~ 44,874 Acres
- Forest Boundary