

National Park Service
U.S. Department of the Interior

ZION NATIONAL PARK
UTAH



July 2006

KOLOB FIRE BURNED AREA REHABILITATION PLAN



BURNED AREA REHABILITATION PLAN REVIEW AND APPROVAL

I. Project Leader approval that the Burned Area Rehabilitation Plan meets approved land management plan management objectives.

Project Leader, IMR BAER Team Leader

Date

II. Superintendent concurrence that the Burned Area Rehabilitation Plan meets approved land management plan management objectives.

Superintendent, Zion National Park

Date

III. Regional Fire Management Coordinator concurrence that the plan fits the technical definition for use of Rehabilitation funding.

Regional Fire Management Coordinator, Intermountain Region

Date

IV. Rehabilitation Funding Approval (check one box below):

- ☐ Approved
- ☐ Approved with Revision (see attached)
- ☐ Disapproved

Regional Director, Intermountain Region

Date

V. Rehabilitation Funding Approval (check one box below):

- ☐ Approved
- ☐ Approved with Revision (see attached)
- ☐ Disapproved

National Office

Date

KOLOB FIRE
EMERGENCY STABILIZATION
&
BURNED AREA REHABILITATION PLAN

UNIT: Zion National Park

LOCATION: Springdale, Washington County, Utah

DATE: 19 July 2006

PREPARED BY: Intermountain Region BAER Team

Submitted By: _____ Date: _____
Burned Area Rehabilitation Team Leader

EXECUTIVE SUMMARY

Introduction

This Burned Area Rehabilitation Plan has been prepared in accordance with Department of the Interior and National Park Service policy. This plan provides rehabilitation recommendations for all lands burned within the Kolob Fire perimeter and downstream impact areas including: public lands administered by the Bureau of Land Management and other jurisdictions if necessary. The primary objectives of the Kolob Fire Burned Area Rehabilitation Plan are:

- § To repair or improve lands unlikely to recover naturally from severe wildland fire damage by emulating historic or pre-fire ecosystem structure, function, diversity, and dynamics according to approved land management plans.
- § Restore or establish healthy, stable ecosystems, even if these ecosystems cannot fully emulate historic or pre-fire conditions as specified in approved land management plans.
- § Repair or replace fire damaged minor operating facilities (e.g., campgrounds, interpretive signs and exhibits, shade shelters, fences, wildlife guzzlers, etc.)

This plan addresses rehabilitation treatments. The burned area response team conducted an analysis of fire damages throughout lands impacted and potentially impacted by the fire. The watershed assessment group assessed the overall watershed changes caused by the fire and developed a soil burn severity map, a watershed response map and an erosion potential map. Resource Advisors assigned to the fire and Kolob BAER team archeologists conducted a cultural resource damage assessment from both suppression activities and fire effects. The vegetation specialist assessed fire damage to vegetative resources and identified values at risk associated with vegetation loss. The GIS specialists gathered the data layers necessary for the plan, coordinated GPS activities, processed satellite imagery and GPS data and made maps for the final plan. The Zion NP Resource Advisors assigned to the fire inventoried fire damaged fences and the Cultural resource specialist developed specifications for fence repair and replacement.

Individual resource Burned Area Assessment Reports produced by these specialists are in Appendix I. The individual rehabilitation treatments specifications including effectiveness monitoring identified in the assessments can be found in Part F. A summary of the costs by jurisdictions is in Part E. Appendix II contains the National Environmental Policy Act (NEPA) compliance documentation summary. Appendix III contains the Burned Area Rehabilitation Plan maps. Appendix IV contains photo documentation. Appendix V contains supporting documentation.

Fire Background

The Kolob Incident started on Saturday evening June 24, 2006 and burned lands on the Bureau of Land Management (BLM), St George Field Office, Zion National Park, state and private unincorporated lands protected by the Utah Division of Forestry, Fire and State Lands in Washington County, Utah. These lands occur in the North Creek watershed of the Virgin River. A Great Basin Type 2 Incident Management Team (IMT) under the command of Jerry Brunner, was delegated authority to manage the Complex starting on June 26, 2006 at 0600 hours. The Kolob fire is approximately 5 miles Northeast of Hurricane, Utah, in Washington County. The fire's center was in the Crater Hill/Cougar Mountain area with an elevation range between 3600 to 6900 feet. Fuel types consisted of juniper, Manzanita, sage and grass. During the first two days of the initial start, rapid rates of spread in heavier fuel loading areas occurred. In addition, fire burned actively during the first two nights. The fire started off the Kolob Terrace (KT) road near the Grapevine trailhead in ZION NP, initially burning to the west and east into the interior of ZION National Park, making a major run to the south on the evening of the 26th driven by north to northwest winds. At the Initial Agency Briefing at 1800 hours, June 26, the Kolob fire was sized at 10,000 acres, however, by the end of the day, it had grown to over 14,000 acres and by June 30th the fire was mapped at 17,632 acres.

Fire Damages and Threats to Human Safety and Natural and Cultural Resources and Proposed Treatments

Because Minimal Impact Suppression Tactics (MIST) were employed in suppressing the fire there was minimal resource damage within the park and the damage that did occur was rehabilitated by the Incident Management Team. Several structures were destroyed but where on private property outside the park. Infrastructure wise, one power transmission pole was damaged by the fire and will be replaced by Utah Power and Light. Four miles of the west boundary fence was damaged and will require replacement of barbed wire and post on the south end and the barbed wire will need to be reattached to post on the north end. Many of the boundary signs within the burn perimeter were destroyed; however the park is assuming responsibility for their replacement. All of the known eligible or potentially eligible cultural sites were assessed and four were found to be at risk to immediate post-fire erosion and selected for emergency stabilization. There was no wildlife assessment written for the plan because earlier on in the planning process it was determined that one would not be necessary because fire impacts to Threatened and Endangered Species were minimal and the park did not have a wildlife biologist on staff to assist in drafting one. However consultation with the Fish and Wildlife Service was initiated. As planning progressed it came to light that the park is designated as Mexican Spotted Owl (MSO) habitat and a portion of the fire did burn into the half mile buffer established around MSO primary activity centers (PAC).

In addition there is a fish species of concern currently being managed under a conservation agreement that occurs in the North Creek watershed but do not occur within the park within the park because of stream channel impediments. These fish are being managed by the Utah Division of Wildlife Resources (UDWR) who will take appropriate management action to protect the population. The watershed assessment has been forwarded to Dave Sharrow, Zion National Park hydrologist who has been consulting with UDWR.

While a significant amount of the burned area already has high watershed response and erosion potential, the fire did increase watershed response and erosion potential over a broad portion of the remaining area.

Values at risk within the watershed were identified on private property beyond the park boundary. However, because of the large area burned by the within the watershed there were no measures that could effectively reduce runoff and stabilizing the slopes so none are recommended. The watershed assessment has been forward to the Natural Resources Conservation Service (see Soils and Watersheds Assessment consultation) who manages emergency watershed protection involving private property.

The fire has type converted most if not all of the pinyon-juniper woodland within the burn perimeter, which is 75% of 10,000 acres that burned within the park. The stand replacing fire has opened up the landscape to becoming cheatgrass dominated which in turn will dramatically shorten the fire return interval (240 acres within the fire burned in 2005) and facilitate the expansion of cheatgrass further into the park. Because of this threat this plan is proposing aggressive measures to protect existing plant communities and restore native vegetation within the burned area. These measures include aerial application of herbicide over much of the fire and seeding local (non-park) seed and one none-source species in a limited portion of the fire, which the mitigation is outlined in the vegetation assessment. Seeding over a larger portion of the fire will involve strategies of herbicide use and a non-native seeding to manage cheatgrass in the short-term (1 to 3 years) until enough Park source native seed is available for reseeding in areas deemed necessary.

This strategy and the rationale are discussed in depth in the vegetation assessment.

Zion National Park Management Requirements

Two significant factors that could affect Burned Area Rehabilitation in the burned area is the Critical Habitat designation for Mexican Spotted Owl and Proposed Wilderness. However the Zion National Park General Management Plan (2001), Fire Management Plan (2004) and the Fish and Wildlife Service's Biological Opinion on the Fire Management Plan support the actions being proposed in this Plan. A Minimum Requirement Analysis will be conducted to determine the appropriateness of the proposed management actions identified in this plan prior to implementation within the Proposed Wilderness.

This plan was developed under the direction of the following management plans and environmental compliance documents:

As stated in the General Management Plan (2001)

Natural Resources

Page 9:

Park staff will apply ecological principles to ensure that natural resources are maintained and not impaired. They will manage fire to maintain and/or restore ecosystem integrity and use integrated pest management procedures when necessary to control nonnative organisms or other pests. Habitats for threatened and endangered species will also be conserved and restored.

Park managers will restore disturbed lands as much as possible and determine on a site-by site basis whether passive or active restoration was necessary. Park staff will carry out active restoration of previously or newly disturbed areas using native genetic materials to regain maximum habitat value. Should facilities be removed, the disturbed lands will be rehabilitated to restore natural topography and soils, and revegetate the areas with native species. Under some circumstances, primarily in frontcountry developed areas, it may be appropriate and within policy to use nonnative plants in restoration efforts. Additionally, certain exotic plant species may be used to control other, more noxious and invasive exotic plant species. These practices are intended for short-term use only, to achieve a long-term overall goal of native plant community integrity.

Cultural Resources

Page 13

- Zion's cultural resources are protected and the integrity of the park's cultural resources is preserved unimpaired. Park visitors and employees recognize and understand the value of the park's cultural resources. Zion is recognized and valued as an example of resource stewardship, conservation, education, and public use.

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- Ensure that archeological monitors are present during all construction activities that may impact subsurface cultural deposits
- Add signs and physical barriers to protect sites listed on the national register (or are eligible for listing) from visitor related impacts.

Mission goals of Zion as stated in the Fire Management Plan (June 2005) are to:

Provide park visitors educational and recreational opportunities that foster an appreciation of Zion and its resources.

Ensure that visitor impacts do not impair resources.

- Maintain the resource, including plant and animal communities, at healthy and viable levels consistent with natural processes.
- Manage cultural and physical resources to ensure long-term integrity.
- Ensure that the built environment provides for safe visitor and staff uses in a sustainable and cost-effective manner.

- Ensure that the organization is responsive to employee needs, recognizing the contribution of each individual.
- Foster mutually supportive partnerships with private organizations and individuals to achieve visitor use and resource protection goals.

Biological Opinion on Zion National Park's Fire Management Plan (page 36)

2. To implement Reasonable and Prudent Measure Number 2, Zion National Park shall fully implement the following measures to minimize harm to the Mexican spotted owl, California Condor, desert tortoise, or Shiwits milkvetch through destruction of their habitats, without placing firefighter personnel at risk:
 - b. Rehabilitation of the burned areas shall be ensured, including seeding and planting of native perennial species if necessary. Revegetation will attempt to reconstruct the natural spacing, abundance, and diversity of native plant species.
 - c. Recovery of vegetation shall be monitored, including establishment and monitoring of paired plots, inside and outside of the burned area unless Zion National Park and the Service concur that monitoring is not required.
 - d. The Fire Management Plan should specifically recognize the primary constituent elements necessary for functional Mexican spotted owl critical habitat to ensure consistent application of measures to maintain these features in all fire management planning and implementation activities

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PART A - FIRE LOCATION AND BACKGROUND INFORMATION

Fire Name	KOLOB
Fire Number	UT-ZIP-0026
Agency Unit	ZION Nat'l Park
Region	Intermountain
State	UT
County(s)	Washington
Ignition Date/Cause	Human/24 June 2006
Zone	Eastern Great Basin
Date Fully Contained	30 June 2006
Jurisdiction	-Acres-
Bureau of Land Management	4,121
National Park Service	10,516
Private	2,731
State of Utah	254
Total Acres	17,632
Date Contained	30 June 2006

PART B - NATURE OF PLAN

Type of Action (check one box below)

X	Initial Submission
	Amendment to the Initial Submission

PART C - REHABILITATION ASSESSMENT

Rehabilitation Objectives

- \$ Locate and stabilize severely burned slopes which pose a direct threat to human life, property or critically important cultural and/or natural resources.
- \$ Replace the existing boundary fence to prevent trespass grazing and vehicle access..
- \$ Prevent the establishment of cheatgrass on a broad scale within the boundary of the fire.
- \$ Prevent more frequent fires within the boundary of the park.
- \$ Prevent further type conversions by more frequent fire disturbance outside the range of natural variability.
- \$ Facilitate the recovery of native vegetation by reducing cheatgrass competition.
- \$ Reestablish native species using seed originating from the park in areas that are at high risk of becoming cheatgrass dominated due to the absence of a resilient understory.
- \$ As practical and necessary, restore natural conditions to areas disturbed by fire suppression actions.
- \$ Monitor sensitive plants species populations and prevent the establishment of exotics within those populations as a result of the fire.
- \$ Monitor treatment effectiveness.

PART D - TEAM ORGANIZATION, MEMBERS, AND RESOURCE ADVISORS

I. Burned Area Emergency Response Team Members: *(List of technical specialists used to develop the plan)*

Position	Team Member (Agency)
Team Leader	Richard Gatewood (NPS)
NEPA Compliance & Planning	Kezia Nielson (NPS)
Hydrologist	Michael Parenti (M. Parenti & Associates)
Soil Scientist	Susanne Loadholt (URS Corporation)
Cultural Resources/Archeologist	Dan Hall (BIA), Juanita Bonnifield (NPS)
Vegetation Specialist	Kara Paintner (NPS)
GIS Specialist	D.W. Ivans (NPS)

III. Resource Advisors: (Note: Resource Advisors are individuals who assisted the burned area emergency response team with the preparation of the plan. See Part H for a full list of agencies and individuals who were consulted or otherwise contributed to the development of the plan.

Name	Affiliation
Jeff Ballard	Zion NP, Roads and Trails Foreman
Allen Bruner	Zion NP, Wildlife Biological Technician
Cheryl Decker	Zion NP, Vegetation Management Specialist
Michelle Dela Cruz	Zion NP, Lead Biological Technician
Kelly Fuhrmann	Zion NP, Fire Ecologist
Thomas Fuller	Zion NP, Kolob Fire Resource Advisor
Brent Hentzler	Zion NP, Wildlife Biological Technician
Sarah Horton	Zion NP, Cultural Resource Specialist
Ray O'Niel	Zion NP, Plateau District Ranger
Jan Passek	Zion NP, Fire Management Officer
Jeremy Priby	Zion NP, Kolob Fire Resource Advisor
Elena Robisch	Zion NP, GIS Specialist
Dave Sharrow	Zion NP, Hydrologist
David Thoma	Colorado Plateau I&M, Hydrologist
Cynthia Wanshura	Zion NP, GIS Technician

PART E - SUMMARY OF ACTIVITIES AND COSTS

The summary of activities and cost table below identifies rehabilitation costs charged or proposed for funding from subactivity 9262 funding sources.

REHABILITATION ACTIVITIES COST SUMMARY TABLE - KOLOB Fire

Spec #	Title	Unit	Unit Cost	# of Units	Work Agent	Cost
C-1	Hydromulch Cultural sites	acres	\$3168	18	C FA	\$52,970
I-1	Boundary Fence Replacement	miles	\$3995	4	C FA	\$15,997
O-1	Implementation Leader	ea	\$29,480			29,480
V-1	Aerial Herbicide – Kolob Fire	Ac	\$46	8353	FA	\$380,969
V-2	NEPA Compliance	ea	\$13,181-	---	FA	\$13,181
V-3	Seed Increase	---	\$268,000	----	----	\$268,000
V-4	Aerial seeding – KT Road (Natives)	acres	\$207	481	C FA	\$99,612
V-5	Crater Hill Revegetation	acres	\$124	633	C FA	\$76,043
V-6	Exotic plant monitoring and control	acres	\$274	30	FA	\$8203
V-7	Sensitive plant and spot treatment monitoring	acres	\$243	6	FA	\$1457
V-8	Treatment Effectiveness Monitoring	acres	—	—	CA	\$340,697
TOTAL COST						\$1,286,609
Work Agent: CA=Coop Agreement, FA=Force Account, G=Grantee, P=Permitee, SC=Service Contract, TSP=Timber Sales Purchaser, V=Volunteer						

PART F –INDIVIDUAL SPECIFICATIONS

C-1: AERIAL HYDROMULCHING

TREATMENT/ACTIVITY NAME	AERIAL HYDROMULCHING	PART E SPECIFICATION #	C-1
NFPORS TREATMENT CATEGORY*	HERITAGE RESOURCES	FISCAL YEAR(S) (list each year):	2006
NFPORS TREATMENT TYPE *	SITE STABILIZATION	WUI? Y / N	N
IMPACTED COMMUNITIES AT RISK	NONE	IMPACTED T&E SPECIES	NONE

* See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

WORK TO BE DONE (describe or attach exact specifications of work to be done):

Number and Describe Each Task: I. General Description: Hydromulch is applied where the pre-burn ground cover was consumed by the fire and the expected overland runoff would threaten values at risk. First year effectiveness includes stabilizing ashes onsite, preventing loss of topsoil, improving infiltration rate and replacing organic litter consumed by the fire. Each mulching area is designated on a map and in an electronic file (Arcview GIS shapefile). Mulching is implemented only on those slopes that are designated by cultural resources and Zion National Park staff. II. Location (Suitable) Sites: Sites 42WS2621, 42WS2622, 42WS2629, and 42WS2631 totaling approximately eighteen (18) acres. III. Design/Construction Specifications: This treatment will be accomplished by one aerial application of hydromulch by fixed wing or rotor aircraft. The application will be conducted by OAS-carded fixed wing or rotor aircraft, under the terms of an "end service contract". The Contractor must be licensed and bonded, and the performance bond shall not be less than 20% of the contract price. The contractor is responsible for materials necessary to complete the project. 1. Site Selection: Suitable sites are designated on the treatment map and in the field by either cultural resources or operations staff. This shall be accomplished by re-mapping site boundaries and updating site records to reflect post-fire enlargement of site boundaries and assemblages as observed during BAER team reconnaissance survey. Park archeologist will serve as COTR to manage hydromulching contract. 2. Hydromulching is to be completed before the storms that will produce soil erosion and overland flow to provide effective groundcover. The first storms after the fire generally wash ash from hillslopes and subsequent storms initiate surface erosion and overland flow. The wood and paper mulches in the hydromulch mixture will protect seed mixed into the mulch slurry from washing off slopes during rainfall, and provide a favorable environment for native and introduced seed germination by regulating soil temperature and holding moisture. 3. Hydromulch Mixture: The contractor will utilize a hydromulch mixture consisting of no less than 2000 gallons of water/acre, 500/lbs of mulch/per acre, 300 lbs of organic binder/acre, and 10 lbs of seed/acre. The mulch will be 60% paper (300 lbs/acre) and 40% wood (200 lbs/acre). The organic binder will be LACCOSSET RE-VEG. Seed will not be added to the hydromulch unless specified and approved by Zion National Park resource management staff. 4. Application of Hydromulch Mixture: Hydromulch will be applied by either fixed wing or rotary wing aircraft. Rotary wing aircraft is the preferred application aircraft. Rotary wing aircraft application will be a Type 1 helitanker equipped with a tank capable of carrying up to one acre of hydromulch mixture. The helitanker will be equipped a manifold which includes an agitator to keep the hydromulch mixture in suspension during flight. The helitanker will be capable of controlling dispersion of the hydromulch mixture to achieve the desired application rate described above in Hydromulch Mixture. 5. Equipment and Transportation: Contractor is responsible for supplying all materials, supplies, equipment, personnel, loading and transportation. 6. Completion Date: Work must be completed by August 31, 2006. IV. Purpose of Treatment Specifications: The basic purpose of hydromulch is to replace only the natural ground cover density that was consumed by the fire, and in doing so protect sensitive National Register eligible cultural resources. Hydromulch can effectively control overland runoff due to bare soil. By controlling the overland runoff, the top soil is also protected. Hydromulch can also: 1) Break the impact of raindrops and prevent soil compaction; 2) Maintain a favorable moisture regime for sprouting seeds that are either stored in the soil; 3) Insulate the topsoil from solar isolation, and provide a more favorable temperature range for new plants; 5) Provide a growing medium for soil biological activity including soil flora, fauna, and fungal complex; and 6) Effectively control sediment loss from a burned area. By treating the source of floodwaters after a burn, the immediate downslope area can also be effectively protected. Rills and gullies that originate on extremely hot burns can migrate downslope from the place of origin and scour the slope for several hundred feet. Therefore mulching
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can protect much larger, downslope areas from the cumulative effect of hillslope runoff.

V. Treatment Effectiveness Monitoring:

Visually inspect effectiveness of treatments and repair as needed.

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
GS7-1 @ \$18.11/Hour X 80 Hours X 1 Fiscal Year	\$1449.
GS5-1 @ \$14.61/Hour X 80 Hours X 1 Fiscal Year	1169.
GS11-4 @ \$37.80/Hour X 8 Hours X 1 fiscal Year	302.
TOTAL PERSONNEL SERVICE COST	\$2920.
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	COST / ITEM
GSA leased vehicle @ .19/mile X 200 miles X 1 Fiscal Year	\$38.
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	COST / ITEM
Film and Development @ \$12. Each X 5 X 1 Fiscal Year	\$60.
TOTAL MATERIALS AND SUPPLY COST	\$60.
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	COST / ITEM
TOTAL TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	COST / ITEM
Contracted hydromulch mixture and aerial delivery of hydromulch mixture, supplies, equipment, personnel, loading and transportation @ \$3000/acre X 18 acres X 1 Fiscal Year	\$54,000.
TOTAL CONTRACT COST	\$54,000.

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE (M/D/YYYY)	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
FY2006	8/1/2006	8/31/2006	F, S	Acres		18	\$57018.
FY__							
FY__							
FY__							
TOTAL							\$57018.

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1.	Estimate obtained from 2-3 independent contractual sources.	C
2.	Documented cost figures from similar project work obtained from local agency sources.	EFC
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, E = Equipment M = Materials/Supplies, T = Travel, C = Contract, F = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

See watershed treatment Map and Soil and Watershed Assessment

TOTAL COST BY JURISDICTION

JURISDICTION	UNITS TREATED	COST
NPS	18	\$57018.
TOTAL COST		\$57018.

I-1: Boundary Fence Replacement

TREATMENT/ACTIVITY NAME	Boundary Fence Replacement	PART E SPECIFICATION #	I-1
NFPORS TREATMENT CATEGORY*	Facilities and Infrastructure	FISCAL YEAR(S) (list each year):	2006
NFPORS TREATMENT TYPE *	Fencing Replacement	WUI? Y / N	N
IMPACTED COMMUNITIES AT RISK	None	IMPACTED T&E SPECIES	None

* See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

WORK TO BE DONE (describe or attach exact specifications of work to be done):

Number and Describe Each Task: A. General Description: Replace barb wire boundary fence. The Kolob Fire incident resulted in approximately 4 miles of park boundary fenceline that sustained damage. This included 1175 burned posts, 54 damaged stays and 4 miles of damaged barbed wire. The task is to replace burned wooden posts with metal T-posts, the damaged stays, and wire. B. Location/(Suitable) Sites: Four fence segments beginning at the southeast corner of the fire, just north of the confluence of Coalpits Wash with the Virgin River and continuing north to include a discontinuous segment that ends at the Dalton Wash Route trailhead. Three fence posts along park boundary fence where the Kolob Terrace (KT) Road enters the park from the southwest. C. Design/Construction Specifications: 1. Roll up and remove all damaged wire. Remove hazard tree functioning as a post along segment north of KT Road. 2. Reconstruct fence with four-strand barbed wire, bottom wire smooth (for wildlife access). Design specifications will be to NPS standards 3. Monitor fence reconstruction where fenceline intersects significant cultural resources locations D. Purpose of Treatment Specifications: The purpose of the treatment is to exclude cattle from the park, thus removing the risk of damage they pose to Federally listed endangered species habitat, rare endemic plants, and to the safety of park visitors and their enjoyment of the Zion National Park experience. The secondary purpose will be to exclude ATVs or other unauthorized entry and/or use of the park. E. Treatment Effectiveness Monitoring Proposed: A Park Service COTR will perform an inspection to ensure that the fence is constructed to Zion National Park standards. Any deficiencies will be reported to the Contracting Officer (CO). The CO will enforce the terms of the contract to assure that the contractor shall correct any identified deficiencies.

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
GS7-1 Archeologist @ \$18.11/Hour X 8 Hours	\$145.
COTR @ \$31.40/Hour X 16 Hours	\$ 503.
TOTAL PERSONNEL SERVICE COST	\$ 648.
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	COST / ITEM
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	COST / ITEM
Barb Wire 2PT 80 Rod Clas @ \$55.46 X 65	\$3605.
Heavy Steel T-Post 6'6" #13 W/Clips @ \$3.97 X 500	\$1985.
36" Twisted wire stay bdl @ \$29.95 X 5	\$ 150.
Twisted Stays Bdl of 100 @ \$39.95 X 5	\$ 200.
Black Wire 100# Coil 12GA @ 92.00 X 1	\$ 92.
Staples Pol 50#Ctn 1 1/2X @ 38.57 X 2	\$ 78.
TOTAL MATERIALS AND SUPPLY COST	\$6110.
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	COST / ITEM
TOTAL TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	COST / ITEM
All contracted labor @ \$2500./Mile X 4 Miles	\$10000.
TOTAL CONTRACT COST	\$10000.

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE (M/D/YYYY)	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
FY2006	08/01/2006	08/31/2006	F, S	Miles	\$4190.	4	\$16758.
FY__							
FY__							
FY__							
TOTAL							\$16758.

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1.	Estimate obtained from 2-3 independent contractual sources.	C
2.	Documented cost figures from similar project work obtained from local agency sources.	C, 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, E = Equipment M = Materials/Supplies, T = Travel, C = Contract, F = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

Operations Assessment and Map Documentation in Emergency Stabilization Plan

TOTAL COST BY JURISDICTION

JURISDICTION	UNITS TREATED	COST
NPS – Zion National Park	4	\$16758.
	TOTAL COST	\$16758.

O-1: BAR Implementation Leader & Administrator

TREATMENT/ACTIVITY NAME	BAR Implementation Leader & Administrator	PART E SPECIFICATION #	O-1
NFPORS TREATMENT CATEGORY*	Implementation	FISCAL YEAR(S) (list each year):	2006
NFPORS TREATMENT TYPE *	Implementation	WUI? Y / N	N
IMPACTED COMMUNITIES AT RISK	None	IMPACTED T&E SPECIES	None

* See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

WORK TO BE DONE (describe or attach exact specifications of work to be done):

Number and Describe Each Task:

A. General Description: Leader and administrative support position for to continue coordination and oversight of the KOLOB Fire, B.A.R. Plan on the Zion National Park.

B. Location (suitable) Sites: Treatment areas are distributed throughout the burned area. Duty Station will be the local Headquarters for Zion National Park.

C. Design/Construction Specifications: The Project Implementation Leader is responsible for the oversight of the BAR., The Leader specifically will write Statement of Work for each contract or agreement, monitoring, and program review, proposed plan revisions and supplemental funding requests. They will also facilitate coordination between all the different specifications, contractors, park and regional staff.

D. Purpose of Treatment Specification: The purpose is to facilitate the early stages of the KOLOB Burn Area Rehabilitation, to include requisitioning, and contracting (keeps the train moving).

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
COTR GS9 @ \$2448per pay period x 10pp	\$24480.
TOTAL PERSONNEL SERVICE COST	\$24480.
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	COST / ITEM
1 GSA 4-wheel drive vehicle @ per month plus mileage, (GSA motor Pool)	\$3500
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	COST / ITEM
Laptop computer @\$1,500, office space and supplies provided by Zion fire office	\$1,500
TOTAL MATERIALS AND SUPPLY COST	\$1,500.
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	COST / ITEM
TOTAL TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	COST / ITEM
TOTAL CONTRACT COST	

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE (M/D/YYYY)	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
FY2006	08/1/2006	9/30/2006	F				\$5,896
FY 2007	10/1/2006	12/31/2006	F				\$23,584
FY__							
FY__							
TOTAL							\$29,480

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1.	Estimate obtained from 2-3 independent contractual sources.	P
2.	Documented cost figures from similar project work obtained from local agency sources.	P
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, E = Equipment M = Materials/Supplies, T = Travel, C = Contract, F = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

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TOTAL COST BY JURISDICTION

JURISDICTION	UNITS TREATED	COST
NPS – Zion National Park		\$29,480.
	TOTAL COST	\$29,480.

V-1: Aerial Herbicide

TREATMENT/ACTIVITY NAME	Aerial Herbicide – KOLOB Fire	PART E SPECIFICATION #	V-1
NFPORS TREATMENT CATEGORY*	Invasive Species	FISCAL YEAR(S) (list each year):	2006
NFPORS TREATMENT TYPE *	Prevention/Seeding, Chemical	WUI? Y / N	N
IMPACTED COMMUNITIES AT RISK	None	IMPACTED T&E SPECIES	None

* See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

WORK TO BE DONE (describe or attach exact specifications of work to be done):

Number and Describe Each Task:

A. General Description: Aerial herbicide application in various treatments options as described below. These are tactical options to minimize invasion of exotic cheat grass.

B. Location/(Suitable Sites): **Option1 is the preferred option.**

Option 1: Spray whole burn inside the park, save and except the, no spray zones (1520 acres), and the Crater Hill area (633 Acres). Total spray acres for option 1 are **8353 acres**.

Option 2: Spray an area of ¼ mile buffers on all accesses into the Park fire area; roads, trails, routes, and fire/park perimeter, save and except no-spray zones. Total spray acres for option 2 are **4485 acres**.

Option 3: Spray an area of ¼ mile buffers on all accesses into the Park fire area; roads, trails, routes, save and except no-spray zones. Total spray acres for option 3 are **2448 acres**.

C. Design/Construction Specifications:

Use IDIQ contracted helicopter to treat above opted location, with a fall application of Plateau herbicide at a rate of 12 oz./acre.

This treatment will be accomplished by one aerial application of herbicide by fixed wing or rotor aircraft.

The flight paths will be recorded by GPS technology (e.g. Satloc), and the contractor shall provide ARCVIEW GIS in NAD 83, Zone 12 N with associated metadata shape file electronic data records of these application paths to the local agency for records archival and project compliance purposes.

Application should be with winds less than 5 miles per hour. Application with winds in excess of this could result in transportation of the herbicide into non-target areas.

The application will be conducted by OAS-carded fixed wing or rotor aircraft, under the terms of an "end service contract". The Contractor must be licensed and bonded, and the performance bond shall not be less than 20% of the contract price. The contractor is responsible for materials necessary to complete the project.

The contractor will follow all herbicide label requirements for material safety and Hazmat. The contractor must be a Utah pesticide applicator.

Due to the complexity of the project recommend the use of Contracting Officer Technical Representative, who is familiar with helicopter spray operations and is familiar with the KOLOB burn assessments. Recommend DW Ivans, Big Thicket NP Fuels Management Specialist who was the GIS – BAER Team member who mapped the project specs, and who has 10 years experience in administering contracts for aerial herbicide treatments. Chad Prosser with the Northern Great Plains Exotic Plant Management Team also as the experience to do this type of work if Mr. Ivans is unavailable.

D. Purpose of Treatment Specifications:

The purpose of this treatment is to maintain or reestablish native herbaceous species in areas that have in the last 2-3 years been heavily invaded by Cheatgrass. Without such treatment the post-fire scenario is likely to be one where cheatgrass and other undesirable exotics will outcompete native vegetation; changing the fire regime by dramatically shortening the fire return interval.

E. Treatment Effectiveness Monitoring Proposed: (see Treatment Effectiveness Monitoring V-8)

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
Option 1: Fuels management specialist COTR: GS9-5 @ \$31.10/ hour x 80 hours x 1 fiscal year; and OT @ \$46.65/hour x 104 hours x 1 fiscal year	\$7,340.
Option 2: Fuels management specialist COTR: GS9-5 @ \$31.10/ hour x 56 hours x 1 fiscal year; and OT @ \$46.65/hour x 47 hours x 1 fiscal year	\$3934.
Option 3: Fuels management specialist COTR: GS9-5 @ \$31.10/ hour x 40 hours x 1 fiscal year; and OT @ \$46.65/hour x 17 hours x 1 fiscal year	\$2035.
TOTAL PERSONNEL SERVICE COST	Dependent on option (above)

EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	COST / ITEM
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	

MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	COST / ITEM
Option 1: Herbicide (Plateau) @ \$269.50/gl. x 783 gls. 1	TOTAL OPTION \$211,044.
Option 2: Herbicide (Plateau) @ \$269.50/gl. x 420 gls. 2	TOTAL OPTION \$113,316.
Option 3: Herbicide (Plateau) @ \$269.50/gl. x 230 gls. 3	TOTAL OPTION \$61,850.
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	COST / ITEM
Option 1: Fuels management specialist COTR: GS9-5 @ \$2711 x 1 round trip; x 1 fiscal year	Total option 1 \$2,596.
Option 2: Fuels management specialist COTR: GS9-5 @ \$1932 x 1 round trip; x 1 fiscal year	Total option 2 \$1,932.
Option 3: Fuels management specialist COTR: GS9-5 @ \$1550 x 1 round trip; x 1 fiscal year	Total option 3 \$1,550.
	COST / ITEM
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	
Option 1: Helicopter setup costs @ \$2000. x 1 fiscal year, @ \$1000./hour x 167 hours x 1 fiscal year	Total Option 1 \$ 169,000.
Option 2: Helicopter setup costs @ \$2000. x 1 fiscal year, @ \$1000./hour x 90 hours x 1 fiscal year	Total Option 2 \$ 9200.
Option 3: Helicopter setup costs @ \$2000. x 1 fiscal year, @ \$1000./hour x 49 hours x 1 fiscal year	Total Option 3 \$5100.

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE (M/D/YYYY)	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
FY2006 Option 1	10/01/2006		S, F	Acres	\$46.68	8353	Option 1 \$389,969.
FY2006 Option 2	10/01/2006		S, F	Acres	\$47.09	4485	Option 2 \$211,189
FY2006 Option 3	10/01/2006		S, F	Acres	\$47.57	2448	Option 3 \$116,435.

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1.	Estimate obtained from 2-3 independent contractual sources.	M
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
5.	No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, E = Equipment M = Materials/Supplies, T = Travel, C = Contract, F = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

Refer to Vegetation Assessment and KOLOB Fire Proposed Treatments Map

TOTAL COST BY JURISDICTION

JURISDICTION		UNITS TREATED	COST
NPS – Zion National Park	Option 1	8353 ac.	\$380,969.
NPS – Zion National Park	Option 2	4485 ac.	\$211,189.
NPS – Zion National Park	Option 3	2448 ac.	\$116,435.

V-2: Environmental Compliance

TREATMENT/ACTIVITY NAME	Environmental Compliance	PART E SPECIFICATION #	V-1
NFPORS TREATMENT CATEGORY*	Planning	FISCAL YEAR(S) (list each year):	2006
NFPORS TREATMENT TYPE *	NEPA EA	WUI? Y / N	N
IMPACTED COMMUNITIES AT RISK	None	IMPACTED T&E SPECIES	None

* See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

WORK TO BE DONE (describe or attach exact specifications of work to be done):

Number and Describe Each Task:
A. General Description: The aerial application of herbicide requires NEPA compliance at the Environmental Assessment level and reaching of a Finding of No Significant Impact (FONSI)
B. Location/ (Suitable) Sites: Sites within the park deemed suitable for the aerial application of herbicides to control the spread of cheat grass.
C. Design/Construction Specifications:
1. Prepare Environmental Assessment (EA)
2. The park will do the public meetings and regional review process
3. Reach FONSI, if possible using preferred alternative
D. Purpose of Activity Specifications: The purpose is to determine if the aerial application of herbicides within the park poses a significant risk to the human environment, and in doing so comply with the National Environmental Policy Act (NEPA).
E. Activity Effectiveness Monitoring Proposed: If a FONSI can be reached, the completed activity will be determined to be effective.

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
Environmental Protection Specialist: GS401-11/5 @ \$30.90/Hour X 120 Hours and OT @ \$46.35/Hour X 40 Hours	\$ 5196.80
Bio Tech GS401-7 @ \$18.11/Hour X 160Hours	\$ 2898.
OT Time for FIO GS401 – 11/5 OT @	\$ 680.20
TOTAL PERSONNEL SERVICE COST	\$ 8775.
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	COST / ITEM
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	COST / ITEM
1 ream premium quality bond paper @ \$10/ each	\$ 10.
1 pack presentation covers @ \$17.00/ each	\$ 17.
1 box binding spines @ \$8.00/ each	\$ 8.
Printing and mounting costs for displays for public meetings (@\$500 for each) x 5=	\$ 2,500.00
TOTAL MATERIALS AND SUPPLY COST	\$
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	COST / ITEM
POV @ .445/Mile X 1200 Miles	\$ 534.
Per Diem: CONUS @ \$99./Day X 12 Days and \$74.25/Day X 2 Days	\$1337.
TOTAL	\$1871.
TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	COST / ITEM
TOTAL CONTRACT COST	

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE (M/D/YYYY)	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
FY06	8/16/2006	8/31/2006	F	EA		1	\$13181.
FY__							
FY__							
FY__							
TOTAL							\$13181

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1.	Estimate obtained from 2-3 independent contractual sources.	M
2.	Documented cost figures from similar project work obtained from local agency sources.	
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	

P = Personnel Services, E = Equipment M = Materials/Supplies, T = Travel, C = Contract, F = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

See Kolob Fire Vegetation Assessment and Proposed Treatment Map

TOTAL COST BY JURISDICTION

JURISDICTION	UNITS TREATED	COST
NPS – Zion National Park	1	\$13181.
	TOTAL COST	\$13181.

V-3: Seed Increase

TREATMENT/ACTIVITY NAME	Seed Increase	PART E SPECIFICATION #	V-3
NFPORS TREATMENT CATEGORY*	Invasive Species	FISCAL YEAR(S) (list each year):	2006
NFPORS TREATMENT TYPE *	Seed Collection	WUI? Y / N	N
IMPACTED COMMUNITIES AT RISK	None	IMPACTED T&E SPECIES	None

* See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

WORK TO BE DONE (describe or attach exact specifications of work to be done):

Number and Describe Each Task:

A. General Description: This activity is to produce a seed bank of two native grass species, Elymus elymoides (bottlebrush squirreltail), and Sporobolus cryptandrus (Sand dropseed). The seed will later be broadcast on and in the direct of vicinity of Crater Hill for a total of 35 seeded acres over a period of three years. (See V-5).

B. Location / (Suitable) Sites: The seed is to be produced at two NRCS Plant Material Centers, one in Tucson, AZ (Sporobolus) and the other in Las Lunas, N.M. (Elymus).

C. Design/Construction Specifications:

1. Year 1: Produce sufficient seed to broadcast 2 acres of Elymus and 3 acres of Sporobolus.

2. Year 2: Produce sufficient seed to broadcast 6 acres of Elymus and 3 acres of Sporobolus.

3. Year 3: Produce sufficient seed to broadcast 15 acres of Elymus and 6 acres of Sporobolus.

D. Purpose of Treatment Specifications: Coordination with resource management occurs to develop native seed sources.

E. Treatment Effectiveness Monitoring Proposed:

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
TOTAL PERSONNEL SERVICE COST	
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	COST / ITEM
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	COST / ITEM
Year 1:Elymus elymoides seed production: 2 acres @ \$8000./acre x 1 fiscal year	\$ 16000.
Year 1:Sporobolus cryptandrus seed production: 3 acres @ \$7000./acre x 1 fiscal year	\$ 21000.
Year 2: Elymus elymoides seed production: 6 acres @ \$8000./acre x 1 fiscal year	\$ 24000.
Year 2: Sporobolus cryptandrus seed production : 3 acres @ \$7000./acre x 1 fiscal year	\$ 21000.
Year 3: Elymus elymoides seed production: 15 acres @ \$8000./acre x 1 fiscal year	\$120000.
Year 3: Sporobolus cryptandrus seed production: 6 acres @ \$7000./acre x 1 fiscal year	\$ 42000.
TOTAL MATERIALS AND SUPPLY COST	\$268000.
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	COST / ITEM
TOTAL TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	COST / ITEM
TOTAL CONTRACT COST	

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE (M/D/YYYY)	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
FY2006	8/1/2006		C	acres	\$7400.	5	\$ 37000.
FY2007			C	acres	\$7667.	9	\$ 69000.
FY2008		8/31/08	C	acres	\$7715.	21	\$162000.
TOTAL							\$268000.

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

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.	
3.	Estimate supported by cost guides from independent sources or other federal agencies	M
4.	Estimates based upon government wage rates and material cost.	
5.	No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, E = Equipment M = Materials/Supplies, T = Travel, C = Contract, F = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

Refer to Vegetation Assessment.

TOTAL COST BY JURISDICTION

JURISDICTION	UNITS TREATED	COST
NPS – National Park Service	35	\$268000.
	TOTAL COST	\$268000.

V-4 Aerial Seeding – Roadside

TREATMENT/ACTIVITY NAME	Aerial Seeding – Roadside	PART E SPECIFICATION #	V-4
NFPORS TREATMENT CATEGORY*	Invasive Species	FISCAL YEAR(S) (list each year):	2006
NFPORS TREATMENT TYPE *	Prevention/Seeding	WUI? Y / N	N
IMPACTED COMMUNITIES AT RISK	None	IMPACTED T&E SPECIES	None

* See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

WORK TO BE DONE (describe or attach exact specifications of work to be done):

Number and Describe Each Task:

A. General Description: Aerial seed suitable sites as described below. These are high watershed response locations of moderate soil burn severity that have recently been subject to cheat grass invasion.

B. Location / (Suitable) Sites: ¼ mile buffer around the Kolob Terrace (KT) Road up to the fire perimeter and park boundary totaling 481 acres.

C. Design/Construction Specifications:

This treatment will be accomplished by one aerial application of herbicide by fixed wing or rotor aircraft under a service contract.

The flight paths will be recorded by GPS technology (e.g. Satloc), and the contractor shall provide ARCVIEW GIS in NAD 83, Zone 12 N with associated metadata shape file electronic data records of these application paths to the local agency for records archival and project compliance purposes.

Application should be with winds less than 5 miles per hour. Application with winds in excess of this could result in transportation of the herbicide into non-target areas.

The application will be conducted by OAS-carded fixed wing or rotor aircraft, under the terms of an "end service contract". The Contractor must be licensed and bonded, and the performance bond shall not be less than 20% of the contract price. The contractor is responsible for materials necessary to complete the project.

1. Purchase seed mix with the following specifications:

- Elymus elymoides at a seeding rate of 5.5 lbs./acre – sourced seed from within 50 miles
- Sporobolus cryptandrus at a seeding rate of 2 lbs./acre
- Sphaeralcea coccinea at a seeding rate of .25 lbs./acre - sourced seed from within 50 miles
- Penstemon palmerii at a seeding rate of .5 lbs./acre - sourced seed from within 50 miles
- Rice hulls – carrier at a seeding rate of 10 lbs/acre

2. Aerial apply seed prior to herbicide treatment (V-4), as per recommended in the vegetation assessment

3. Monitor treatment application for any deficiencies and correct if necessary

D. Purpose of Treatment Specifications: The purpose of this treatment is to reestablish native plants in areas that have in the last 2-3 years been heavily invaded by cheat grass. Without such treatment in association with herbicide application (see specification V-4), the post-fire scenario is likely to be one where cheat grass and other undesirable exotics will outcompete at the expense of natives.

E. Treatment Effectiveness Monitoring Proposed: See treatment effectiveness specification (V-8)

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
Landscape architect COTR: GS11-5 @ \$37.53/hour x 32 hours x 1 fiscal year; and OT @ \$34.01/hour x 8 hours x 1 fiscal year	\$1473.
TOTAL PERSONNEL SERVICE COST	\$1473.
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	COST / ITEM
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	COST / ITEM
Elymus elymoides (Bottlebrush squirreltail) @ \$25/lb. x 2645.5 lbs. x 1 fiscal year	\$ 66138.
Sporobolus cryptandrus (Sand dropseed) @ \$3.5/lb. x 962 lbs. x 1 fiscal year	\$ 3367.
Sphaeralcea coccinea (Scarlet globemallow) @ \$80./lb. x 120.25 lbs. x 1 fiscal year	\$ 9620.
Penstemon palmeri (Palmer's penstemon) @ \$24/lb. x 240.5 lbs. x 1 fiscal year	\$ 5772.
Rice Hulls – carrier @ \$.3/lb. x 4810 lbs x 1 fiscal year	\$ 1443.
TOTAL MATERIALS AND SUPPLY COST	\$ 86340.
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	COST / ITEM
TOTAL TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	COST / ITEM
Helicopter setup cost @ \$2000. x 1 fiscal year	\$ 2000.
Helicopter time for aerial seeding @ \$1000./hour x 9.62 hours x 1 fiscal year	\$ 9620.
TOTAL CONTRACT COST	\$11620.

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE (M/D/YYYY)	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
FY2006 FY____ FY____ FY____	10/01/2006	12/31/2006	S, F	Acres	\$208.	481	\$99433.
TOTAL							\$99433.

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1.	Estimate obtained from 2-3 independent contractual sources.	M
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
5.	No cost estimate required - cost charged to Fire Suppression Account	

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

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

Refer to Vegetation Assessment and KOLOB Fire Proposed Treatments Map

TOTAL COST BY JURISDICTION

JURISDICTION	UNITS TREATED	COST
NPS-Zion National Park	481	\$99433.
	TOTAL COST	\$99433.

V-5: Crater Hill Revegetation

TREATMENT/ACTIVITY NAME	Crater Hill Revegetation	PART E SPECIFICATION #	V-5
NFPORS TREATMENT CATEGORY*	Invasive Species	FISCAL YEAR(S) (list each year):	2006
NFPORS TREATMENT TYPE *	Prevention/Seeding, Chemical	WUI? Y / N	N
IMPACTED COMMUNITIES AT RISK	None	IMPACTED T&E SPECIES	None

* See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

WORK TO BE DONE (describe or attach exact specifications of work to be done):

Number and Describe Each Task: A. General Description: Aerial seed suitable sites as described below. These are high watershed response locations of moderate soil burn severity that have recently been subject to cheat grass invasion. B. Location/(Suitable Sites): Crater Hill and area west to park boundary and east to Coalpits Wash. C. Design/Construction Specifications: This treatment will be accomplished by one aerial application of herbicide by fixed wing or rotor aircraft. The flight paths will be recorded by GPS technology (e.g. Satloc), and the contractor shall provide ARCVIEW GIS in NAD 83, Zone 12 N with associated metadata shape file electronic data records of these application paths to the local agency for records archival and project compliance purposes. Application should be with winds less than 5 miles per hour. Application with winds in excess of this could result in transportation of the herbicide into non-target areas. The application will be conducted by OAS-carded fixed wing or rotor aircraft, under the terms of an "end service contract". The Contractor must be licensed and bonded, and the performance bond shall not be less than 20% of the contract price. The contractor is responsible for materials necessary to complete the project. 1. Stabilize slopes and introduce a species that is competitive with Cheatgrass • Winter wheat at a seeding rate of 60 lbs./acre • Broadcast seed October-December of 2006 2. Treat year 2 with herbicide (Plateau) at a rate of 12 oz./acre 3. Broadcast seed year 3 with local native species (Elymus elymoides and Sporobolus cryptandrus) generated from seed increase activity (V-3). D. Purpose of Treatment Specifications: The purpose of this treatment is to reestablish native herbaceous species in areas that have in the last 2-3 years been heavily invaded by Cheatgrass. Without such treatment, the post-fire scenario is likely to be one where Cheatgrass and other undesirable exotics will outcompete at the expense of natives. E. Treatment Effectiveness Monitoring Proposed: See specification for Effectiveness monitoring (V-8)

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
Landscape architect COTR: GS11-5 @ \$37.53/hour x 24 hours x 1 fiscal year; and OT @ \$34.01/hour x 8 hrs x 1 FY	\$1148.
Fuels management specialist COTR: GS9-5 @ \$31.10/ hour x 24 hrs x 1 FY; and OT @ \$46.65/hour x 8 hrs x 1 FY	\$1121.
Landscape architect COTR: GS11-5 @ \$37.53/hour x 48 hours x 1 fiscal year; and OT @ \$34.01/hour x 16 hrs x 1 FY	\$544.16.
TOTAL PERSONNEL SERVICE COST	\$2,813.16
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	COST / ITEM
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	COST / ITEM
Winter Wheat @ \$0.12/lb. x 55,440 lbs. x 1 fiscal year	\$ 6653.
Herbicide (Plateau) @ \$269.50/gl. x 63 gls.	\$16979.
Local native seed purchased through coop with NRCS. See spec. V-3, Seed increase	\$ 0.
TOTAL MATERIALS AND SUPPLY COST	\$23632.
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	COST / ITEM
TOTAL TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	COST / ITEM
Helicopter setup costs @ \$2000. x 3 fiscal year	\$ 6000.
Helicopter time for aerial seeding of winter wheat @ \$1000./hour x 12.66 hours x 1 fiscal year	\$12660.
Helicopter time for aerial application of herbicide @ \$1000./hour x 12.66 hours x 1 fiscal year	\$12660.
Helicopter time for aerial seeding of local native species @ \$1000./hour x 18.48 hours x 1 fiscal year	\$18480.
TOTAL CONTRACT COST	\$49800.

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE (M/D/YYYY)	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
FY2006	10/01/2006		S, F	Acres	\$34.19	663	\$22665.
FY2007			S, F	Acres	\$49.11	663	\$32557.
FY2008		6/30/2009	S, F	Acres	\$22.53	924	\$20,820.16
FY__							
TOTAL							\$76,042.16

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

SOURCE OF COST ESTIMATE

1.	Estimate obtained from 2-3 independent contractual sources.	M
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
5.	No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, E = Equipment M = Materials/Supplies, T = Travel, C = Contract, F = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

Refer to Vegetation Assessment and KOLOB Fire Proposed Treatments Map

TOTAL COST BY JURISDICTION

JURISDICTION	UNITS TREATED	COST
NPS – Zion National Park	633	\$22665.
NPS – Zion National Park	633	\$32557.
NPS – Zion National Park	924	\$20,820.16
TOTAL COST		\$76,042.16

V-6: Exotic Monitoring and Control

TREATMENT/ACTIVITY NAME	Exotic Monitoring and Control	PART E SPECIFICATION #	V-6
NFPORS TREATMENT CATEGORY*	Invasive Species	FISCAL YEAR(S) (list each year):	2006, 2007, 2008, 2009
NFPORS TREATMENT TYPE *	Chemical, Mechanical, Hand	WUI? Y / N	N
IMPACTED COMMUNITIES AT RISK	None	IMPACTED T&E SPECIES	None

* See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

WORK TO BE DONE (describe or attach exact specifications of work to be done):

Number and Describe Each Task:

A. General Description: Control and monitor the spread of undesirable exotic species.

B. Location/(Suitable) Sites:

- Road Sides
- Trails and Routes
- Trail Heads
- Washes
- Retardant Drop locations
- Other areas of concern

C. Design/Construction Specifications:

1. Identify Priority Exotics
2. Select and apply appropriate treatment (chemical, mechanical, or hand)
3. Monitor for effectiveness (see E. below)

D. Purpose of Treatment Specifications: Over 100 non-native plant species occur in Zion; 12 are of priority management for control and eradication. Tamarisk (*Tamarix ramossissima*) and Russian olive (*Eleagnus angustifolia*) are the primary invasive species along riparian areas. Both non-native tree species are increasing throughout the West and are able to effectively displace native riparian communities, creating monocultures in formerly biologically diverse habitats. Tamarisk in particular alters riparian communities that typically have moderate fire severity and intensity to a vegetation community type with a high or extreme fire severity and intensity. Zion has actively controlled these species for the past two decades.

In disturbed areas, Scotch thistle (*Onopordum acanthium*), bull thistle (*Cirsium vulgare*), and white top (*Cardaria draba*) are most commonly seen along trails in the front and backcountry. Zion staff work diligently with hundreds of volunteers to control these invasive weeds. Currently, knapweed (*Centaurea* spp.) and yellow starthistle (*Centaurea solstitialis*) occur in small infestations, but are of great potential threat. Known occurrences of non-native species will be controlled each growing season and new populations will be detected as early as possible.

E. Treatment Effectiveness Monitoring Proposed: Zion park vegetation management staff will do followup monitoring like other park exotic treatment and removal projects.

LABOR, MATERIALS AND OTHER COST:

PERSONNEL SERVICES: (Grade @ Cost/Hour X # Hours X # Fiscal Years = Cost/Item): Do not include contract personnel costs here (see contractor services below).	COST / ITEM
Biotech (1), GS5-5 @ \$14.63/hour x 160 hours x 3 fiscal yrs.	\$7023.
TOTAL PERSONNEL SERVICE COST	\$7023.
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	COST / ITEM
GSA Vehicle @ \$.19/mile x 500 miles x 3 fiscal yrs.	\$285.
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	\$285.
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	COST / ITEM
Herbicide (Roundup - Pro) @ \$143/gl. x 5 gallons	\$715.
TOTAL MATERIALS AND SUPPLY COST	\$715.
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	COST / ITEM
TOTAL TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	COST / ITEM
TOTAL CONTRACT COST	

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE (M/D/YYYY)	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
FY2006			F				\$715.
FY2007	1/15/07	06/30/07	F	Acres	\$243.60	10	\$2436.
FY2008	1/15/08	06/30/08	F	Acres	\$243.60	10	\$2436.
FY2009	1/15/09	06/30/09	F	Acres	\$243.60	10	\$2436.
TOTAL							\$8023.

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

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.	
3.	Estimate supported by cost guides from independent sources or other federal agencies	
4.	Estimates based upon government wage rates and material cost.	P, M
5.	No cost estimate required - cost charged to Fire Suppression Account	

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

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

See Vegetation Assessment

TOTAL COST BY JURISDICTION

JURISDICTION	UNITS TREATED	COST
NPS – Zion National Park	30	\$7308.
TOTAL COST		\$7308.

V-7: Sensitive Plant Monitoring – Spot control

TREATMENT/ACTIVITY NAME	Sensitive Plant Monitoring – Spot control	PART E SPECIFICATION #	V-7
NFPORS TREATMENT CATEGORY*	Invasive	FISCAL YEAR(S) (list each year):	2006
NFPORS TREATMENT TYPE *		WUI? Y / N	N
IMPACTED COMMUNITIES AT RISK	None	IMPACTED T&E SPECIES	None

* See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

WORK TO BE DONE (describe or attach exact specifications of work to be done):

Number and Describe Each Task: A. General Description: Identify presence, abundance and condition of sensitive plants within the burn area B. Location/(Suitable) Sites: Sandstone crevices and derived soils or hanging gardens within the fire perimeter C. Design/Construction Specifications: 1. Identify, survey and inventory likely sensitive plant locations 2. Spot treat as needed to reduce competition from exotics 3. Monitor for effectiveness (See E. below) D. Purpose of Treatment Specifications: Zion hosts 22 plant species considered "sensitive" by the park and the state of Utah because of their limited distribution (endemism) or are disjunct from more abundant population centers. Most of these species are specialized to sandstone crevices and derived soils or hanging gardens. Many of these habitats are not susceptible to fire, and therefore fires are infrequent or rare in areas where these plants may occur. Four known populations were within the burn perimeter, Zion daisy, (Erigeron sionis, Religious daisy, (Erigeron religiosus) and Zion penstemon, (Penstemon humilus var. obtusifolia). The purpose of the treatment is to determine if any of the known populations described above are present within the burn area, and if so, describe their abundance, condition, and any competitive threats that may exist from exotics that may be addressed through spot applications of herbicide. E. Treatment Effectiveness Monitoring Proposed:

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
Biotech (1) @ \$14.63/hour x 26.66 hours x 3 fiscal years	\$1171.
TOTAL PERSONNEL SERVICE COST	\$1171.
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	COST / ITEM
GSA Vehicle @ \$.19/mile x 250 miles x 3 fiscal years	\$143.
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	\$143.
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	COST / ITEM
Herbicide (Roundup Pro) @ \$143/gl. x 1 gls.	\$143.
TOTAL MATERIALS AND SUPPLY COST	\$143.
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	COST / ITEM
TOTAL TRAVEL COST	
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	COST / ITEM
TOTAL CONTRACT COST	

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE (M/D/YYYY)	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
FY2006							\$143.
FY2007	4/1/2007	6/30/2007	F	Acres	\$219.	2	\$438
FY2008	4/1/2008	6/30/2008	F	Acres	\$219.	2	\$438.
FY2009	4/1/2009	6/30/2009	F	Acres	\$219.	2	\$438.
TOTAL							\$1457.

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

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.	
3.	Estimate supported by cost guides from independent sources or other federal agencies	
4.	Estimates based upon government wage rates and material cost.	P,M
5.	No cost estimate required - cost charged to Fire Suppression Account	

P = Personnel Services, E = Equipment M = Materials/Supplies, T = Travel, C = Contract, F = Suppression

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

Refer to Vegetation Assessment.

TOTAL COST BY JURISDICTION

JURISDICTION	UNITS TREATED	COST
NPS – Zion National Park	6	\$1457.
	TOTAL COST	\$1457.

V-8: Treatment Effectiveness Monitoring

TREATMENT/ACTIVITY NAME	Treatment Effectiveness Monitoring	PART E SPECIFICATION #	V-8
NFPORS TREATMENT CATEGORY*	Monitoring	FISCAL YEAR(S) (list each year):	2006, 2007, 2008, 2009
NFPORS TREATMENT TYPE *	Treatment Effectiveness Monitoring	WUI? Y / N	N
IMPACTED COMMUNITIES AT RISK	None	IMPACTED T&E SPECIES	None

* See NFPORS Restoration & Rehabilitation module - Edit Treatment screen for applicable entries.

WORK TO BE DONE (describe or attach exact specifications of work to be done):

Number and Describe Each Task: A. General Description: Monitor effectiveness of treatment nos. V-1: Aerial Herbicide, V-4: Aerial Seeding-Roadside, and V-5: Crater Hill - Revegetation. B. Location/(Suitable) Sites: All treatments will have some untreated controls to be designated in the monitoring design and plan. Additionally, areas in the burn and outside the burn will be monitored per the Biological Opinion (USFW, 2005) - For V-1: All areas within the burn perimeter excluding Crater Hill and the immediately surrounding vicinity. - For V-4: ¼ mile buffer around the Kolob Terrace (KT) and Smith Mesa Roads up to the fire perimeter and park boundary - For V-5: Crater Hill and area east to Coalpits Wash and west to park boundary, excluding a ¼ mile buffer that will be treated in V-1 C. Design/Construction Specifications: - Develop sampling design and monitoring plan and schedule for paired plots – see monitoring design for JFS research in Zion Canyon and 2006 ESR MONITORING PLAN - Southern Nevada Complex Fires and 2003-2005 Ely District Fires with Dr. Matt Brooks (USGS) - Establish paired plots both inside and outside the burn per park approval - Implement monitoring plan, collect and analyze data, communicate results to park and other interested parties. D. Purpose of Treatment Specifications: Monitor effectiveness of all treatments including aerial herbicide application, roadside seeding and Crater Hill revegetation. In addition the Biological Opinion (BO) that supports the Fire Management Plan (FMP) states in Reasonable and Prudent measure 2, that Zion National Park shall fully implement the following measures to minimize harm to the Mexican spotted owl, California Condor, desert tortoise, or Shiwits milkvetch through destruction of their habitats, without placing firefighter personnel at risk: - Rehabilitation of the burned areas shall be ensured, including seeding and planting of native perennial species if necessary. - Revegetation will attempt to reconstruct the natural spacing, abundance, and diversity of native plant species. Recovery of vegetation shall be monitored, including establishment and monitoring of paired plots, inside and outside of the burned area unless Zion National Park and the Service concur that monitoring is not required. E. Treatment Effectiveness Monitoring Proposed: This Specification is the Treatment Effectiveness monitoring.

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
TOTAL PERSONNEL SERVICE COST	
EQUIPMENT PURCHASE, LEASE AND/OR RENT (Item @ Cost/Hour X # of Hours X #Fiscal Years = Cost/Item): Note: Purchases require written justification that demonstrates cost benefits over leasing or renting.	COST / ITEM
4x4 vehicle x 6 months x \$583.33 /month = \$3500 x 3 years = \$10,500.00	
TOTAL EQUIPMENT PURCHASE, LEASE OR RENTAL COST	\$10,500.00
MATERIALS AND SUPPLIES (Item @ Cost/Each X Quantity X #Fiscal Years = Cost/Item):	COST / ITEM
Supplies \$3000 per year X 3 years = \$9000.00	
TOTAL MATERIALS AND SUPPLY COST	\$9,000
TRAVEL COST (Personnel or Equipment @ Rate X Round Trips X #Fiscal Years = Cost/Item):	COST / ITEM
(20 field days x 1 person) + (40 field days x 4 persons)] x \$75/day = \$13,500/year X 3 years = \$40,500.00	
TOTAL TRAVEL COST	40,500.00
CONTRACT COST (Labor or Equipment @ Cost/Hour X #Hours X #Fiscal Years = Cost/Item):	COST / ITEM
GS12 project manager term (0.5FTE) = \$38, 932 X 3 years =	\$116,796.06
GS7 biol tech temp 1person x 3 months (May-July) 0.25 FTE = \$9,656 x 3 years =	\$28,968.03
GS5 biol tech temp 3 people x 3 months (May-July) 0.75 FTE = \$23,388 x 3 years =	\$70,164.09
Overhead charge through CESU – 17.5% on all costs	\$48,287.43
Inflation at 5% year for year 2 and 3 – see spreadsheet for calculations	\$11,077.37
TOTAL CONTRACT COST	\$280,696.57

SPECIFICATION COST SUMMARY

FISCAL YEAR	PLANNED INITIATION DATE (M/D/YYYY)	PLANNED COMPLETION DATE (M/D/YYYY)	WORK AGENT	UNITS	UNIT COST	PLANNED ACCOMPLISHMENTS	PLANNED COST
FY06	08/01/2006		C	1	NA		
FY07							\$108,071.87
FY08							\$113,475.46
FY09		06/30/09					\$113,475.46
TOTAL							\$340,696.57

Work Agent: C=Coop Agreement, F=Force Account, G=Grantee, P=Permittees, S=Service Contract, T=Timber Sales Purchaser, V=Volunteer

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.	C, T, M, E
3.	Estimate supported by cost guides from independent sources or other federal agencies	
4.	Estimates based upon government wage rates and material cost.	C
5.	No cost estimate required - cost charged to Fire Suppression Account	

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

RELEVANT DETAILS, MAPS AND DOCUMENTATION INCLUDED IN THIS REPORT:

Refer to Vegetation Assessment, Zion Canyon JFSP grant and 2006 ESR MONITORING PLAN - Southern Nevada Complex Fires and 2003-2005 Ely District Fires. (Matt Brooks, USGS), treatment effectiveness cost spreadsheet

TOTAL COST BY JURISDICTION

JURISDICTION	UNITS TREATED	COST
NPS – Zion National Park	1	\$340,696.57
TOTAL COST		\$340,696.57

**APPENDIX I –
BURNED AREA
EMERGENCY STABILIZATION
AND
BURNED AREA REHABILITATION
ASSESSMENTS**

BURNED AREA EMERGENCY STABILIZATION AND REHABILITATION PLAN

KOLOB FIRE

I-A: CULTURAL RESOURCE ASSESSMENT

I. OBJECTIVES

- Assess the effects of fire and the risks posed by post-fire effects to cultural resources evaluated as or treated as eligible for inclusion to the National Register of Historic Places (National Register)
- Prescribe emergency treatments for those eligible resources identified as being at risk from post-fire effects
- Assess potential effects to eligible resources from proposed burned area emergency response treatments
- Initiate emergency Section 106 consultation with the Utah State Historic Preservation Office

II. ISSUES

- Potential adverse effects to National Register eligible resources resulting from a projected increase in watershed response
- Possible increase in looting or vandalism of eligible resources due to increased exposure from the removal understory vegetation

III. OBSERVATIONS

A. Background - Archaic Period (8,000-1,500 B.P.)

The Archaic period adaptations that developed in the Great Basin and transition zone to the Colorado Plateau have been described by Jennings (1978) as the "Desert Archaic". This adaptation is generally modeled to include mobile hunting and collecting, focused on the efficient exploitation of a limited number of plant and animals species across diverse environmental zones (Shroedl 1976; Simms 1979). The toolkit of the Desert Archaic groups was comprised of large lanceolate, notched, and stemmed projectile points, classified as Pinto, Humbolt, Elko, and Gypsum types. These were attached to shafts and propelled by wooden throwing devices, known as atlatls. Fiber sandals, cordage, and hide moccasins have also been recovered from Desert Archaic contexts. Ceramics are not present in the material culture of this period (Jennings 1978, Thompson and Thompson 1982). Garden plot horticulture may have been practiced during the terminal Archaic in well-watered localities, such as along river courses and near springs. A growing body of evidence indicates that human groups were exploiting resources in southwestern Utah during the Archaic period.

Formative Period (1,500-650 B.P.)

Within the Virgin River drainage and on the Arizona Strip, Archaic subsistence strategies give way to Formative period horticulture by about A.D. 1. Formative period cultural adaptations in southwestern Utah are generally characterized by habitation sites containing architecture, storage facilities, ceramics, groundstone, and increasing use of the bow and arrow. The material culture suggests a strong reliance on horticulture, permitting sedentary lifestyles and year-round occupation of habitation sites near dependable water sources, like the Virgin River and its tributaries. Upland areas continued to be exploited for hunting, seed collection, and for tool stone quarrying.

Virgin (Branch) Anasazi (A. D. 1-1250)

The Anasazi are an archeologically known cultural group whose material culture was initially defined by sites excavated in the Four Corners region of the Colorado Plateau. Through time, considerable variability among the Anasazi cultural expressions has been documented, particularly among groups living on the periphery of the Four Corners "core area". One such regional variant, the Virgin Branch of the Kayenta Anasazi, has been recognized as inhabiting the Virgin, Muddy, and lower Colorado River drainages in southwestern Utah,

western Arizona, and southern Nevada from approximately A.D. 1 until the 12th century.

Virgin Anasazi sites have been identified along the river courses, where full time horticulture was made possible by perennial water sources. Upland dry farming was also practiced throughout much of region's mesa tops (McFadden 1996). Much like the Fremont, Virgin Anasazi material culture included pit houses and surface architecture; adobe or stone masonry granaries; flaked stone, and groundstone assemblages; gray, black-on-gray, red ware, and corrugated ceramics. A variety of perishable items, including basketry and cordage and bone implements, were made. Projectile points include Rosegate, Parowan Basal-notched, and Cottonwood Triangular types.

Neo-Archaic (A.D. 1150-1300) Proto-Historic (A.D. 1300-1700)

Speculation surrounds the apparent disappearance of the Formative cultures from this region by A.D. 1300. Several causal explanations have been advanced, including environmental change, demographic shifts, and assimilation or competition with more mobile Numic-speaking groups (e.g., Southern Paiute, Ute) that were present in the Great Basin and western Colorado Plateau by the 10th century (Shutler 1961, Lyneis 1990, 1994). Archeological and ethnographic evidence indicates that the Southern Paiute have utilized the Virgin River Basin, Cedar Valley, and surrounding areas of southwestern Utah from approximately A.D. 1100 until the present. The Southern Paiute traditional subsistence strategies have been described as a return to the "broad spectrum" hunting and gathering pattern of the Desert Archaic groups. Several researchers have applied the term "Neo-Archaic" (Thompson and Thompson 1982, Walling et al., 1986, Altschul and Fairley 1989) to describe this adaptation. Steward (1970) and others describe the cultivation of small garden plots and the inclusion of cultivated foods in the Southern Paiute diet. Euro-American explorers in southwestern Utah during the 18th century observed the Southern Paiute cultivating extensive fields of corn, beans, sunflowers, and other crops along the Virgin River and its smaller tributaries, and near springs. Hunting of game and the collection of wild seeds continued to be important components of their subsistence strategies.

The material culture of the Southern Paiute reflects the apparent mobility of their lifeways. Habitation structures were semi-permanent, generally consisting of brush shelters ("wickiups") and rock shelters. The Southern Paiute lithic assemblages included ground and chipped stone, with projectile points comprised of small Desert Side-notched and Cottonwood Triangular types (Thompson and Thompson 1982). Sinew-backed bows and arrows were used for hunting, as were cordage nets, curved sticks, and deadfall trigger snares. For many Southern Paiute groups, lightweight basketry served multiple subsistence-related functions, including food collection, storage, and meal preparation. Pottery was made and used by some Southern Paiute groups, particularly those that practiced horticulture. Brownware ceramics, variously labeled as Southern Paiute Utility Ware, or Intermountain Brownware were produced, with wide-mouthed conical jars being considered the diagnostic vessel form. Vessels are generally smooth and thick walled, although corrugated vessels have been recorded at sites in southern Utah (Walling et al. 1986). Surface treatment is generally limited to fingernail indentations as a narrow band of decoration, just below the rim of the vessel.

Historic Period (A.D. 1700 – Present)

Ferris (2001) divides the Historic Period into three periods: Euro-American exploration, Mormon settlement, and federal administration. The Historic Period begins in 1776 with the explorations of the Dominguez-Escalante expedition in southern Utah. In the 1820s American fur trappers began further exploration along the Dominguez-Escalante route. By 1830, pack trains were making annual trips along the "Old Spanish Trail" between Santa Fe and southern California.

Between 1847 and 1850, Mormon parties explored southern Utah, investigating the feasibility of establishing permanent settlements. Mormon exploration led to the establishment of ranching outposts in the region in the 1860s and 1870s (Billat et al. 1992). During this period the communities of Grafton, Rockville, Shunesburg, and Springdale were established. By the turn of the century oil exploration began as an income source to augment agriculture. Oil drilling began in 1907 northeast of Virgin in an area referred to as the Virgin oil fields (Alder and Brooks 1996). The local oil deposits were depleted by the late 1930s.

The federal administration period of Zion began in 1909 with the creation of Mukuntuweap National Monument, a small monument encompassing 15,840 acres along the North Fork of the Virgin River.

Following the creation of the National Park Service with the passage of the National Park Service Organic Act in 1916 (16 U.S.C. 1), steps were taken to convert this small national monument into a national park. On November 19, 1919, President Wilson signed a Congressional bill establishing Zion National Park. Traditional practices such as homesteading and agriculture declined and tourism became the main economic source in the area following the creation of the National Park.

Previous Inventory

The area within the Kolob Fire boundaries is largely un-surveyed. Eight cultural resource inventories, covering approximately 1700 acres, have been completed within the Kolob Fire. Four linear surveys have been conducted within the fire. In 2002 JBR Environmental Consultants, Inc. completed a Phase II cultural resource inventory of the Toquerville to Springdale power line (Jensen and Billat 2002). The Kodak and McBride 1985 Archeological Surveys (Hartley 1985), the Western Kolob Terrace Fence Survey (Walling and Thompson 1988) and the Fence Line Survey South of Paradise Canyon Ranch (Frank 1996) were boundary fence surveys encompassing 130 acres along the western boundary of Zion National Park.

The additional cultural resource inventories were conducted in three distinct areas: Crater Hill, Coalpits Wash, and near North Creek. The Crater Hill survey (Walling 1993) encompassed 300 acres adjacent to Crater Hill. The archeological inventory of the Coalpits Wash Burn Unit (Hansen 2000) and the Coalpits Helipad and Firing Range archeological survey (Naylor 1993) identified cultural resources in 930 acres of the Coalpits Wash area. The cultural resource inventory of the North Creek Burn Unit (Bonnifield and Walker 2002) covered 340 acres along the Kolob Terrace Road between the Park boundary and the Left Fork Trailhead.

B. Reconnaissance Methodology and Results - Thirty-five (35) National Register eligible cultural resources, Thirty-three (33) prehistoric archeological sites and two (2) historic sites, are known to exist within the fire perimeter. Of these, fourteen (14) sites were identified to be potentially at risk from downstream precipitation events, eight (8) sites were identified as being potentially subject to unauthorized collection and/or looting, and one site, a rock art panel, is potentially at risk from vandalism. (Table 6.3.1)

Table 6.3.1 Cultural Resources Potentially at Risk

Site Number	Site Type	Potential Risk
42WS0130	Habitation Site	Possible Looting
42WS1822	Lithic Scatter	Possible Looting
42WS1824	Lithic Scatter	Possible Looting
42WS1825	Lithic Scatter	Possible Looting
42WS2236	Historic Dugway	Erosion
42WS2511	Rock Art	Vandalism
42WS2573	Rockshelter	Erosion
42WS2588	Open Artifact Scatter	Erosion
42WS2621	Open Artifact Scatter	Erosion
42WS2622	Open Artifact Scatter	Erosion
42WS2623	Open Artifact Scatter	Erosion
42WS2627	Open Artifact Scatter	Erosion
42WS2628	Rock Shelter	Erosion
42WS2629	Lithic Scatter	Erosion
42WS2631	Lithic Scatter	Erosion
42WS2632	Lithic Scatter	Erosion
42WS2633	Rock Shelter	Erosion
42WS3987	Open Artifact Scatter	Erosion
42WS4348	Open Artifact Scatter	Possible Looting
42WS4349	Flaked/Ground Stone Scatter	Possible Looting

42WS4350	Open Artifact Scatter	Possible Looting
42WS4353	Flaked/Ground Stone Scatter	Possible Looting
42WS4362	Open Artifact Scatter	Erosion

These sites are located in the following areas: The Dalton Wash Route, the western park boundary in the vicinity of the Dalton Wash Trailhead, the Kolob Terrace (KT) Road between the western park boundary to just above the intersection with Smith Mesa Road, the western park boundary off of Smith Mesa Road, Coalpits Wash and along State Highway 9 above the Virgin River. A reconnaissance survey was conducted between the dates of July 14-18, 2006 to further evaluate the potential risks to these resources. Survey methodology entailed: the re-identification of cultural resources locations, an estimate of post-fire site boundaries (vegetation removal often exposes site constituents that would be otherwise obscured), and verification or negation of potential risks.

C. Findings - During reconnaissance 23 eligible or undetermined sites were visited. Initial assessment indicated the sites in the vicinity of the Dalton Wash route were larger than originally recorded, due in part to exposed ground surface. Sites in other areas of the fire did not exhibit the same level of exposure therefore there was not a noticeable increase in site size. Three (3) types of potential risks were identified: erosion, potential looting, and vandalism (Table 6.3.2).

Table 6.3.2 Cultural Resources Found To Be At Risk

SITE NUMBER	SITE TYPE	CONCERNS	RECOMMENDED TREATMENT	ALTERNANT TREATMENT	SPEC. RELATED
42WS0130	Habitation Site	Possible Looting	Increase Patrol	N/A	No
42WS1822	Lithic Scatter	Possible Looting	Increase Patrol	N/A	No
42WS1824	Lithic Scatter	Possible Looting	Increase Patrol	N/A	No
42WS1825	Lithic Scatter	Possible Looting	Increase Patrol	N/A	No
42WS2511	Rock Art	Vandalism	Replace Sign	No Action	No
42WS2573	Rockshelter	Possible Looting	Install Sign	No Action	No
42WS2621	Open Artifact Scatter	Erosion	Hydromulch	No Action	Yes
42WS2622	Open Artifact Scatter	Erosion	Hydromulch	No Action	Yes
42WS2628	Rockshelter	Erosion	No Action	Check Dams	No
42WS2629	Lithic Scatter	Erosion	Hydromulch	No Action	Yes
42WS2631	Lithic Scatter	Erosion	Hydromulch	Contour Felling	Yes
42WS2632	Lithic Scatter	Possible Looting	Install Sign/Increase Patrol	Hydromulch	No/Yes
42WS4348	Open Artifact Scatter	Possible Looting	Increase Patrol	N/A	No
42WS4349	Flaked/Ground Stone Scatter	Possible Looting	Increase Patrol	N/A	No
42WS4350	Open Artifact Scatter	Possible Looting	Increase Patrol	N/A	No
42WS4353	Flaked/Ground Stone Scatter	Possible Looting	Increase Patrol	N/A	No

Five (5) sites were identified as potentially at risk of erosion. Cultural resource sites within the Dalton Wash Route that are potentially at risk (50% first year) to offsite movement and damage from increased sheet and rill erosion resulting from a change in watershed response resulting from the Kolob Fire. Erosion potential was analyzed for site conditions that occur at cultural resource sites along the Dalton Wash route. Pre-fire and post-fire erosion rates were calculated using the Revised Universal Soil Loss

Equation (calculation included in Appendix A). The post-fire condition that was used included; 3 percent slope, very fine sandy loam surface texture, less than 25 percent rock fragments, and a watershed response classification of high in a pinyon juniper vegetation type (no vegetative cover remaining). The pre-fire erosion rate was calculated to be 0.2 tons/acre/year. The post-fire annual rate of erosion was calculated at 0.8 tons/acre.

Potential treatment alternatives for reducing erosion potential include:

- Rolled erosion control products (i.e., erosion control blankets),
- Hydromulch,
- Straw mulch, and
- Contour felling and lop and scatter of standing dead material.

Treatments to address movement of cultural resource artifacts from current locations into adjacent water conveyance features such as rill, gullies, and ephemeral stream channels include: placement of felled dead material or fiber rolls adjacent to conveyance features to prevent movement of artifacts into the conveyance. The following table (Table 6.3.3) presents costs, effectiveness, and risks of effects on other resources.

Table 6.3.3 Treatment Type Comparison

Treatment	Cost (per Acre)	Effectiveness	Other Effects
Rolled Erosion Control Products			
Biodegradable	\$6,000 to \$12,000	65-95% (Appendix B)	Requires staples to be anchored 6 inches into the soil.
Non-Biodegradable	\$2,000 to \$36,000	50-90 % (Appendix A)	Staples may not be compatible with wilderness values. Requires staples to be anchored 6 inches into the soil. Staples may not be compatible with wilderness values.
Hydromulch	\$1,500 (Truck Application) \$2,000 to \$3,000 (Aerial Application)	97% (SDSU 2002) Reduced sediment yield from 14.93 Mg/ha to 6.78 Mg/ha where applied on the Cedar Fire, Cleveland National Forest (Wohlgemuth et al., 2004)	Netting can trap wildlife. Possible positive benefits to soil microbial activity. May reduce invasive species productivity due to increase in carbon:nitrogen from paper and wood in mulch mix.
Straw Mulch	\$1,800 to \$2,000 (with tackifier)	50-94% (Bautista and others 1996; Faust 1998; Dean 2001; Wagenbrenner 2003)	Risk of invasive species in straw cannot be mitigated.
	\$1,000 to \$1,500	<10%	

Contour Felling	(without tackifier – the method used when apply aerially) \$1000 to \$1500	Effective for low to moderate rainfall intensity storm events. (Robichaud et al., 2003)	Standing dead provides wildlife habitat values.
Lop and Scatter	\$1000 to \$1500	Effectiveness information not available in literature. Effectiveness lower relative to straw mulch and hydromulch because scattered material will result in ground cover that less than (maximum of 40%) due to stocking level of trees.	Standing dead provides wildlife habitat values.
Fiber Rolls	\$5/linear foot	58% (Appendix A)	Wheat straw rolls may be contaminated with invasive species. Netting can trap wildlife.
Placement of Felled Dead Material	\$500 to \$1000	See Contour Felling	Standing dead provides wildlife habitat values.

Hydromulch is the recommended treatment for erosion at four (4) of the sites: 42WS2621, 42WS2622, 42WS2629, and 42WS2631. The basic purpose of hydromulch is to stabilize slopes to reduce the potential for soil movement, and in doing so protect sensitive National Register eligible cultural resources. The sites at which hydromulch is the recommended treatment are both lithic scatters and open artifact scatters containing lithic and ceramic artifacts. These sites are unique in Zion National Park because of their size, relative density of artifacts, and multi-component aspects.

The recommended alternative treatment for these four sites is “no action”. Other treatment options (see Table 6.3.3) were determined to be potentially damaging to the sites through ground disturbing actions or to have a lower cost to benefit ratio.

Site 42WS2628 is a small rockshelter with associated debris. This site is potentially at risk from erosion. Treatment options for this site include placement of check-dams or no action. The recommended treatment for this site is “no action” because it was determined there was a higher potential for damage to the site from placement of the check-dams than from erosion.

Ten (10) sites were identified to be potentially subject to unauthorized collection and/or looting. At eight (8) of the sites the recommended treatment to minimize the potential for unauthorized collection and/or looting is mitigation through increased patrol and site monitoring by Park rangers. These sites include 42WS4348, 42WS4349, 42WS4350, and 42WS4353 along the Kolob Terrace (KT) Road, 42WS1822, 42WS1824, and 42WS1825 near the Dalton Wash route, and 42WS0130 near Coalpits Wash.

Sites 42WS4348, 42WS4349, 42WS4350, and 42WS4353 consist of open artifact scatters containing lithic and ceramic artifacts and flaked and ground stone scatters located adjacent to two popular hiking trails. Treatment has been proposed for seeding and re-vegetation in this area, until the ground cover is re-established consistent patrol and monitoring is needed.

Sites 42WS1822, 42WS1824, and 42WS1825 are lithic scatters along the Park boundary fence near the Dalton Wash route trailhead north of Crater Hill. Artifacts are exposed and may attract the attention of hikers, alerting them to the presence of archeological sites. Increased patrol and monitoring will mitigate possible unauthorized collecting until the vegetation has regenerated.

Site 42WS0130 is a Formative Period habitation site near Coalpits Wash and State Route 9. Increased patrol and monitoring will provide a presence at the site without drawing undue attention. Other treatments, such as sign installation, may have a negative impact by drawing more attention to the site.

At two (2) of the sites identified as potentially subject to unauthorized collection and/or looting the recommended treatment is placement of archeological site/ARPA signs. These two sites are located along the Dalton Wash route. Site 42WS2573 is a rockshelter with associated debris adjacent to the wash. Site 42WS2632 consists of an open artifact scatter containing both prehistoric and historic components. The site is located on a low, flat terrace near Coalpits Wash. Recent use of the flat includes backcountry camp sites. The recommended treatment consists of placement of archeological site/ARPA signs. The alternative treatment of the site is hydromulch. Slope of the site is low therefore, the potential for on-site erosion is minimal. Hydromulch is not the preferred treatment because of the low potential for erosion and the relatively limited use of the area.

One (1) site was identified containing a potential risk for vandalism. The site 42WS2511 is a rock art panel near Coalpits Wash. The non-spec management recommendation is replacement of the existing sign which was damaged during the fire.

IV. RECOMMENDATIONS

Based on the results of the above observations:

A. Emergency Stabilization – Fire Suppression Repair

There were no effects to eligible cultural resources as the result of fire suppression activities

B. Emergency Stabilization

Aerial Hydromulching, C-1. Hydromulch is applied where the pre-burn ground cover was consumed by the fire and the expected overland runoff would threaten values at risk. First year effectiveness includes stabilizing ashes onsite, preventing loss of topsoil, improving infiltration rate and replacing organic litter consumed by the fire. Each mulching area is designated on a map and in an electronic file (Arcview GIS shapefile). Mulching is implemented only on those slopes that are designated by cultural resources and Zion National Park staff. The purpose of the treatment is to protect sensitive National Register eligible cultural resources through slope stabilization. Sites recommended for treatment are: 42WS2621, 42WS2622, 42WS2629, and 42WS2631. This treatment is of the nature that it is covered under the NPS Servicewide Programmatic Agreement as an undertaking that will be reviewed for Section 106 purposes within the NPS, and not require further review by the Advisory Council on Historic Preservation or the State Historic Preservation Officer.

C. Rehabilitation

None.

D. Management Recommendations – Non-Specification Related

- Replace sign at site 42WS2511. The recently installed sign was burned during the fire incident.
- Install a sign alerting visitors to the presence of archaeological resources and the penalties for their disturbance at site 42WS2632. The site is located at the juncture of a

well traveled trail and route. It is currently exposed from the removal of vegetation due to the fire and may be subject to opportunistic unauthorized collection activities. Also increase patrol and monitoring at this location.

- Increase law enforcement patrol and monitoring of eligible archaeological sites 42WS0130, 42WS1822, 42WS1824, 42WS1825, 42WS2573, 42WS2632, 42WS4348, 42WS4349, 42WS4250, and 42WS4253

V. CONSULTATIONS

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VI. REFERENCES

Adler, Douglas D. and Brooks, Karl F.

- 1996 *A History of Washington County: From Isolation to Destination*. Utah Historical Society, Washington County Commission, Salt Lake City.

Altschul, J. H. and Helen C. Fairley

- 1989 *Man, Models and Management: An Overview of the Archeology of the Arizona Strip and the Management of its Cultural Resources*. Report Prepared for USDI Bureau of Land Management. On file, Kaibab National Forest, Fredonia, Arizona, and Bureau of Land Management, Arizona Strip District, St. George, Utah.

Billat, Lorna B., James D. Wilde, and Richard K. Talbot

- 1992 *Archaeological Testing and Excavation of Five Western Anasazi Sites Along State Route 9, East of Virgin City, Utah*. Museum of Peoples and Cultures Technical Series No. 90-20 Brigham Young University, Provo.

Bonnifield, Juanita and Jonathon Walker

- 2003 *Cultural Resource Inventory of the North Creek Burn Unit in Zion National Park, Utah*. SHPO Project Number U-03-NA-0179n. Manuscript on file, Zion National Park, Utah

Ferris, Dawna

- 2001 Historical Overview. In *High-altitude Archeological Investigations at Cedar Breaks National Monument, Utah*. Timothy W. Canaday, author. Cultural Resources Selections Intermountain Region, National Park Service. No. 17.

Frank, Barbara A.

- 1996 *Archeological Survey of a Proposed Fence Line South of Paradise Canyon Ranch on North Creek in Zion National Park*. SHPO Project Number U-96-NA-0191n. Manuscript on file, Zion National Park, Utah

Hansen, Britt J.

- 2000 *Archeological Inventory of the Coalpits Wash Burn Unit in Zion National Park*. SHPO Project Number U-00-NA-0181n. Manuscript on file, Zion National Park, Utah

Hartley, Ralph J.

- 1986 *Archeological Survey Zion National Park, 1985*. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln, Nebraska.

Jennings, Jesse D.

- 1978 *Prehistory of Utah and the Eastern Great Basin*. University of Utah Anthropological Papers, Number 98, Salt Lake City.

Jensen, Chris and Scott Billat

- 2002 *Cultural Resource Inventory of the Torquerville to Springdale Power Line, Phase II, in Zion National Park and Adjacent Lands, Washington County, Utah*. JBR Cultural

Lyneis, Margaret M

- 1990 Buff and Brownwares at Lost City: A Fresh Look at Intrusives. *Nevada Archeologist* 8: 25-34.
- 1994 East and Onto the Plateau? An Archeological Examination of the Numic Expansion in Southern Nevada, Northern Arizona, and Southern Utah. In *Across the West: Human Population Movement and the Expansion of the Numa*, ed. David B. Madsen and David Rohde. Pp 141-149. University of Utah Press, Salt Lake City.

McFadden, Douglas A.

- 1996 Virgin Anasazi Settlement and Adaptation the Grand Staircase. *Utah Archeology* 9:1- 34.

Naylor, Laird P.

- 1993 *Coalpits Wash Helipad and Firing Range Survey*. Rocky Mountain Region Archaeological Project Report. SHPO Project No. U-93-NA-364n.

Schroedl, Alan R.

- 1976 *The Archaic of the Northern Colorado Plateau*. Ph.D. dissertation, Department of Anthropology, University of Utah, Salt Lake City. University Microfilms, Ann Arbor.

Simms, Steven

- 1986 New Evidence for Fremont Adaptive Diversity. *Journal of California and Great Basin Anthropology* 8:204-216.

Steward, Julian H.

- 1970 The Foundations of Basin-Plateau Shoshonean Society. In *Languages and Cultures of Western North America: Essays in honor of Sven S. Liljeblad*, Caldwell, Idaho.

Thompson, Richard A. and Georgia B. Thompson

- 1982 *The Prehistory and Environment of Southwest Utah*. Ms. Intersearch, Cedar City, Utah.

Walling, Barbara A.

- 1994 *Crater Hill Survey*. Rocky Mountain Region Archaeological Project Report. SHPO Project No. U-92-IG-603n. On File, Zion National Park, Utah.

Walling, Barbara A. and Richard A. Thompson

- 1988 *Western Kolob Terrace Boundary Fence Survey*. SHPO Project Number U-88IG-378n. Manuscript on file, Zion National Park, Utah.

Walling, Barbara A., Richard A. Thompson, Gardiner F. Dalley, and Dennis G. Weder

- 1986 *Excavations at Quail Creek*. Utah Bureau of Land Management Cultural Resource Series No. 20, Salt Lake City.

Altschul, J. H. and Helen C. Fairley

- 1989 *Man, Models and Management: An Overview of the Archeology of the Arizona Strip and the Management of its Cultural Resources*. Report Prepared for USDI Bureau of Land Management. On file, Kaibab National Forest, Fredonia, Arizona, and Bureau of Land Management, Arizona Strip District, St. George, Utah.

Jennings, Jesse D.

- 1978 *Prehistory of Utah and the Eastern Great Basin*. University of Utah Anthropological Papers, Number 98, Salt Lake City.

Lyneis, Margaret M

- 1990 Buff and Brownwares at Lost City: A Fresh Look at Intrusives. *Nevada Archeologist* 8: 25-34.

- 1994 East and Onto the Plateau? An Archeological Examination of the Numic Expansion in Southern Nevada, Northern Arizona, and Southern Utah. In *Across the West: Human Population Movement and the Expansion of the Numa*, ed. David B. Madsen and David Rohde. Pp 141-149. University of Utah Press, Salt Lake City.
- McFadden, Douglas A.
1996 Virgin Anasazi Settlement and Adaptation the Grand Staircase. *Utah Archeology* 9:1- 34.
- Schroedl, Alan R.
1976 *The Archaic of the Northern Colorado Plateau*. Ph.D. dissertation, Department of Anthropology, University of Utah, Salt Lake City. University Microfilms, Ann Arbor.
- Simms, Steven
1986 New Evidence for Fremont Adaptive Diversity. *Journal of California and Great Basin Anthropology* 8:204-216.
- Steward, Julian H.
1970 The Foundations of Basin-Plateau Shoshonean Society. In *Languages and Cultures of Western North America: Essays in honor of Sven S. Liljeblad*, Caldwell, Idaho.
- Thompson, Richard A. and Georgia B. Thompson
1982 *The Prehistory and Environment of Southwest Utah*. Ms. Intersearch, Cedar City, Utah.
- Walling, Barbara A., Richard A. Thompson, Gardiner F. Dalley, and Dennis G. Weder
1986 *Excavations at Quail Creek*. Utah Bureau of Land Management Cultural Resource Series No. 20, Salt Lake City.

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**Kolob Fire
Burned Area Emergency Rehabilitation Team
Cultural Assessment**

Appendix A



Dalton Wash Route at Confluence with Coalpits Wash. High Watershed Response in selected locations have put cultural resources at high risk from erosion.



Overview of burned over archaeological site showing denuded landscape and unstable soils.



Rock Shelter (bottom right) exposed after fire may be vulnerable to looting or unauthorized surface collection.



Burned over Cheatgrass still functioning to obscure artifacts on site

**INTERAGENCY
BURNED AREA EMERGENCY STABILIZATION & REHABILITATION PLAN**

KOLOB FIRE

I-B: SOIL AND WATERSHED RESOURCE ASSESSMENT

B. OBJECTIVES

- Assess overall watershed changes 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 soil conditions, hydrologic function, and watershed response to precipitation events,
- Develop maps of soil burn severity and watershed response,
- Identify potential flood and erosion source areas,
- Identify potential threats to life, property, cultural, and natural resources in relation to flood and erosion source areas,
- Develop treatment recommendations if necessary, and
- Identify future monitoring needs.

C. ISSUES

- Potential threats to human life and property within and downstream of the Kolob Fire from potential increases in overland flow that could cause accelerated surface erosion, debris flows, and flooding. The values at risk include homes on private property, bridges, trails and routes (unmaintained trails) within and downstream of the fire.
- Changes in water quality within and downstream of the fire due to increased suspended sediment and ash from increased soil erosion within the fire areas.

D. OBSERVATIONS

Background

1. Geology/Physiography

The Kolob Fire is located in northeastern Washington County, Utah. The landscape is characterized by highly eroded badlands, steep rock land that includes areas of shallow soils and nearly vertical sandstone cliffs, mesas, incised canyons with relatively narrow floodplains and stream terraces, and volcanic cinder cones and basalt lava flows. Elevation ranges from about 3,500 feet near State Route 9 at the southern end of the fire to about 6,500 feet in the northeastern part of the fire.

The geologic formations were created during the formation of the Colorado Plateau during the Mesozoic era. Originally created from ancient sediments, the major formations that occur within the fire from oldest to youngest are: Chinle, Moenave, Kayenta, Navajo, Temple Cap, Quaternary

basalt flows and cinder cones, and Quaternary slide deposits. The Quaternary slide deposits include fragmented rock fall debris and talus materials cemented with calcite. Holocene (recent) alluvium deposits occur in channels, floodplains and on stream terraces.

2. Soils

The Washington County Area, Utah soil survey was used to obtain information on soils (USDA 1977). There are 22 soil map units that occur within the fire (Table 1).

Table 1. Soil map units within the Kolob Fire

Soil Type	% of soil within fire	Slope %	Pre-fire Water Erosion Hazard
Rock land, stony	20	30-70	moderate
Mathis-Rock outcrop complex	18	20-50	severe
Rock outcrop	10	variable	moderate
Clovis-Pastura complex	9	1-10	moderate
Stony colluvial land	9	30-70	moderate
Bond sandy loam	8	1-10	moderate
Clovis fine sandy loam	5	1-5	moderate
Veyo-Pastura complex	5	1-10	slight
Badland, very steep	4	>30	very high
Naplene silt loam	2	2-6	moderate
Cinder land	2	variable	moderate
Magotsu-Pastura complex	2	2-20	moderate
Badland	1	variable	very high
Rock land	1	variable	moderate
Spenlo very fine sandy loam	1	2-10	moderate
Pastura-Esplin complex	1	0-10	moderate
Fluvaquents and Torrifluvents, sandy	<1	variable	severe
Collbran very cobbly clay loam	<1	2-30	moderate
Gravel pits	<1	variable	slight
Gullied land	<1	variable	severe
Palma fine sandy loam	<1	1-5	moderate
Mespu fine sand	<1	0-10	moderate

Below are brief descriptions of the major soil map units that occur over more than 5 percent of the Kolob Fire area:

Rock land, stony and Rock outcrop: Consists of stony and bouldery soils with sandstone outcrops and cliffs. Stones and boulders are commonly underlain by sand, shale, or siltstone and weathered rock. Soil development is minor due to continual deposits of material from higher lying slopes. Rock outcrops are mostly sandstone, limestone, conglomerate, or basalt.

Mathis-Rock outcrop complex: Consists of somewhat excessively drained soils on severely eroded, dissected mountain side slopes and mesa remnants. Surface soil is typically very stony loamy fine sand with sandstone bedrock at a depth of about 30 inches.

Clovis-Pastura complex: Occurs mainly on old basalt mesas with the Clovis soil on gently sloping swales and Pastura soil on ridges and steeper slopes.

Stony colluvial land: Consists of unconsolidated colluvial land covered with stones and rock fragments. Shale bedrock is generally at a depth of less than 12 inches. There are a few small areas of shallow soils.

Bond sandy loam: Consists of shallow, well-drained soils on high, broad mesa tops. Soils formed in residuum weathered from conglomerate and sandstone.

3. Climate

Washington County is characterized by an arid climate. Average annual precipitation in the Kolob Fire area is approximately 11 inches. The rainfall occurs in two distinct seasons: 1) early winter and spring when storms from the Pacific Ocean move across the intermountain area, and 2) throughout summer when thunderstorms develop from moist air moving northward across the region from the Gulf of Mexico.

4. Hydrology

The fire area drains to the Virgin River that is located at the southern edge of the fire. Tributaries of the Virgin River that are within the fire include ephemeral streams named Coal Pits Wash, Dalton Creek, and Black Wash. One perennial stream, North Creek, runs north-south through the middle of the fire and has several unnamed ephemeral channels that drain to North Creek. Two streams, Right Fork North Creek and Left Fork North Creek, join to form North Creek within the fire.

There are two different flow regimes that occur in the fire area; winter precipitation events that are generally long duration, low intensity storms that produce gradual rises in streamflow, and short-duration, high intensity thunderstorms that can result in rapid rises in streamflow and flash flooding.

Methodology

The purpose of this assessment is to determine if the fire caused emergency watershed conditions and if there are values at risk from these conditions. 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 values at risk. Emergency watershed conditions include both hydrologic and soil factors; typically potential for increased flooding and sedimentation and deterioration of soil condition, particularly loss of soil cover, leading to erosion and changes in hillslope hydrologic function resulting decreased infiltration rates.

The BAER Team hydrologist and soil scientist conducted aerial reconnaissance flights and field visits to review resource conditions after the fire. The objectives of the field visits were to:

- 1) develop soil burn severity and watershed response maps;
- 2) identify and inventory values-at-risk,
- 3) identify the watershed conditions that are creating risks;
- 4) review channel morphology and riparian conditions;
- 5) assess hillslope conditions; and
- 6) determine needs for emergency stabilization.

Values-at-risk are properties and capital improvements located within or downstream of the fire that may be subject to damage from flooding, ash, mud and debris deposition, and hillslope erosion. Values-at-risk for the Kolob Fire include:

- Private property including homes
- Aquatic species
- Routes and trails
- Roads and bridges

1. Satellite Mapping Using Burned Area Reflectance Classification Map

A Burned Area Reflectance Classification (BARC) map is a satellite derived map of post-fire condition that classifies the burned area into unburned, low, moderate and high. The satellite image was taken by Landsat 5 on July 8, 2006 and the image was initially classified using bands 7, 4, and 3 in positions 1, 2, and 3. The BARC map was verified by field visits and helicopter reconnaissance, and changes were made to the initial BARC classification based on GPS points and field data to produce the final soil burn severity and watershed response maps. The field forms that were used to record site specific information at seven BARC verification GPS points are included in Appendix A and also shown on the Analysis Watersheds Map in Appendix B. The watershed response map was used to predict the runoff response of the watersheds and rates of erosion.

2. Soil Burn Severity

Soil burn severity is not the same concept as fire intensity and fire severity as recognized by fire behavior specialists. Fire intensity and fire severity relate to fire behavior and fire effects on overstory and understory vegetation, respectively, while soil burn severity relates specifically to effects of the fire on soil conditions. Although soil burn severity is not primarily a reflection of fire effects on vegetation, vegetative conditions and pre-fire vegetation density are among the indicators used to assess soil burn severity.

Soil burn severity parameters include changes in litter and duff (vegetative ground cover), loss of soil structure, destruction of fine and very fine roots in the surface horizon, and development of hydrophobic (water repellent) soil surfaces. In some cases there may be complete consumption of vegetation by fire with little effect on soil. In general, the denser the pre-fire duff and litter layer and the longer the residence time of the fire, the more severe the effects are on soil. For example, deep ash after a fire usually indicates a deeper litter layer prior to the fire, which generally supports longer residence times.

3. Watershed Response

The major determining factor influencing runoff and erosion from burned hillslopes is the amount of disturbance to the vegetative groundcover that protects the underlying mineral soil (Robichaud 2000). The unburned forest floor (vegetative groundcover) 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 in excess of 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 a 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.

Overland flow is also influenced by the fire induced water repellency or hydrophobicity of 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. Infiltration increases with time because the hydrophobic substances responsible for water repellency 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).

Raindrops striking exposed mineral soil with sufficient force can dislodge soil particles and small aggregates. Once soil particles are detached by splash erosion they are more easily transported in overland flow. Surface erosion is defined as the movement of individual soil particles by a force, and is initiated by the planar removal of material from the soil surface (sheet erosion) or by concentrated removal of material in a downslope direction (rill erosion). Surface erosion is a function of four factors: 1) susceptibility of the soil to detachment, 2) magnitude of external forces (raindrop impact or overland flow), 3) the amount of protection available by material that reduces the magnitude of the external force, and 4) the management of the soil that makes it less susceptible to erosion (Foster 1982, Megahan 1986).

Cannon et al. 2000 found that the generation of debris flows at Storm King Mountain, Colorado started with significant sheetwash, rill, and rainsplash erosion and transport of burned mineral soil and dry-ravel materials from hillslopes high within contributing areas. The majority of the debris flows from Storm King Mountain initiated in 0 - and 1st order channels and hollows.

The watershed response map in the Map Volume includes four classifications that are similar to the soil burn severity classification – unburned, low, moderate, and high. The watershed response classes are based upon the primary factor driving watershed response - the condition of the ground cover and soils and the condition of the canopy. The classes are as follows:

Low watershed response	<30% mineral soil, ash and rock >1 inch and >70% canopy intact
Moderate watershed response	30%-70% mineral soil, ash and rock >1 inch 30%-70% canopy intact
High watershed response	>70% mineral soil, ash and rock >1 inch <30% canopy intact

4. Erosion Potential Modeling

Erosion potential was calculated using the Revised Universal Soil Loss Equation (RUSLE) in a spatially based ArcView model. The model predicts erosion in tons per acre per year averaged over a 10 meter square spatially (due to use of a 10 meter Digital Elevation Model provided by Zion National Park staff). The Cedar City Bureau of Land Management office provided the GIS vegetation layer. The GIS soil layer came from the Natural Resources Conservation Service SSURGO database and is based on the Washington County Area soil survey (USDA 1977).

The RUSLE equation: $A = R * K * LS * C$

A is the annual soil loss expected in tons/acre, R is the rainfall factor, K is the soil erodibility value, LS is the slope factor accounting for slope length and step effect, and C is the cover factor. The precipitation value for the 2-year 6-hour storm in the Kolob Fire area is 0.98 inches, which was used to determine the rainfall factor. The LS factor is incorporated spatially using a Digital Elevation Model. C factors were calculated for each different vegetation type in conjunction with burn severity (i.e., a polygon of pinyon/juniper woodland classified as moderate watershed response is attributed with a different cover factor than a polygon of pinyon/juniper woodland classified as high watershed response). C factors are determined using a series of inputs including percent bare soil, amount of root mat in the soil surface, and canopy height. The watershed response classification (not soil burn severity) was used to develop C factors.

5. Pre and Post-Fire Flow Modeling

Pre and post-fire flows were modeled using a modified Rational Equation run in the ArcView software environment. The model has been used to calculate peak flows for fire ranging in size from 2,500 acres to 100,000 acres using a modified Rational Formula. The modified Rational

Formula was originally intended to accurately calculate peak flows for watersheds up to 640 acres in size. The primary reasons for the size limitation of the modified Rational Formula are the assumption that rainfall is distributed equally over the entire watershed and the lack of a flow routing component. This model has accurately predicted post-fire flows for watersheds up to 5,000 acres in size. Absolute peak flow values for watershed greater than 5,000 acres should be used with caution, however the increase in post-fire peak flows relative to pre-fire peak flows for watersheds greater than 5,000 acres can be used to evaluate post-fire flow conditions.

The peak flow rate is calculated using the following equation:

$$Q = C' I A$$

Q = peak flow rate (cubic feet per second)

I = rainfall intensity (inches per hour)

C' = runoff coefficient calculated as described below (dimensionless)

A = drainage area (acres)

Rainfall Intensity

Precipitation values used in the flow modeling were downloaded from the NOAA Precipitation Frequency Estimates Server and are included in Appendix A.

Time of Concentration

$$T_c = 0.60 \times T_L$$

where:

T_c = the time of concentration (hours)

T_L = the lag time (hours)

Lag time is calculated using the following method developed by the Natural Resources Conservation Service:

$$T_L = (L^{0.8} (S_c + 1)^{0.7}) / (1900 \times S^{0.5})$$

where:

T_L = lag time (hours)

L = greatest flow length in watershed (feet)

S_c = Storage coefficient = 1000/CN – 10 (inches)

CN = Curve number

S = Average watershed slope (percent)

Flow length and average watershed slope are calculated from the DEM and grids derived from the DEM. Curve number is input as a grid.

Runoff Coefficient

$$C' = C + C_s + C_i$$

$$C_s = ((0.8 - C) [\ln(S - 1)] S^{0.5}) / 56$$

$$C_i = \frac{1}{[0.80 - (C + C_s)] \times [1 - 1 + \ln(i + 1)] e^i}$$

where:

C' = runoff coefficient

C = base runoff coefficient

C_s = slope adjustment factor

C_i = rainfall intensity adjustment factor

S = average ground slope of the incremental drainage (percent)

i = rainfall intensity (inches/hour)

The slope adjustment factor accounts for the fact that steeper slopes generate higher flows than shallow slopes. The intensity factor accounts for more intense storms producing more runoff.

The pre-fire and post-fire curve numbers were selected from the Flow Model Curve Number Table (Appendix A) which was correlated to vegetation types within the fire areas. Pre-fire runoff coefficients are based upon the unburned runoff coefficient in Table 3. The unburned coefficient was derived from a conifer vegetation type and all other runoff coefficients are relative to the unburned conifer condition. For example, conifer has a natural unburned runoff coefficient of 0.10 where as chaparral has a runoff coefficient of 0.13 because the litter layer produced by chaparral vegetation can store less water relative to the litter and duff layer of a conifer forest.

The post-fire runoff coefficients (Table 4) used in the model were determined from research conducted at experimental plots in the Bitterroot National Forest (Robichaud 2000). Hydraulic conductivity rates in mm/hr were measured from simulated rainfall events applied several days after a prescribed burn. The simulator rained at a rate of 94 mm/hr on randomly located one meter square plots on natural (unburned), low severity, high severity, and high severity plus strongly hydrophobic soil plots, with three replications. Hydraulic conductivity rates (K) were reported as a range of values but the lowest number in each range for varying burn severity type was used to calculate the runoff coefficient. K values were subtracted from the total simulated rainfall to determine the amount of runoff and then divided by the rainfall rate to calculate percent runoff. Moderately burned areas were extrapolated from the low and high severity values.

Table 3. Unburned Runoff Coefficients

Veg Name	Coefficient
Altered or Disturbed Land	0.20
Barren Land	0.70
Deciduous Forest	0.12
Developed Land	0.70
Agricultural Land	0.30
Evergreen Forest	0.12
Grassland/Herbaceous	0.20
Mixed Forest	0.10
Shrub/Scrub	0.25
Woody Wetland	0.10

Table 4. Post-Fire Runoff Coefficients

Plot	K (mm/hr)	Runoff rate (mm/hr)	% Runoff / Runoff coefficient
Natural (unburned)	85	9	10/0.10
Low	60	34	36/0.36
Moderate	43	52	55/0.55
High	25	69	73/0.73

Flows were bulked to account for sediment and debris that could be entrained in the post-fire peak flows. Post-fire peak flows for areas of high watershed response were increased 150%.

Moderate watershed response area flows were increased 100% and low watershed response areas were increased 30%. The bulking equation is as follows:

Post-fire peak flow (cfs) + (Post-fire peak flow (cfs) x % of high watershed response area x 1.5) + (Post-fire peak flow (cfs) x % of moderate watershed response area x 1.0) + (Post-fire peak flow (cfs) x % of low watershed response area x 0.3)

Pre and post-fire flows were modeled for several watersheds (Appendix B – Analysis Watersheds Map).

Findings

1. Soil Burn Severity and Watershed Response

Table 5 displays a summary of soil burn severity and watershed response acres and percentages for the Kolob Fire. Soil burn severity and watershed response maps are included in the BAER Assessment.

Table 5. Soil Burn Severity and Watershed Response

Soil Burn Severity (acres/% of fire)			Watershed Response (acres/% of fire)		
High	161	1	High	9,018	51
Moderate	8,366	47	Moderate	4,730	27
Low	6,261	36	Low	1,931	11
Unburned	2844	16	Unburned	1,953	11
Total	17,632	100	Total	17,632	100

Grasslands and areas of sparse vegetation provided little to burn and very short fire residence times, thus soil properties were not significantly altered. These areas are classified as low soil burn severity. Low soil burn severity in shrub/scrub or pinyon/juniper vegetation is characterized by remaining litter and duff, some of which may be charred but not entirely consumed, and vegetation is generally mostly green and expected to survive.

Areas of moderate severity are characterized by partial consumption of litter and duff, and tree crowns are a mix of green and brown. Trees and shrubs with brown leaves/needles will provide leaf/needle cast that will act as a ground cover, providing protection from erosion and raindrop impact, help reduce runoff velocity, and promote infiltration. A thin layer of water repellency was observed in areas of moderate soil burn severity. Surface soil structure and fine and very fine roots were mostly intact. Post-fire runoff and erosion are expected to increase over pre-fire levels until the vegetation recovers.

High soil burn severity areas showed the effects of longer periods of intense heat as observed by the complete loss of organic surface materials, most commonly directly underneath the canopy of pinyon and juniper trees. Water repellency was noted at the soil surface. Soil structure does not appear to have been altered. Some fine and very fine roots remain in the surface soil. Post-fire runoff and erosion are expected to increase significantly over pre-fire levels due to the loss of ground cover.

The primary watershed response of the Kolob Fire is expected to include: 1) an initial flush of ash; 2) sediment delivery and deposition in low gradient stream reaches and 3) increases in peak flows that could potentially cause flooding downstream of the fire. Debris and mud flows may also occur. The potential for increased peak flows, debris and mud flows, and sediment deposition will be the highest during the monsoon rainy season, winter rains and rain-on-snow events the first winter after the fire. Vegetation recovery is expected to be rapid with annual forbs and grasses providing cover in the early spring. By the second winter season, annual forbs and grasses and sprouting vegetation should provide sufficient cover to reduce watershed response from high to moderate or low, as sprouting vegetation begins to produce brush crowns and a thin duff/litter layer.

Infiltration rates and watershed response and soil burn severity were evaluated at seven locations within the Kolob Fire (Appendix B – Analysis Watersheds). Data collected at each site is included in Appendix A. Infiltration rates ranged from 0.01 cm/sec at B4 to 0.05 cm/sec at B6.

Photos showing examples of low, moderate, and high soil burn severity and watershed response classes are included in Appendix C.

2. Erosion Potential

Soils within the fire occurring on steep slopes and in areas of moderate and high watershed response have a high potential for accelerated rill and sheet erosion during precipitation events. Sediment generated from slopes classified as moderate and high watershed response has the

potential to be delivered to waterways, causing bulked water flows during flood events. Burned areas are also more susceptible to wind erosion than pre-fire conditions due to a loss vegetative groundcover.

The results of the RUSLE model are presented on the Erosion Potential Map (in the Kolob Fire BAER Plan Maps). Two categories of erosion rates occur both pre- and post-fire: high rates of erosion occur on the steep side slopes and areas of shallow soils and rock outcrop, and flatter areas (generally less than 10 percent slope) such as mesa tops and stream terraces have low rates of erosion naturally since erosion is driven predominately by percent slope.

The RUSLE model was run for unburned conditions, and then run again for post-fire conditions. The ArcView grid of pre-fire erosion rates was subtracted from the post-fire grid of erosion rates. The results of this subtraction, which are presented on the Erosion Potential Map, show the potential increase in rates of erosion in the first year after the fire. Erosion rates increase in the steeper areas from 1 ton/acre annually to over 25 tons/acre annually. In the flatter areas, erosion rates could increase from 0.1 tons/acre to about 5 tons/acre due to the fire depending on the severity of the fire and resulting watershed response classification. As presented on the Erosion Potential map, the areas dominated by rock (rock outcrop and boulders, stones, etc.) show rates of erosion over the entire area that is predominately rock, but the erosion calculated for these areas only applies to the limited soil that occurs on the surface slope; so erosion rates in the steep, rocky areas would be considerably less than is visually indicated on the map.

3. Peak Flows and Sediment Delivery

Pre-fire and post-fire watershed parameters that influence peak runoff are shown in Table 6a and Table 6b. Pre-fire and post-fire peak runoff numbers are shown in Table 7. These tables illustrate predicted changes in peak runoff that could result from burned hillslopes. Flood peak increases at the large watershed scale (e.g. North Creek) are less than 10%. At smaller scales, 200 acres to 15,000 acres, flood peak increases range from 13% to 69%.

Sediment delivery was not calculated for the Kolob Fire. However, sediment delivery is expected to increase in response to post-fire rainfall events. Increases in sediment delivery will be in response to increased sheet, rill, and gully erosion on hillslopes with moderate and high watershed response and the occurrence of debris flows.

Debris flows are frequently produced in response to convective thunderstorm activity over basins burned by wildfire (Parrett 1987, Meyer & Wells 1997, Cannon 2001), as well as in response to winter frontal storms (Morton 1989, Cannon 2000). Debris flows pose a hazard distinct from other sediment-laden flows because of their unique destructive power; debris flows can occur with little warning, can exert great impulsive loads on objects in their paths, and even small debris flows can strip vegetation, block drainage ways, damage structures, and endanger human life.

Cannon (et al. ,2003) found that nearly 70 percent of the debris-flow generating storms for the Coal Seam and Missionary Ridge fires of 2002 were of durations equal to or less than 2 hours, and 93 percent of these had recurrence intervals of less than or equal to 2 years. The average intensities of the debris-flow triggering storms ranged between 0.04 and 0.67 inches/hour, (1.0 and 17.0 mm/hr) with 10-minute peak intensities up to 2.46 inches/hour (62.5 mm/hr). Robichaud (2002) found that debris flows were likely to initiate when rainfall intensities exceeded 0.15 inches in 30 minutes.

Cannon (et al., 2003) reported that debris flows were produced from basins underlain by interbedded sandstones, siltstones, and conglomerates, and from basins underlain by gneissic quartz monzonite and quartzite. The dominant geologic types within the Kolob Fire (see Geology section above) are similar to the geologic types reported by Cannon and therefore debris flow potential is high within the Kolob Fire area.

Flood, debris and mud flow potential and sediment delivery will decrease as hillslopes re-vegetate and groundcover increases, providing organic matter to the forest floor that will gradually increase soil infiltration capacity and hillslope roughness, thereby reducing overland flow.

Table 6a. Watershed Parameters

Watershed	Acres	Pre-FireTime of Concentration (hrs)	Post-FireTime of Concentration (hrs)	Average Slope %	Pre-Fire Average Curve Number	Post-Fire Average Curve Number	Pre-Fire Average Runoff Coefficient	Post-Fire Average Runoff Coefficient
North Creek at Sunset Ranch	38,137	4.4	4.0	44	69	73	0.24	0.30
North Creek at Kolob Rd	41,623	3.9	3.4	42	68	73	0.24	0.31
North Creek at Staples Ranch	61,637	4.6	4.2	35	65	68	0.22	0.28
North Creek at Highway 9	64,343	4.6	4.3	35	65	68	0.23	0.26
Unnamed Creek N of Crater Hill	245	2.0	0.7	12	49	86	0.16	0.72
Upper Coal Pits Wash	12,726	2.5	2.0	56	63	72	0.21	0.35
Dalton Wash at Highway 9	4,224	3.3	2.5	19	66	75	0.27	0.39
Coal Pits at Highway 9	13,830	2.9	2.3	54	65	73	0.22	0.36
Black Wash	3,286	3.4	2.3	25	57	72	0.17	0.43
Right Great Fork	10,228	1.6	1.4	67	77	81	0.26	0.38
Left Great Fork	25,624	4.4	4.2	35	68	70	0.25	0.25

Table 6b. Watershed Response

Watershed	Acres	Low Watershed Response (Acres)	Moderate Watershed Response (Acres)	High Watershed Response (Acres)	High Watershed Response	Moderate Watershed Response	Low Watershed Response	Burned	Unburned
North Creek at Sunset Ranch	38,137	363	815	2,695	7%	2%	1%	10%	90%
North Creek at Kolob Rd	41,623	642	1,435	3,724	9%	3%	2%	14%	86%
North Creek at Staples Ranch	61,637	705	1,577	3,939	6%	3%	1%	10%	90%
North Creek at Highway 9	64,343	705	1,577	3,939	6%	2%	1%	10%	90%
Unnamed Creek N of Crater Hill	245	2	9	234	95%	4%	1%	100%	0%
Upper Coal Pits Wash	12,726	489	1,029	2,391	19%	8%	4%	31%	69%
Dalton Wash at Highway 9	4,224	292	564	672	16%	13%	7%	36%	64%
Coal Pits at Highway 9	13,830	699	1,267	2,650	19%	9%	5%	33%	67%
Black Wash	3,286	277	612	1,017	31%	19%	8%	58%	42%
Right Great Fork	10,228	182	377	1,572	15%	4%	2%	21%	79%
Left Great Fork	25,624	16	48	88	0%	0%	0%	1%	99%

Table 7. Discharge Analysis

Watershed	Acres	Pre-Fire 2yr15min Discharge (cfs)	Post-Fire 2yr15min Discharge (cfs)	Post-Fire 2yr15min Bulked (cfs)	Increase in Flow (Bulked Flow relative to Pre-Fire Flow)
North Creek at Sunset Ranch	38,137	28,850	31,989	33,974	6%
North Creek at Kolob Rd	41,623	30,942	34,633	37,506	8%
North Creek at Staples Ranch	61,637	42,784	49,443	52,400	6%
North Creek at Highway 9	64,343	45,081	51,520	54,472	6%
Unnamed Creek N of Crater Hill	245	114	166	280	69%
Upper Coal Pits Wash	12,726	10,219	11,351	13,391	18%
Dalton Wash at Highway 9	4,224	2,635	3,019	3,599	19%
Coal Pits at Highway 9	13,830	10,999	12,194	14,512	19%
Black Wash	3,286	1,888	2,463	3,267	33%
Right Great Fork	10,228	9,085	9,564	10,804	13%
Left Great Fork	25,624	18,098	20,443	20,514	0%

Watershed	Acres	Pre-Fire 5yr15min Discharge (cfs)	Post-Fire 5yr15min Discharge (cfs)	Post-Fire 5yr15min Bulked (cfs)	Increase in Flow (Bulked Flow relative to Pre-Fire Flow)
North Creek at Sunset Ranch	38,137	40,895	42,816	45,473	6%
North Creek at Kolob Rd	41,623	43,949	46,703	50,578	8%
North Creek at Staples Ranch	61,637	61,277	64,501	68,358	6%
North Creek at Highway 9	64,343	64,492	66,327	70,127	6%
Unnamed Creek N of Crater Hill	245	173	358	603	69%
Upper Coal Pits Wash	12,726	14,388	15,728	18,554	18%
Dalton Wash at Highway 9	4,224	3,827	4,480	5,341	19%
Coal Pits at Highway 9	13,830	15,503	17,025	20,261	19%
Black Wash	3,286	2,775	3,761	4,989	33%
Right Great Fork	10,228	12,657	13,375	15,108	13%
Left Great Fork	25,624	25,865	26,030	26,120	0%

Watershed	Acres	Pre-Fire 10yr15min Discharge (cfs)	Post-Fire 10yr15min Discharge (cfs)	Post-Fire 10yr15min Bulked (cfs)	Increase in Flow (Bulked Flow relative to Pre-Fire Flow)
North Creek at Sunset Ranch	38,137	75,109	77,770	82,596	6%
North Creek at Kolob Rd	41,623	81,027	84,842	91,880	8%
North Creek at Staples Ranch	61,637	114,718	119,184	126,312	6%
North Creek at Highway 9	64,343	120,482	123,023	130,072	6%
Unnamed Creek N of Crater Hill	245	358	614	1,036	69%
Upper Coal Pits Wash	12,726	26,091	27,947	32,968	18%
Dalton Wash at Highway 9	4,224	7,346	8,251	9,835	19%
Coal Pits at Highway 9	13,830	28,169	30,278	36,033	19%
Black Wash	3,286	5,434	6,800	9,021	33%
Right Great Fork	10,228	22,483	23,477	26,520	13%
Left Great Fork	25,624	48,232	48,461	48,629	0%

Table 7. Discharge Analysis

Watershed	Acres	Pre-Fire 2yr1hour Discharge (cfs)	Pre-Fire 2yr1hour Discharge (cfs)	Post-Fire 2yr1hour Bulked (cfs)	Increase in Flow (Bulked Flow relative to Pre-Fire Flow)
North Creek at Sunset Ranch	38,137	11,342	12,050	12,797	6%
North Creek at Kolob Rd	41,623	12,126	13,141	14,231	8%
North Creek at Staples Ranch	61,637	16,556	17,743	18,805	6%
North Creek at Highway 9	64,343	17,476	18,152	19,192	6%
Unnamed Creek N of Crater Hill	245	40	108	182	69%
Upper Coal Pits Wash	12,726	4,058	4,552	5,369	18%
Dalton Wash at Highway 9	4,224	998	1,238	1,476	19%
Coal Pits at Highway 9	13,830	4,361	4,922	5,857	19%
Black Wash	3,286	701	1,065	1,412	33%
Right Great Fork	10,228	3,664	3,929	4,438	13%
Left Great Fork	25,624	7,027	7,088	7,112	0.3%

Watershed	Acres	Pre-Fire 5yr1hour Discharge (cfs)	Pre-Fire 5yr1hour Discharge (cfs)	Post-Fire 5yr1hour Bulked (cfs)	Increase in Flow (Bulked Flow relative to Pre-Fire Flow)
North Creek at Sunset Ranch	38,137	15,688	16,636	17,668	6%
North Creek at Kolob Rd	41,623	16,784	18,143	19,649	8%
North Creek at Staples Ranch	61,637	22,977	24,568	26,037	6%
North Creek at Highway 9	64,343	24,245	25,150	26,591	6%
Unnamed Creek N of Crater Hill	245	56	148	249	69%
Upper Coal Pits Wash	12,726	5,601	6,262	7,388	18%
Dalton Wash at Highway 9	4,224	1,391	1,713	2,042	19%
Coal Pits at Highway 9	13,830	6,021	6,773	8,060	19%
Black Wash	3,286	982	1,469	1,948	33%
Right Great Fork	10,228	5,041	5,395	6,095	13%
Left Great Fork	25,624	9,745	9,827	9,861	0%

Watershed	Acres	Pre-Fire 10yr1hour Discharge (cfs)	Post-Fire 10yr1hour Bulked (cfs)	Post-Fire 10yr1hour Bulked (cfs)	Increase in Flow (Bulked Flow relative to Pre-Fire Flow)
North Creek at Sunset Ranch	38,137	19,781	20,933	22,232	6%
North Creek at Kolob Rd	41,623	21,178	22,830	24,724	8%
North Creek at Staples Ranch	61,637	29,079	31,013	32,868	6%
North Creek at Highway 9	64,343	30,671	31,772	33,592	6%
Unnamed Creek N of Crater Hill	245	73	184	310	69%
Upper Coal Pits Wash	12,726	7,046	7,849	9,260	18%
Dalton Wash at Highway 9	4,224	1,770	2,161	2,576	19%
Coal Pits at Highway 9	13,830	7,577	8,490	10,104	19%
Black Wash	3,286	1,255	1,847	2,450	33%
Right Great Fork	10,228	6,318	6,749	7,623	13%
Left Great Fork	25,624	12,324	12,423	12,466	0%

Table 7. Discharge Analysis

Watershed	Acres	Pre-Fire 2yr6hour Discharge (cfs)	Post-Fire 2yr6hour Discharge (cfs)	Pre-Fire 2yr6hour Bulked (cfs)	Increase in Flow (Bulked Flow relative to Pre-Fire Flow)
North Creek at Sunset Ranch	38,137	3,053	3,249	3,451	6%
North Creek at Kolob Rd	41,623	3,262	3,543	3,837	8%
North Creek at Staples Ranch	61,637	4,442	4,771	5,057	6%
North Creek at Highway 9	64,343	4,691	4,878	5,158	6%
Unnamed Creek N of Crater Hill	245	10	29	49	69%
Upper Coal Pits Wash	12,726	1,095	1,231	1,453	18%
Dalton Wash at Highway 9	4,224	266	333	397	19%
Coal Pits at Highway 9	13,830	1,176	1,331	1,584	19%
Black Wash	3,286	187	287	381	33%
Right Great Fork	10,228	991	1,065	1,203	13%
Left Great Fork	25,624	1,887	1,904	1,910	0%

Table 8 summarizes the chance of various return interval events occurring within 7 years after the fire. This "Risk" analysis evaluates the chance that an event of "T" recurrence interval will be equaled or exceeded in "n" years after the fire.

Table 8. Summary of "Risk" of Equal or Exceeded Recurrence Intervals within a 7-Year Period

Return Interval "T"	Risk within 1 year	Risk within 2 years	Risk within 3 years	Risk within 4 years	Risk within 5 years	Risk within 6 years	Risk within 7 years
2	50%	75%	88%	94%	97%	98%	99%
10	10%	19%	27%	34%	41%	52%	52%
25	4%	8%	12%	15%	18%	25%	25%
50	2%	4%	6%	8%	10%	11%	13%
100	1%	2%	3%	4%	5%	6%	7%

4. Values at Risk

Values at risk from erosion, flood or debris flows include human life, safety, and property and critical natural and cultural resources. The following is a discussion of the values at risk and the factors and processes contributing to the risk.

Life and Property

Zion National Park

Zion National Park (Park) users that access trails and routes that cross stream channels or are located in narrow canyon bottoms will be exposed to a higher frequency of flash floods due to the difficulty of escaping a flash flood or debris flow. The following trails and routes either cross stream channels or are located within 50 feet of a stream channel:

- Dalton Wash,
- Coal Pits Wash,
- Right Fork North Creek, and
- Left Fork North Creek.

Private Property

Private properties and associated dwellings and outbuildings downstream of the Park boundary are at risk to minor property damage from increased flows in North Creek. The following properties were identified as being at risk:

Sunset Ranch - This property is located within the fire area adjacent to North Creek. Attempts were made to contact the owner of the property, Mr. Moyle, to arrange for a site visit and to evaluate the flood risk to his property – attempts to contact Mr. Moyle were not successful. Helicopter reconnaissance and viewing of the Sunset Ranch from a vantage point on the Kolob Terrace Road indicate that the primary dwellings are located above the active channel.

Staples Ranch - A site visit was made to the property on July 14, 2006 by Michael Parenti, BAER Team Hydrologist. Parenti met with John Staples and inspected site drainage features. Two 36-inch culverts convey water through the property from a stream outside of the fire area. Sediment deposition in one of the culverts has reduced the conveyance capacity of the culvert by approximately 10 to 20%. Parenti recommended that the culvert be cleaned.

Mr. Staples showed Parenti the high water line from the January 2005 flood event and said that increases in water surface elevation were caused by the formation of a debris dam downstream of the property. Mr. Staples also stated that debris jam formation at the bridge crossing the Kolob Terrace Road (KT Road) caused flooding of the upper portion of the Staples Ranch during high flow events. The conveyance capacity of the bridge is less than the conveyance capacity of the upstream bridge on the KT Road. The potential for debris jam formation has increased as a result of the fire due to mortality of riparian trees. However, the potential for a debris jam is relatively low because mortality in the North Creek riparian area is low. Mr. Staples also indicated that a fish kill occurred in the pond adjacent to his home after the rainfall event on July 8, 2006.

Jacobs Ranch - An attempt was made to contact the landowner on July 14, 2006 but was unsuccessful. The ranch dwellings are located above the active floodplain. Outbuildings appear to be located within the floodplain.

Mr. John Esplin of the Natural Resources Conservation Service was contacted by Michael Parenti on July 18, 2006 and briefed on private property at risk. Mr. Esplin indicated that Mr. Tom Simper will be responsible for reviewing this watershed assessment and determining the appropriate follow-up with regards to Emergency Watershed Protection (EWP) on private property, if any.

Photos of properties at risk are included in Appendix C.

Water Quality

The pH of water after fires can be affected by ash deposition immediately after a fire. Generally, pH increases after a fire due to the transport of cations such as calcium (Ca), magnesium (Mg), and potassium (K) which are converted to oxides and deposited as ash (Neary et al., 2005). Nitrogen and phosphorous loads can also increase after fires. Ash deposition and increases in nitrogen and phosphorous generally occur in the first flush of flows after the fire (Neary et al. 2005). Ash flows and deposition have already occurred in the North Creek watershed in response to a short duration high intensity rainfall event that occurred on July 8, 2006 (see photos in Appendix C). Ash remains on the burned hillslopes and will be delivered to streams in subsequent short duration high intensity rainfall events that will occur during the monsoon season.

Aquatic Species

There is a limited understanding of the short and long-term effects on fish that contributes to considerable uncertainty of the effects of fires on aquatic species because of the diverse and complex effects that fire can have on aquatic ecosystems (Rieman and Clayton 1997, Bisson et al., in press). Fires can have several effects on aquatic ecosystems including decreased stream channel stability, altered flow regimes, changes in coarse woody debris delivery and storage, increased nutrient availability, increased sediment delivery and transport, and increased solar radiation and altered water temperature regimes (McMahon and deCalesta 1900; Young 1994; Reeves et al., 1995; Minshall et al., 1997, 2001; Benda et al., 1998; and Greswell 1999). Most of the effects of fire and fire management activities are indirect with the exception of the effect of direct application of fire retardant into water bodies.

Increased suspended sediment concentrations can contribute to fish mortality due to gill abrasion and lower dissolved oxygen. Fish kills can extend several miles downstream of the fire. Fish kills

occurred on the Animas River and Pine River near Durango, Colorado after the Missionary Ridge Fire of 2002 - a fire that was dominated by sandstone geology. It is likely that fish kills will occur in North Creek and possibly downstream of the fire in the Virgin River due to increased suspended sediment concentrations and lower dissolved oxygen concentrations.

E. RECOMMENDATIONS

Fire Suppression Repair

No recommendations.

Emergency Stabilization

No recommendations.

1. Monitoring

No recommendations.

Rehabilitation

1. Management

No recommendations.

2. Monitoring

No recommendations.

Management Recommendations (Non-Spec)

Zion National Park should consider revising the warning message posted when trails are closed as a result of the prediction of flash floods.

CONSULTATIONS

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John Staples, Private Citizen	(435) 656-2452

REFERENCES

- Barfield, B.J, Warner, R.C, and C.T. Haan. 1981. Applied Hydrology and Sedimentology for Disturbed Areas. Technical Press: Stillwater, OK; 603.
- Benda, L.E., Miller, D.J., Dunne, T., Reeves, G.H., and J.K., Agee. 1998. Dynamic Landscape Systmes. In: R.J. Naiman, and R.E. Bilby (eds.), River Ecology and Management: Lessons From the Pacific Coastal Ecoregion, Springer Verlag: New York, pp. 261-288.
- Bisson, P., Rieman, B., Luce, C., Hessburg, P., Lee, D., Kershner, J., and G., Reeves. Fire and aquatic ecosystems: a synthesis. Submitted to For. Ecol. Manage.
- Cannon, S.H., Gartner, J.E., Sears, A.H., Thurston, B.M., and A.J., Gleason. 2003. Debris flow response of basins burned by the 2002 Coal Seam and Missionary Ridge Fires, Colorado. *in* Boyer, D.D., Santi, P.M., and Rogers, W.P., eds., Engineering Geology in Colorado—Contributions, Trends, and Case Histories: Association of Engineering Geologists Special Publication 14, Colorado Geological Survey Special Publication 55, on CD-ROM
- Cannon, S.H., 2001, Debris-flow generation for recently burned watersheds: Environmental & Engineering Geoscience, Vol. VII, No. 4, pp. 321-341.
- Cannon, S.H., Kirkham, R.M., and M. Parise. 2000. Wildfire-related debris-flow initiation processes Storm King Mountain, Colorado. *Geomorphology* 39:171-188.
- DeBano, L.F., Osborn, J.F., Krammes, J.S., and J. Letey Jr. 1967. Soil wettability and wetting agents...our current knowledge of the problem. General Technical Report PSW-43. Berkeley, CA. U.S. Department of Agriculture, Forest Service, Pacific Southwest Forest and Range Experiment Station. 13 p.
- Foster, G.R. 1982. Modeling the erosion process. In: Haan, C.T., Johnson, H.P., Brakensiek, D.L., eds. Hydrologic Modeling of Small Watersheds. St. Joseph, MI. American Society of Agricultural Engineers. Chapter 8.
- Huggins, L.F. and J.R., Burney. 1982. Surface runoff, storage, and routing. In: Haan, C.T., Johnson, H.P., Brakensiek, D.L., eds. Hydrologic Modeling of Small Watersheds. St. Joseph, MI. American Society of Agricultural Engineers. Chapter 5.
- Gresswell, R.E. 1999. Fire and aquatic ecosystems in forested biomes of North America. *Transactions of the Amrrican fisheries society* 128, 193-221.
- Martin, D.A. and J.A. Moody. 2001. Comparison of soil infiltration rates in burned and unburned mountainous watersheds. *Hydrological Processes*. 15:2893-2903.
- Megahan, W.F., 1986. Recent studies on erosion and its control on forest lands in the United States. In: Richard, F. ed. Range basin sediment delivery: Proceedings, 1986, August. Albuquerque, NM. IAHS Publication 159, Wallingford, Oxon, United Kingdom:178-189.
- Neary, D.G., Ryan, K.C., and L.F., DeBano, eds. 2005. Wildland fire in ecosystems: effects of fire on soil and water. Gen. Tech. Rep. RMRS-GTR-42-vol.4. Ogden, UT: United States Department of Agriculture.
- McMahon, T.E., and D.S. deCalesta. 1990. Effects of forest in fish and wildlife. In Walstad, J.D., Radosevich, S.R., and D.V. Sandberg (eds). Natural and prescribed fire in Pacific Northwest forests. Oregon State University Press, Corvallis, OR pp. 233-250.

- Minshall, G.W., Brock, J.T., Andrews, D.A., and Robinson, C.T. 2001. Water quality substratum and biotic responses of five central Idaho (USA) streams during the first year following the Mortar Creek fire. *International Journal Wildland Fire* 10, 185-199.
- Minshall, G.W., Robinson, C.T., and D.E. Lawrence. 1997. Postfire responses of lotic ecosystems in Yellowstone National Park, U.S.A. *Canadian Journal Fisheries Aquatic Sciences* 54, 2509-2525.
- Meyer, G.A. and Wells, S.G. 1997, Fire-related sedimentation events on alluvial fans, Yellowstone National Park, U.S.A.: *Journal of Sedimentary Research*, Vol. 67, No. 5, pp. 776-791.
- Morin, J and Y. Benyamini. 1977. Rainfall infiltration into bare soils. *Water Resources Research*. 13(5):813-817.
- Morton, D.M., 1989, Distribution and frequency of storm-generated soil slips on burned and unburned slopes, San Timoteo Badlands, Southern California, *in* Sadler, P.M., and Morton, D.M., eds., *Landslides in a Semi-Arid Environment with Emphasis on the Inland Valleys of Southern California: Publications of the Inland Geological Society*, Vol. 2, pp. 279-284.
- Neary, D.G., Klopatek, C.C., DeBano, L.L. and F. Folliot. 1999. Fire effects on below ground sustainability: a review and synthesis. *Forest Ecology and Management*. 122:51-71.
- Parrett, C., 1987, Fire-related debris flows in the Beaver Creek drainage, Lewis and Clark County, Montana: U.S. Geological Survey Water-Supply Paper 2330, pp. 57-67.
- Reeves, G.H., Benda, L.E., Burnett, K.M., Bisson, P.A., and J.R., Sedell. 1995. A disturbance-based ecosystem approach to maintaining and restoring freshwater habitats of evolutionary significant units of salmonids in the Pacific Northwest. In: Nielsen, J. (ed.), *Evolution and Aquatic Ecosystem*. Amer. Fisheries Soc. Symp. 17, Bethesda, MD, pp. 334-339.
- Rieman, B.E., and J.L., Clayton. 1997. Fire and fish: issues of forest health and conservation of native fishes. *Fisheries* 22(11), 6-15.
- Robichaud, P.R. 2000. Fire effects on infiltration rates after prescribed fire in Northern Rocky Mountainforests, USA. *Journal of Hydrology*. 231-232:220-229.
- Robichaud, P.R., 2002, Wildfire and erosion: when to expect the unexpected: Geological Society of America Abstracts with Program.
- Shurman, G., J.E. Slosson, and D. Yoakum. 1985. Relationship of the fire/flood to debris flows, *in* Bowles, D.S. (ed.), and *Delineation of landslide, flash flood and debris flow in Utah: Utah Water Research Laboratory*, Logan, Utah.
- USDA, Soil Conservation Service, 1977. Soil Survey, Washington County Area, Utah.
- Young, M.K., editor. 1995. Conservation assessment for inland cutthroat trout. USDA Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado, General Technical Report RM-GTR-256.

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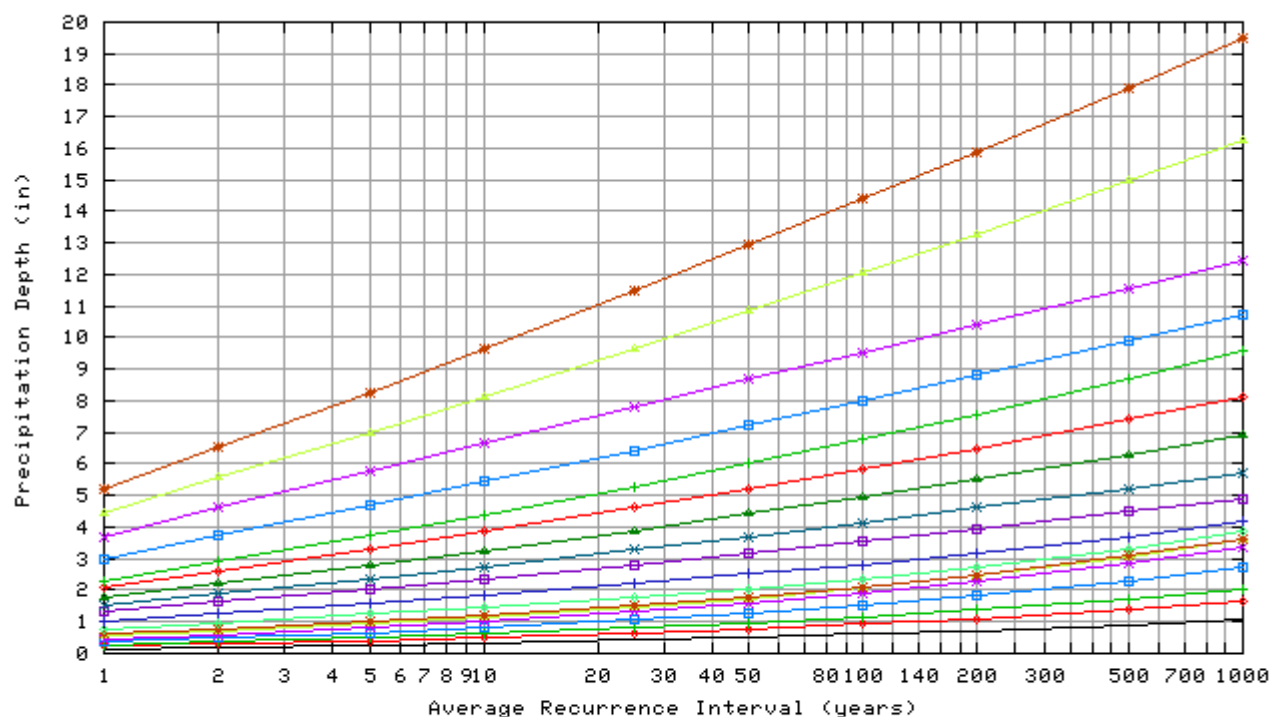
**Kolob Fire
Burned Area Emergency Rehabilitation Team
Watershed Assessment**

Appendix A

Curve Numbers

							Adjusted for Hydrophobicity	
Hydro Group A								
Vegetation Type	Good	Rx Fire	Fair	Poor	Mod Burn	High Burn	Mod Burn	High Burn
Oak-Aspen-Mtn Brush	20	33			77	77	82.25	98
Herbaceous-grass-brush	51	65			77	77	82.25	82.25
Conifer	27	38	36	45	77	77	82.25	98
Sagebrush-grass	30	55			77	77	82.25	82.25
Oak woodland	32	47	44	55	77	77	82.25	98
Pinyon juniper	30	59			77	77	82.25	98
Broad leaf chaparral	31	41	40	53	77	77	82.25	98
Narrow leaf chaparral	55	67	55	70	77	77	82.25	98
Barren	77	77		77	77	77	82.25	82.25
Annual grass	38	51	49	65	77	77	82.25	82.25
Hydro Group B								
Vegetation Type	Good	Rx Fire	Fair	Poor	Mod Burn	High Burn	Mod Burn	High Burn
Oak-Aspen-Mtn Brush	30	53	48	66	63	86	71.75	98
Herbaceous-grass-brush	62	76	74	85	81	86	85.25	85.25
Conifer	55	63	60	66	73	86	79.25	98
Sagebrush-grass	35	60	51	67	65	86	73.25	73.25
Oak woodland	58	69	65	73	80	86	84.5	98
Pinyon juniper	41	68	58	75	77	86	82.25	98
Broad leaf chaparral	57	67	63	70	75	86	80.75	98
Narrow leaf chaparral	65	77	72	82	77	86	89	98
Barren	86	86	86	86	86	86	89	89
Annual grass	61	74	69	78	83	86	86.75	86.75
Hydro Group C								
Vegetation Type	Good	Rx Fire	Fair	Poor	Mod Burn	High Burn	Mod Burn	High Burn
Oak-Aspen-Mtn Brush	41	63	57	74	72	91	78.5	98
Herbaceous-grass-brush	74	86	81	87	89	91	91.25	91.25
Conifer	70	75	73	77	84	91	87.5	98
Sagebrush-grass	47	73	63	80	78	91	83	83
Oak woodland	72	79	76	82	89	91	91.25	98
Pinyon juniper	61	83	73	85	87	91	89.75	98
Broad leaf chaparral	71	77	75	80	81	91	85.25	98
Narrow leaf chaparral	77	83	81	88	85	91	88.25	98
Barren	91	91	91	91	91	91	92.75	92.75
Annual grass	75	83	79	86	90	91	92	92
Hydro Group D								
Vegetation Type	Good	Rx Fire	Fair	Poor	Mod Burn	High Burn	Mod Burn	High Burn
Oak-Aspen-Mtn Brush	48	69	63	79	93	93	94.25	98
Herbaceous-grass-brush	85	91	89	93	93	93	94.25	94.25
Conifer	77	81	79	83	93	93	94.25	98
Sagebrush-grass	55	78	70	85	93	93	94.25	94.25
Oak woodland	79	84	82	86	93	93	94.25	98
Pinyon juniper	71	85	80	90	93	93	94.25	98
Broad leaf chaparral	78	82	81	85	93	93	94.25	98
Narrow leaf chaparral	83	87	86	90	93	93	94.25	98
Barren	93	93	93	93	93	93	94.25	94.25
Annual grass	81	87	84	89	93	93	94.25	94.25

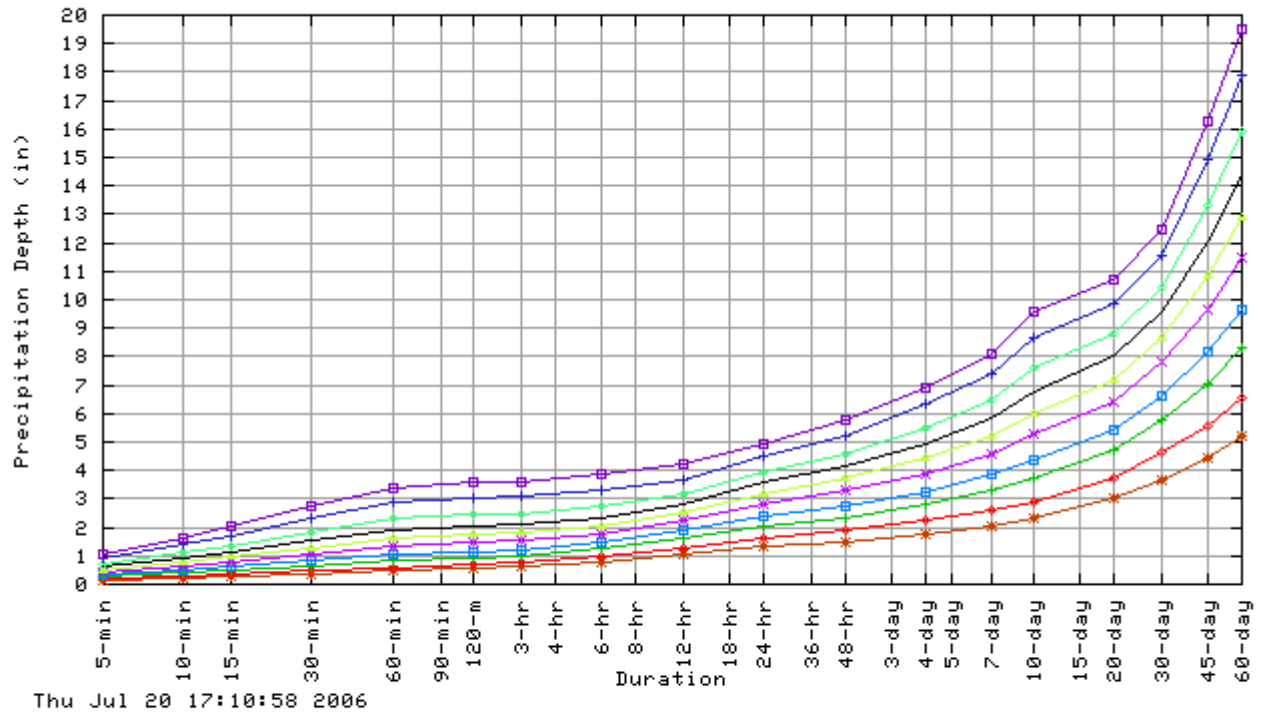
Partial duration based Point Precipitation Frequency Estimates Version: 4
37.2083 N 112.9842 W 4002 ft



Thu Jul 20 17:10:58 2006

Duration			
5-min	—	120-min	—▲—
10-min	—◆—	3-hr	—*—
15-min	—+—	6-hr	—+—
30-min	—□—	12-hr	—+—
60-min	—×—	24-hr	—□—
		48-hr	—×—
		4-day	—▲—
		7-day	—◆—
		10-day	—+—
		20-day	—□—
		30-day	—×—
		45-day	—▲—
		60-day	—*—

Partial duration based Point Precipitation Frequency Estimates Version: 4
37.2083 N 112.9842 W 4002 ft



Average Recurrence Interval (years)	
1	*
2	+
5	+
10	+
25	+
50	+
100	+
200	+
500	+
1000	+

Confidence Limits -

* Upper bound of the 90% confidence interval Precipitation Frequency Estimates (inches)																		
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.17	0.27	0.33	0.44	0.55	0.64	0.71	0.88	1.15	1.40	1.61	1.90	2.24	2.48	3.21	3.98	4.77	5.64
2	0.23	0.34	0.43	0.57	0.71	0.81	0.90	1.11	1.44	1.74	2.01	2.37	2.81	3.13	4.03	4.97	5.98	7.10
5	0.31	0.47	0.59	0.79	0.98	1.07	1.16	1.40	1.80	2.18	2.51	2.97	3.54	4.00	5.01	6.18	7.55	8.98
10	0.39	0.59	0.73	0.98	1.21	1.31	1.39	1.65	2.10	2.54	2.92	3.47	4.14	4.70	5.81	7.12	8.78	10.44
25	0.50	0.76	0.95	1.28	1.58	1.68	1.74	2.01	2.50	3.04	3.51	4.16	4.98	5.71	6.87	8.37	10.46	12.47
50	0.60	0.92	1.14	1.54	1.90	2.01	2.06	2.32	2.83	3.44	3.98	4.73	5.65	6.51	7.71	9.33	11.76	14.06
100	0.73	1.11	1.38	1.85	2.29	2.42	2.45	2.67	3.19	3.86	4.46	5.34	6.35	7.38	8.59	10.32	13.14	15.73
200	0.88	1.33	1.65	2.23	2.75	2.89	2.91	3.13	3.59	4.31	5.00	5.98	7.10	8.30	9.50	11.30	14.59	17.45
500	1.11	1.70	2.10	2.83	3.50	3.65	3.66	3.88	4.22	4.94	5.73	6.90	8.16	9.60	10.77	12.64	16.56	19.86
1000	1.33	2.03	2.52	3.39	4.20	4.36	4.41	4.57	4.89	5.44	6.33	7.65	9.01	10.68	11.77	13.66	18.14	21.77

* The upper bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are greater than.

** These precipitation frequency estimates are based on a partial duration series. ARI is the Average Recurrence Interval. Please refer to the [documentation](#) for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

* Lower bound of the 90% confidence interval Precipitation Frequency Estimates (inches)																		
ARI** (years)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
1	0.13	0.19	0.24	0.32	0.40	0.48	0.55	0.71	0.93	1.22	1.41	1.66	1.94	2.15	2.81	3.45	4.12	4.82
2	0.16	0.25	0.31	0.41	0.51	0.61	0.70	0.89	1.16	1.52	1.77	2.08	2.44	2.72	3.52	4.33	5.17	6.06
5	0.22	0.34	0.42	0.57	0.70	0.81	0.90	1.11	1.44	1.90	2.21	2.60	3.07	3.46	4.38	5.37	6.50	7.64
10	0.27	0.42	0.52	0.70	0.86	0.98	1.07	1.30	1.67	2.20	2.58	3.04	3.58	4.05	5.09	6.17	7.53	8.89
25	0.35	0.53	0.66	0.89	1.10	1.23	1.32	1.57	1.98	2.61	3.07	3.63	4.27	4.86	5.99	7.21	8.90	10.52
50	0.41	0.63	0.78	1.05	1.31	1.44	1.53	1.78	2.21	2.93	3.45	4.08	4.80	5.49	6.68	7.98	9.92	11.78
100	0.49	0.74	0.92	1.23	1.53	1.68	1.77	2.02	2.45	3.25	3.82	4.56	5.36	6.13	7.36	8.74	10.95	13.02
200	0.56	0.86	1.06	1.43	1.77	1.94	2.04	2.29	2.71	3.58	4.21	5.04	5.88	6.76	8.03	9.44	11.96	14.25
500	0.68	1.03	1.27	1.72	2.12	2.31	2.44	2.73	3.09	4.01	4.71	5.65	6.61	7.64	8.88	10.36	13.29	15.82
1000	0.77	1.17	1.45	1.96	2.42	2.63	2.79	3.10	3.48	4.34	5.09	6.12	7.14	8.32	9.52	11.04	14.27	17.03

* The lower bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are less than.

** These precipitation frequency estimates are based on a partial duration maxima series. ARI is the Average Recurrence Interval.

Please refer to the [documentation](#) for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

STRATUM: GROUND SURFACE

Total cover (%) for each soil component on a 1/300th acre plot

Ash: Loose burnt unrecognizable material

Water: Visible surface water not just moisture

New litter: litter fallen onto the ground surface since fire
Litter type

Previous Litter: loose undecomposed material

Percent of total cover that is:

Unburned: no sign of charcoal

Light Char: blackened but definable as plant parts

Previous Humus: decomposed organic layer below litter

Unburned: no sign of charcoal

Light Char: blackened but can find

Surface Mineral soil

Unburned: no sign of charcoal

Light char: blackened

Moderate char: ash colored (grey)

Deep char: orange

BCR: brown or white cubical rotten wood

Unburned: no sign of charcoal

Light char: burned on surface

Moderate char: burned but still present

Deep char: imprint on soil surface

CWD < 3": woody debris less than 3" in diameter (sticks)

Unburned: no sign of charcoal

Light char: burned on surface but still see unburned areas on sticks

Moderate char: all sticks are charred (all black)

CWD > 3": woody debris greater than 3" (small to large logs)

Unburned: no sign of charcoal

Light char: blackened or scorched but still see unburned areas

Moderate char: all blackened and charring goes into the wood

Deep char: only large logs are present and are deeply charred

Stump: sound human created stumps (post-harvest)

Unburned: no sign of charcoal

Light char: stumps intact but blackened

Moderate char: burned deep enough to form charcoal

Deep char: stump gone, hole in ground

New litter, previous litter, and previous humus depth: take at 4 cardinal directions at center of 6.8' pole in mm.

STRATUM: GRASS, FORBS, SMALL SHRUBS (< 1.5 ft), SEEDLINGS (< 1 in dbh)

Total cover (%) for each component on a 1/300th acre plot

Proportion of total cover that is

Unburned should be the same)

Light char: blackened soil with shrubs or forbs present; small seedlings not yet established

STRATUM: MEDIUM (1.5-6 ft) AND TALL SHRUBS (> 6 ft) AND SAPLINGS (1-4.9 dbh in)

Total cover (%) for each component on a 1/24th acre plot

Proportion of total cover that is

Unburned

Light char: part of the shrub is blackened (usually at base) and stems still in tact

Moderate char: stub of shrub exists

Deep char: holes left from shrubs

Saplings

Unburned

Light char: blackened but some needles (live or dead) exist on trees

Moderate char: dead trees with bare stems

Deep Char: holes left from stumps

STRATUM: TREES

Tree: number of intermediate trees that express similar fire severity

Species: PP (Ponderosa pine); (DF) Douglas fir, ES (Englemann spruce), AF (Alpine fir), LP (Lodgepole pine), H (Hardwood, e.g., Canyon Live Oak), A (Aspen)

Ht: estimated height of tree

CR = crown ratio

Unburned - no sign of burned area

Proportion of crown ratio that is:

% green: percent of crown with green needles

% brown: percent crown with brown needles

% black: no needles

Soil Burn Severity/Watershed Response Form

Date 7-2-06 Fire and watershed name Kalob Fire Crew S. Loadholt & M. Parenti
 BARC Map Classification Moderate
 Aspect W Slope % 15 Slope position _____
 GPS coord. (lat, long) or recorded GPS point BARC 1 Photo name or number _____
 Soil Texture _____ Soil Structure _____

Items A through Q should total 100%. Record cover to the nearest 5%. If cover component is <5% record as <1 and do not include in 100%. Unburned, Lt Char, Mod. Char, and Deep Char should add up to 100% for each cover component.

Strata	Total Cover	Unburned	Lt. Char	Mod. Char	Deep Char	Comment			
Ground surface – 1/300th acre plot (4 m diameter)									
A. Ash	<1	Color		Depth					
B. Water	0								
C. New litter	0	Type (fir or pine, shrub)							
D. Litter	5								
E. Humus	0								
F. Mineral soil	10								
G. Rock <1" (#)	80								
H. BCR	0								
I. CWD <3"	0								
J. CWD >=3"	0								
K. Stump human or natural	0								
New litter thick _____ mm Litter thick _____ mm Humus thick _____ mm									
Grass, Forbs, low shrubs (< 1.5 ft or 0-1/4 in basal dia.) - 1/300th acre plot (4 m diameter)						Dominant Species			
<u>50% area rock > 1" diameter</u>									
L. Grass	0								
M. Forbs	0								
N. Seedlings (#)	0								
O. Low shrubs (#)	0								
Medium (1.5 - 6 ft or 1/4-1 in basal dia) and tall shrubs (> 6 ft or >1 in), and saplings (upto 4.9 in) – 1/300th acre plot (4 m diameter)									
P. Medium shrubs (#)	0								
Q. Tall shrubs (#)	0								
R. Saplings (#)	#	#	#	#	#				
S. Trees (> 4.9 in dbh) trees - 1/24th acre plot (20 m diameter)									
#	Species	Ht	DBH	Unburned	If Crown Present			Water Repellency	
Tree					CR	% grn	% brn	% blk	
									Depth _____ Continuity _____
									Thickness _____
									Duration _____

T. Percent of bare soil with dense mat of fine roots in top 3 cm of soil 0 %

Soil Burn Severity: Low _____ Moderate X High _____

Watershed Response: Low <30% mineral soil, rock and ash and >70% green canopy
 Moderate 30-70% mineral soil, rock and ash and 30%-70% green canopy
 High >70% mineral soil, rock and ash and <30% green canopy

*Back

Barc II

Soil Burn Severity/Watershed Response Form

Date 7.12 Fire and watershed name Kolob Fire Crew S. Loadholt & M. Parent
 BARC Map Classification Mod
 Aspect NW Slope % 30 Slope position Mid
 GPS coord. (lat, long) or recorded GPS point BARC 2 Photo name or number _____
 Soil Texture _____ Soil Structure _____

Items A through Q should total 100%. Record cover to the nearest 5%. If cover component is <5% record as <1 and do not include in 100%. Unburned, Lt Char, Mod. Char, and Deep Char should add up to 100% for each cover component.

Strata	Total Cover	Unburned	Lt. Char	Mod. Char	Deep Char	Comment		
Ground surface – 1/300th acre plot (4 m diameter)								
A. Ash	<u>1</u>	Color		Depth				
B. Water	<u>0</u>							
C. New litter	<u>1</u>	Type (fir or pine, shrub)		<u>Pine</u>				
D. Litter	<u>2</u>							
E. Humus	<u>0</u>							
F. Mineral soil	<u>>0</u>							
G. Rock <1#	<u>85</u>							
H. BCR	<u>0</u>							
I. CWD <3"	<u>0</u>							
J. CWD >=3"	<u>0</u>							
K. Stump human or natural	<u>0</u>							
New litter thick <u>0.5</u> mm Litter thick _____ mm Humus thick _____ mm								
Grass, Forbs, low shrubs (< 1.5 ft or 0-1/4 in basal dia.) - 1/300th acre plot (4 m diameter)						Dominant Species		
L. Grass	<u>0</u>							
M. Forbs	<u>0</u>							
N. Seedlings (#)	<u>0</u>							
O. Low shrubs(#)	<u>0</u>							
Medium (1.5 - 6 ft or 1/4-1 in basal dia) and tall shrubs (> 6 ft or >1 in), and saplings (upto 4.9 in) – 1/300th acre plot (4 m diameter)								
P. Medium shrubs(#)	<u>0</u>							
Q. Tall shrubs(#)	<u>0</u>							
R. Saplings(#)	# <u>0</u>	#	#	#	#			
S. Trees (> 4.9 in dbh) trees - 1/24th acre plot (20 m diameter)								
#	Species	Ht	DBH	Unburned	If Crown Present			
Tree					CR	% gm	% bm	% blk
<u>2</u>	<u>Pied</u>	<u>3m</u>	<u>8"</u>	<u>0</u>	<u>80%</u>	<u>0%</u>	<u>50</u>	<u>50</u>
<u>5</u>	<u>Junco</u>	<u>3m</u>	<u>4"</u>	<u>0</u>	<u>80%</u>	<u>0%</u>	<u>50</u>	<u>50</u>

Water Repellency

Depth _____ Continuity _____

Thickness _____

Duration _____

T. Percent of bare soil with dense mat of fine roots in top 3 cm of soil _____%

Soil Burn Severity: Low _____ Moderate X High _____

Watershed Response: Low <30% mineral soil, rock and ash and >70% green canopy
 Moderate 30-70% mineral soil, rock and ash and 30%-70% greens canopy
High >70% mineral soil, rock and ash and <30% green canopy

Soil Burn Severity/Watershed Response Form

Date 7-12-06 Fire and watershed name Kolob Fire Crew S. Loadholt & M. Parent
 BARG Map Classification _____ Close to established plot #44 (aluminum tag on rebar)
 Aspect _____ Slope % 2 Slope position top
 GPS coord. (lat, long) or recorded GPS point BARC3 Photo name or number _____
 Soil Texture _____ Soil Structure _____

Items A through Q should total 100%. Record cover to the nearest 5%. If cover component is <5% record as <1 and do not include in 100%. Unburned, Lt Char, Mod. Char, and Deep Char should add up to 100% for each cover component.

Strata	Total Cover	Unburned	Lt. Char	Mod. Char	Deep Char	Comment				
Ground surface - 1/300th acre plot (4 m diameter)										
A. Ash	0	Color		Depth						
B. Water	0									
C. New litter	0	Type (fir or pine, shrub)								
D. Litter	100				100%					
E. Humus	0									
F. Mineral soil	90									
G. Rock <1#	0									
H. BCR	0									
I. CWD <3"	0									
J. CWD ≥ 3"	0									
K. Stump human or natural	0									
New litter thick _____ mm Litter thick <u>1</u> mm Humus thick _____ mm										
Grass, Forbs, low shrubs (< 1.5 ft or 0-1/4 in basal dia.) - 1/300th acre plot (4 m diameter)						Dominant Species				
L. Grass	0									
M. Forbs	0									
N. Seedlings (#)	0									
O. Low shrubs (#)	0									
Medium (1.5 - 6 ft or 1/4-1 in basal dia) and tall shrubs (> 6 ft or >1 in), and saplings (upto 4.9 in) - 1/300th acre plot (4 m diameter)										
P. Medium shrubs (#)	0									
Q. Tall shrubs (#)	0									
R. Saplings (#)	#	#	#	#	#					
S. Trees (> 4.9 in dbh) trees - 1/24th acre plot (20 m diameter)										
If Crown Present										
# Tree	Species	Ht	DBH	Unburned	CR	% gm	% brn	% blk	Water Repellency	
15	juniper	3m	3"	—	90	—	—	100	Depth _____	Continuity _____
									Thickness _____	
									Duration _____	

T. Percent of bare soil with dense mat of fine roots in top 3 cm of soil 0 %

Soil Burn Severity: Low _____ Moderate X High _____

Watershed Response: Low <30% mineral soil, rock and ash and >70% green canopy
 Moderate 30-70% mineral soil, rock and ash and 30%-70% greens canopy
 High >70% mineral soil, rock and ash and <30% green canopy

Soil Burn Severity/Watershed Response Form

Date 7-13-06 Fire and watershed name Yalob Fire Crew S. Loadholt & M. Parenti
 BARC Map Classification _____ *NO seed sample
 Aspect E Slope % 40 Slope position _____ taken
 GPS coord. (lat, long) or recorded GPS point BARC 5 Photo name or number _____
 Soil Texture _____ Soil Structure _____

Items A through Q should total 100%. Record cover to the nearest 5%. If cover component is <5% record as <1 and do not include in 100%. Unburned, Lt Char, Mod. Char, and Deep Char should add up to 100% for each cover component.

[illegible]

T. Percent of bare soil with dense mat of fine roots in top 3 cm of soil _____%

Soil Burn Severity: Low Moderate High

Watershed Response: Low <30% mineral soil, rock and ash and >70% green canopy
 Moderate 30-70% mineral soil, rock and ash and 30%-70% greens canopy
 High >70% mineral soil, rock and ash and <30% green canopy

but close to moderate

BARC Map Classification _____

GPS coord. (lat, long) or recorded GPS point BARC 1006 Photo name or number _____

Items A through Q should total 100%. Record cover to the nearest 5%. If cover component is <5% record as <1 and do not include in 100%. Unburned, Lt Char, Mod. Char, and Deep Char should add up to 100% for each cover component.

T. Percent of bare soil with dense mat of fine roots in top 3 cm of soil _____%

Watershed Response: Low <30% mineral soil, rock and ash and >70% green canopy

Watershed Response: Low <30% mineral soil, rock and ash and >70% green canopy
Moderate 30-70% mineral soil, rock and ash and 30%-70% greens canopy
High >70% mineral soil, rock and ash and <30% green canopy

Soil Burn Severity/Watershed Response Form

Date 7-13-06 Fire and watershed name Kolob Fire Crew S. Loadholt & M. Parent

BARC Map Classification _____

Aspect W Slope % 40 Slope position side

GPS coord. (lat, long) or recorded GPS point BARC 1 Photo name or number _____

Soil Texture fine sandy loam Soil Structure _____

Items A through Q should total 100%. Record cover to the nearest 5%. If cover component is <5% record as <1 and do not include in 100%. Unburned, Lt Char, Mod. Char, and Deep Char should add up to 100% for each cover component.

Not include in 100% Unburned, Lt. Char, Mod. Char						Total Cover	Unburned	Lt. Char	Mod. Char	Deep Char	Comment
Ground surface – 1/300th acre plot (4 m diameter)											
A. Ash			<u>10</u>	Color		Depth					
B. Water			<u>0</u>								
C. New litter			<u>0</u>	Type (fir or pine, shrub)							
D. Litter			<u>10</u>								
E. Humus			<u>0</u>								
F. Mineral soil			<u>15</u>								
G. Rock <1#			<u>many 25</u>								
H. BCR			<u>0</u>								
I.CWD <3"			<u>0</u>								
J. CWD>=3"			<u>0</u>								
K. Stump human or natural			<u>0</u>								
New litter thick	mm	Litter thick	mm	Humus thick	mm						
Grass, Forbs, low shrubs (< 1.5 ft or 0-1/4 in basal dia.) - 1/300th acre plot (4 m diameter)											Dominant Species
<u>Rock >1" = many 30 90</u>											
L. Grass			<u>10</u>					<u>50</u>	<u>50</u>		
M. Forbs			<u>0</u>								
N. Seedlings (#)			<u>0</u>								
O. Low shrubs(#)	<u>1</u>		<u><1</u>								
Medium (1.5 - 6 ft or ¼-1 in basal dia) and tall shrubs (> 6 ft or>1 in), and saplings (upto 4.9 in) – 1/300th acre plot (4 m diameter)											
P. Medium shrubs(#)											
Q. Tall shrubs(#)											
R. Saplings(#)	#	#	#	#	#	#	#	#	#	#	
S.Trees (> 4.9 in dbh) trees - 1/24th acre plot (20 m diameter)											
					If Crown Present				Water Repellency		
# Tree	Species	Ht	DBH	Unburned	CR	% grn	% brn	% blk	Depth _____	Continuity _____	
	<u>NONE</u>								Thickness <u>1min.</u>	{ Start <u>43</u> Stop <u>45</u>	
									Duration _____		

T. Percent of bare soil with dense mat of fine roots in top 3 cm of soil 25 %

Soil Burn Severity: Low Moderate High

Watershed Response: Low <30% mineral soil, rock and ash and >70% green canopy
 Moderate 30-70% mineral soil, rock and ash and 30%-70% greens canopy
 High >70% mineral soil, rock and ash and <30% green canopy

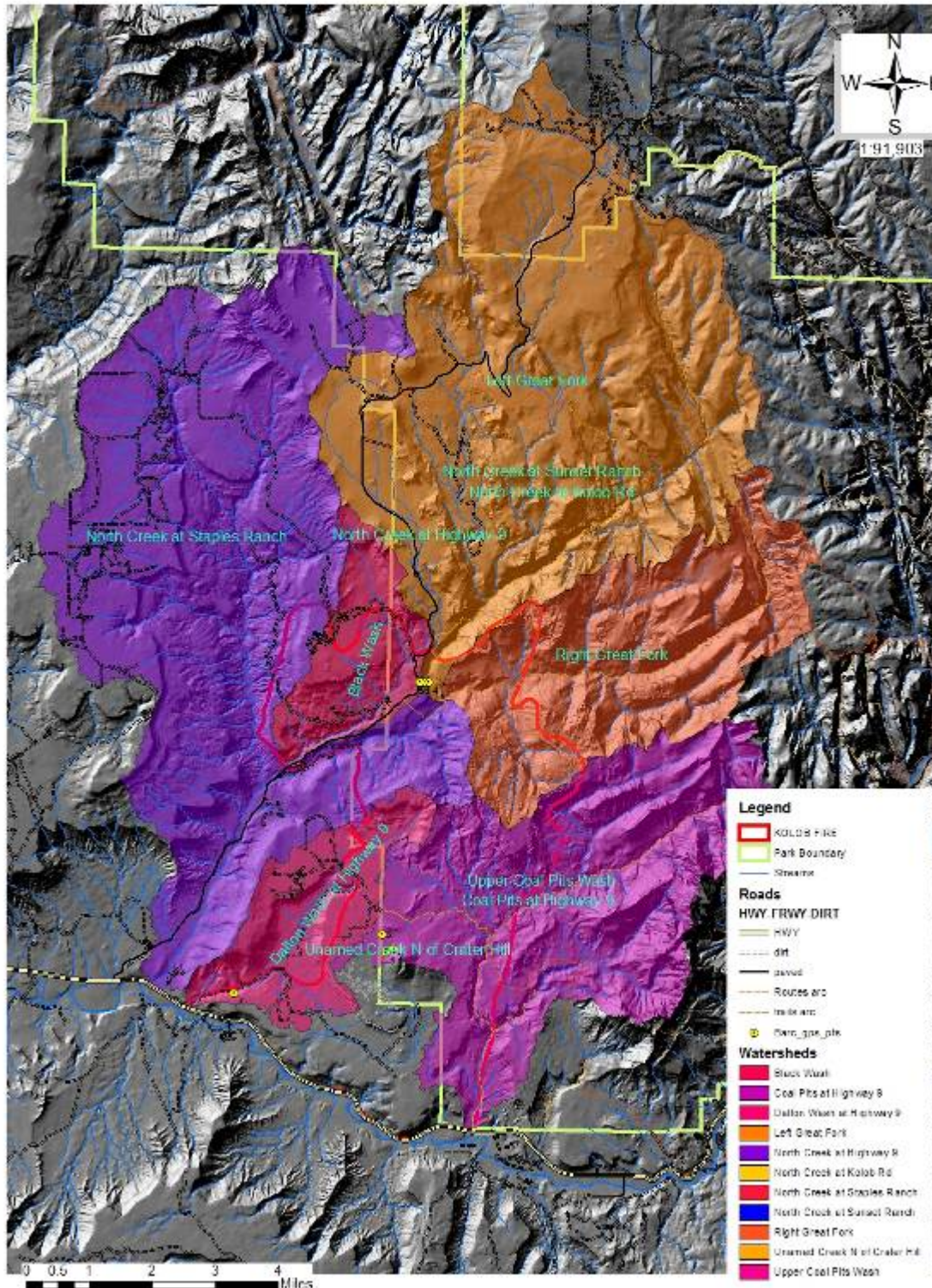
**Kolob Fire
Burned Area Emergency Rehabilitation Team
Watershed Assessment**

Appendix B



KOLOB Fire

Analysis Watersheds and Field Sample Locations



**Kolob Fire
Burned Area Emergency Rehabilitation Team
Watershed Assessment**

Appendix C



Moderate watershed response. Low soil burn severity.



Moderate watershed response. Low soil burn severity



High watershed response. Moderate soil burn severity.



High watershed response. Moderate soil burn severity.



Photo at right shows the variability of how the fire impacted soils and vegetation. This area is classified as moderate soil burn severity and high watershed response. The pre-fire watershed response was moderate due to the amount of groundcover and rock on the ground surface.

Low soil burn severity can be seen in the interstitial spaces between trees, and high soil burn severity can be seen under the tree canopy in this photo.





The left photo above shows the unburned condition of the pinyon-juniper vegetation type with an understory of cheatgrass. The right photo shows the amount of litter and duff present underneath a juniper tree in the pre-fire condition.



The left photo above shows the post-fire condition of the pinyon-juniper vegetation type with an understory of cheatgrass. The right photo shows the post-fire condition underneath a juniper tree, illustrating a complete consumption of duff and litter.



Sunset Ranch



Staples Ranch



Ash deposition and ash flow in North Creek following storm event of July 8, 2006. Ash deposition line is at approximate elevation of bankfull flow.



Ash deposition in North Creek following storm event of July 8, 2006.

BURNED AREA EMERGENCY STABILIZATION AND REHABILITATION PLAN

KOLOB WILDFIRE

I-C: VEGETATION RESOURCE ASSESSMENT

I. OBJECTIVES

- Evaluate and assess fire and suppression impacts on vegetation resources and identify values at risk associated with vegetation losses.
- Determine stabilization, rehabilitation and monitoring needs to aid in vegetative recovery and soil stabilization efforts.
- Evaluate potential for invasive plant species introduction or encroachment into native plant communities within, and adjacent to, fire areas and along travel ways.
- Provide management recommendations to assist in vegetative recovery and species habitat protection and rehabilitation.

II. ISSUES

- Suppression and fire impacts to plant communities and vegetation resources, both short and long term.
- Availability of local seed sources to reestablish native communities, both naturally and commercial availability.
- Availability and adequacy of critical habitat for the Mexican spotted owl.
- Invasive plant species introduction and/or proliferation including monitoring for early detection, potential spread and control of non-native noxious and invasive species.
- Maintain natural vegetation communities with fire return intervals within the natural range of variation. Stop the cycle of ecosystem degradation by shortening the fire return interval and state change.
- Threatened, Endangered and Sensitive Plant species occurrence, populations and site potentials for 3 sensitive plant species occurring in the burn perimeter; Zion daisy, (*Erigeron sionis*), Religious daisy, (*Erigeron religiosus*) and Zion penstemon, (*Penstemon humilus* var. *obtusifolia*).

III. OBSERVATIONS

A. Background

The Wildland Fire Management Plan for Zion National Park (2005) lists four desired future conditions for vegetation:

- Fire processes in fire dependent/adapted vegetation communities are managed to promote healthy and functional ecosystems. Vegetation succession reflects the natural range of variability under conditions that would occur under historical fire regimes.
- Fire is used as a tool to protect and enhance native vegetation communities.
- Fire program operations do not contribute to the spread of invasive weeds in Zion.
- Coordination with Resource Management occurs in developing native seed sources.

The Kolob wildfire will challenge the park to meet all of these conditions. The largest fire in park history burned from 3,648 to 6,547 feet in elevation. Several different vegetation community types burned with a wide range of fire return intervals and fire adaptations, Table 1 and map in Appendix III - E.

Vegetation Communities:

Vegetation in these elevations is generally sparse and low in stature due to lack of moisture, often with long fire return intervals and less fire adaptations than systems that historically burned more frequently. This coupled with the spread of cheatgrass and red brome through these lower elevations vegetation communities will alter the natural flow of post fire regeneration on the landscape. In the Crater Hill area, at least one location has already burned 2 years in a row due to the availability of fine fuels caused by cheatgrass invasion. The annual precipitation for this area, as recorded by the Zion Canyon weather station is 14.93 inches per year with years as low as 7.37 and as high as 21.25 in the last 10 years.

Table 1 – Plant Communities from the Zion FMP, Acreage and Percentage within the Kolob Fire and Fire Return Intervals from Zouhar (2003) and Campbell and others (2003)

Plant Communities	Acres	Area	Fire Return Interval (years)
Juniper/Pinyon - PJ	7,882	75%	50-150
Shrublands	723	7%	40-60
Bare-Soil/Stone Formations	530	5%	NA - unburnable
Desert Shrublands	440	4%	100+
Mountain Shrub	394	4%	20-40
Grass/Herbaceous Lands	231	2%	25-50
Wetland/Riparian	191	2%	100+
Ponderosa Pine	67	1%	5-25
Exotic Grasses	26	0%	1-10
Slickrock	17	0%	NA - unburnable
Exotic Riparian	3	0%	Unknown
Douglas Fir	2	0%	50-80
Total (NPS)	10,506	100%	

Semi-arid desert species are common; such as blackbrush (*Coleogyne ramosissima*), four-wing saltbush (*Atriplex canescens*) and mesquite (*Prosopis glandulosa*). Sandy slopes upland from waterways support mostly pinyon pines (*Pinus edulis*, *P. monophylla*), one-seed juniper (*Juniperus osteosperma*), sand and big sagebrush (*Artemisia filifolia* and *A. tridentata*), and rubber rabbitbrush (*Chrysothamnus nauseosa*). Interspersed within these species are pockets of grasses, mainly sand dropseed (*Sporobolus cryptandrus*), mutton grass (*Poa fendleriana*), and the invading non-native red brome (*Bromus rubens*) and cheatgrass (*Bromus tectorum*). Cheatgrass and Red brome are a substantial concern at lower elevations because of its abundance and flammability.

The fire also burned through and around riparian areas. Canyons in the park are an important desert oasis, with streams, seeps, wetlands, and hanging gardens. Perennial and ephemeral streams converge into the East and North Forks of the Virgin River, hosting riparian tree species such as the Fremont cottonwood (*Populus fremontii*), Goodings willow (*Salix goodingii*), boxelder (*Acer negundo*), and velvet ash (*Fraxinus velutina*). Seepwillow (*Baccharis emoryi*) and Coyote willow (*Salix exigua*) are common riparian shrubs. A substantial threat to native plant communities within floodplains and increasingly in the uplands (especially in Zion Canyon) is the invasion and dominance of the exotic annual grasses, cheatgrass and ripgut brome (*Bromus diandrus*).

The vegetation types across the fire have a wide variety of fire adaptations and fire return intervals. Over three quarters of the vegetation burned in the fire was in the pinyon juniper community. Historically this type has a highly variable fire return interval. Earlier work in the park estimated that this type has not burned in at least 160 years

(West and Loope, 1977). Much the pinyon juniper in the burn has a major to minor native herbaceous component. These herbaceous natives should naturally reestablish after fire, if they aren't out competed by cheatgrass.

There is one vegetation association within the pinyon juniper group of particular concern, the Utah Juniper (*Juniperus osteosperma*) / Big Sagebrush (*Artemisia tridentata*) Woodland. This juniper and sagebrush woodland mainly occurs in the Crater Hill area with fine sandy to cindery soils. The herbaceous layer is absent or very sparse (Cogan et al., 2003). Fires in this association are thought to be infrequent because smaller Utah juniper and big sagebrush are easily killed by burns and do not resprout (Barney and Frischknecht 1974, Everett 1987). Big sagebrush will re-establish relatively quickly (about 10-20 years) if a seed source is nearby (Barney and Frischknecht 1974, Bunting 1987). However, the the Crater Hill area over 1000 acres of this type burned at moderate soil burn severity. That combined with the high erosion potential and watershed response of the area will make it particularly difficult to revegetate.

Additionally, Utah Juniper is relatively slow to recover following fire, and sagebrush may dominate the sites for decades (Jameson et al. 1962). If fire-return intervals are more frequent than 10 years, as expected cheatgrass becoming dominant on these sites, then big sagebrush has difficulty recovering (Bunting 1987, Everett 1987).

Most of the major trees and shrubs in the juniper/big sagebrush woodland and through the rest of the pinyon juniper type regenerate from seed. Both pinyon and juniper have large seeds with short dispersal distances, except when eaten by birds. Pinyon pine is fairly susceptible to both crown scorch and cambial damage. Junipers can sustain much more crown scorch and survive. All of the woody sagebrushes in the park are not sprouting species and need a local seed source to reoccupy the site. Below is a short table (Table 2) with a few of the common shrubs and there ability to resprout from the crown. This ability will be critical with cheatgrass invasion and shorten fire return intervals. Evidence from the northern Great Basin and shown that non sprouting shrub species are the most easily displaced from the system by shortened fire return intervals, although with very repeated frequent fire sometimes even the sprouting species are taken out of the system.

Table 2 – Common shrubs and their sprouting capability in the lower elevation communities at Zion NP

Common Name	Scientific Name	Resprout?
Big Sagebrush	<i>Artemisia tridentata</i>	No
Little leaf manzanita	<i>Acrotstaphylos patula</i>	Yes
Sand Sagebrush	<i>Artemisia filifolia</i>	No
Rabbitbrush	<i>Chrysothamnus</i> spp.	Yes
Blackbrush	<i>Coleogyne ramosissima</i>	No
Broom snakeweed	<i>Gutierrezia sarothrae</i>	Yes
Four-wing saltbush	<i>Atriplex canescens</i>	No
Mormon tea	<i>Ephedra nevadensis</i>	No
Gamble oak	<i>Quercus gambellii</i>	Yes
Shrub live oak	<i>Quercus turbinella</i>	No
Utah serviceberry	<i>Amelanchier utahensis</i>	Yes

Invasive Plants:

Over 100 non-native plant species occur in Zion; 12 are of priority management for control and eradication. Tamarisk (*Tamarix ramossissima*) and Russian olive (*Eleagnus angustifolia*) are the primary invasive species along riparian areas. Both non-native tree species are increasing throughout the West and are able to effectively displace native riparian communities, creating monocultures in formerly biologically diverse habitats. Tamarisk in particular alters riparian communities that typically have moderate fire severity and intensity to a vegetation community type with a high or extreme fire severity and intensity. Zion has actively controlled these species for the past two decades.

In disturbed areas, Scotch thistle (*Onopordum acanthium*), bull thistle (*Cirsium vulgare*), and white top (*Cardaria draba*) are most commonly seen along trails in the front and backcountry. Zion staff work diligently with hundreds of volunteers to control these invasive weeds. Currently, knapweed (*Centaurea* spp.) and yellow starthistle

(*Centaurea solstitialis*) occur in small infestations, but are of great potential threat. Known occurrences of non-native species will be controlled each growing season and new populations will be detected as early as possible. Covering immense areas throughout the Intermountain West, cheatgrass, red brome and ripgut brome have also expanded into Zion, infesting over 8,000 acres. Because these exotic annuals germinate in the fall or winter, they effectively outpace native bunch grasses that emerge weeks or months later. The non-native annual grasses not only preemptively use water, they also form dense, continuous fuels that cure in the heat of the summer, unlike native species that occur in patchy bunches and “green up” during mid-summer. This creates a fire potential in areas where the herbaceous understory is almost entirely exotic bromes. This is a large concern in the lower elevations of the park where fuels are characteristically very sparse and the native plant communities are intolerant of fire. This change has the potential to cause a permanent type conversion in most of the vegetation communities found on the fire as experienced in the northern Great Basin.

Threatened and Endangered Species:

An Endangered species is defined as a species that is in danger of extinction throughout all or a significant portion of its range. A Threatened species is defined as a species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Of the Threatened or Endangered plant and animal species that occur in Zion none of their habitats were directly affected in the Kolob Fire. Two T & E species occurred within three quarters of a mile of the fire; Mexican Spotted Owl (*Strix occidentalis lucida*), and Shivwits milkvetch (*Astragalus ampullarioides*).

Zion is within the Colorado Plateau Recovery Unit for the Mexican spotted owl which is federally listed as a threatened species. The Mexican spotted owl reaches the northwestern limits of its range in this recovery unit (USDI, NPS, 2001), and all of Zion is designated as critical habitat for this species. Zion has 17 (possibly 18) known Mexican spotted owl territories, which are widely distributed (USDI, NPS, 2001). A spotted owl monitoring program for the park was initiated in 1995. High severity fire and timber harvest within upland forests, which are potentially used for foraging, dispersal, and wintering, are considered threats to spotted owl populations (USDI, USFWS, 1995).

The one federally-listed endangered plant species, the Shivwits milkvetch, occurs in Zion. This species was listed in 2001 by the USFWS because of its extremely limited range on the Chinle Formation and its rapidly vanishing habitat due to development (USDI, USFWS, 2001a). In a healthy system, its sparsely vegetated habitat is not prone to fire and thus this milkvetch is not fire-adapted. However, red brome and cheatgrass are now invading these areas, creating dense, continuous fuels and a potential threat to this endangered species.

Sensitive Species:

Two protected animals and four sensitive plant populations occurred in the burn perimeter.

Although the peregrine falcon (*Falco peregrinus anatum*) was removed from the federal list of endangered and threatened species in 1999, Zion has continued to monitor territories associated with climbing routes. Zion is known to have 19 historic falcon territories. A subset of those territories and the climbing route territories are monitored each year (USDI, NPS, 2001d). Four peregrine territories were within the burn.

The Virgin spinedace (*Lepidomeda mollispinis mollispinis*) is managed under a Conservation Agreement in lieu of listing as a threatened species. Virgin spinedace are found in the North Fork and East Fork of the Virgin River and several tributaries within and beyond the park. Since 1994, the Utah Division of Wildlife Resources (UDWR) has been monitoring the spinedace at two park locations (UDWR, 2003). In 2002, several additional locations were added in the North Fork of the Virgin River near the Zion Lodge. Monitoring of this species will continue annually. Spinedace may have been affected on the North Creek just outside the park on BLM lands.

Zion also hosts 22 plant species considered “sensitive” by the park and the state of Utah because of their limited distribution (endemism) or are disjunct from more abundant population centers. Most of these species are specialized to sandstone crevices and derived soils or hanging gardens. Many of these habitats are not susceptible to fire, and therefore fires are infrequent or rare in areas where these plants may occur. Four known populations were within the burn perimeter; Zion daisy, (*Erigeron sionis*), Religious daisy, (*Erigeron religiosus*) and

Zion penstemon, (*Penstemon humilus* var. *obtusifolia*). Table 3 lists the affected plant species by habitat and sensitivity of that habitat to fire.

Table 3: Sensitive Plant Species by Habitat			
Common Name	Scientific Name	Fire-prone Habitat	Habitat
Zion penstemon	<i>Penstemon humilus</i> var. <i>obtusifolia</i>	Yes	Ponderosa pine forest understory or pinyon pine understory
Religious daisy	<i>Erigeron religiosus</i>	Yes	Dry meadows
Shivwits milkvetch	<i>Astragalus ampullarioides</i> (federally endangered)	Rare	Exposed limestone ¹
Zion daisy	<i>Erigeron sionis</i>	Rare	Hanging garden or wetland
¹ Habitat not fire-prone, but with invasion of red brome fire frequency can dramatically increase			

Wildlife Habitat:

One issue concerning wildlife habitat was carried forward within this plan to evaluate the possible effects of fire suppression and fire effects on designated critical habitat for the Mexican spotted owl. If it is determined that a complete wildlife assessment needs to be written, this could happen and the BAER plan amended. All of the following background information comes from the Biological Opinion issued for the Fire Management Plan by the Utah Field Office in February 2005 (USFW, 2005).

Zion National Park is within the Colorado Plateau Recovery Unit and the entire park is designated critical habitat for Mexican spotted owl. Primary constituent elements related to critical habitat in Utah include one or more of the following: (1) presence of water (often providing cooler temperatures and higher humidity than the surrounding areas); (2) clumps or stringers of mixed conifer, pine-oak, pinyon-juniper, and/or riparian vegetation; (3) canyon wall containing crevices, ledges, or caves; and (4) high percent of ground litter and woody debris. The primary constituent elements provide a qualitative description of those physical and biological features necessary to ensure the conservation of the owl in Utah (50 FR 53182).

The overall goal of the Zion National Park Fire Management Plan is to manage fire in a manner that provides long-term benefits to wildlife and habitats. Beneficial aspects include increased response of herbaceous vegetation after a fire. Restoration of grasses and forbs is likely to increase species that support the owl's prey base.

Zion National Park routinely implements measures to minimize effects to listed species from land use activities, however because this is a long-term plan, there is the potential that Fire Management Plan activities may also result in direct and indirect negative impacts to the Mexican spotted owl and its critical habitat due to disturbance from thinning hazardous fuels, conducting prescribed burns, or implementing fire suppression in areas near known owl nesting sites in nearby slot canyons. Fuels reduction treatments and fire suppression can directly affect the owl through auditory or visual disturbance from fire personnel presence. Disturbance can disrupt activities such as breeding, foraging, and roosting. During and immediately following a fire, indirect effects such as a decrease in cover and forbs available to rodents and other prey species may change the structure of spotted owl prey species' habitat, affecting the abundance and composition of prey species for the owl.

Direct effects from fire suppression actions to the owl depend upon their proximity to occupied habitat and their timing of activities. Disturbance to the owl from tanker overflights and firefighters will be greatest the closer these actions occur to owl habitat, particularly nesting areas during the breeding season. Suppression actions occurring through the first two-thirds of the breeding season could result in the death of nestlings or juveniles due to their lack of mobility. Fire suppression could directly kill nestlings or juveniles through the management actions used to control or suppress the fire, such as fireline construction and aerial retardant or water drops. Smoke, heat, and noise in or near owl habitat may result in displacement of adults or juveniles, result in additional stress, or disrupt normal behavioral activities, such as foraging. These effects are expected to be temporary and activities would return to pre-disturbance levels. Smoke, heat, and noise impacts are greatly reduced with implementation of the applicable committed conservation measures.

Fire can cause indirect effects by altering vegetation structure and composition, thereby affecting small mammal habitat. Negative effects include the initial loss of owl prey habitat components such as herbaceous cover, down logs, and snags. The effects of fire on the prey base of the spotted owl are complex and are dependent on the variations in fire characteristics and in prey habitat. Fire intensity, size, and behavior are influenced by numerous factors such as vegetation type, moisture, fuel loads, weather, season, and topography. Because the Zion National Park Fire Management Plan includes conservation measures specific to fire activities in canyon habitats, we anticipate the effects to primary constituent elements of critical habitat will be avoided or minimized. Fire and related activities may result in short-term effects to vegetation within canyon habitat that constitutes a primary constituent element, however, as previously discussed; these effects are anticipated to be short-term. In addition, Zion National Park is implementing conservation measures to protect canyon vegetation, particularly in owl habitat (see Project Description, Species-Specific Environmental Protection Measures (USFW, 2005)). Other constituent elements including the presence of water and the abundance of canyon walls with crevices and caves are not expected to be negatively affected by fire activities.

Vegetation management, prescribed burns, and suppression activities, in particular, may need to occur in species habitats during the life of this plan. While measures will be implemented to minimize effects to species, particularly during breeding and wintering seasons, there is still the potential that an incidental take may occur, particularly in the form of harm or harassment to owls which may be disturbed by project activities. Disturbances have the potential to disrupt foraging or breeding behavior, at least temporarily.

B. Reconnaissance Methodology and Results

Remote sensing, aerial surveys, ground surveys, and consultation with local resources were utilized for reconnaissance of the impacted area. The BAER Team held consultation meetings with BLM Saint George Field Office and NPS Zion National Park personnel to identify potential issues of concern and determine priority areas for resource assessment. Data on vegetation resources, non-native invasive plant species, and local agency seeding and rehabilitation strategies was obtained during these meetings.

Ground surveys were conducted July 11, July 15 and July 17 to refine and calibrate aerial survey (July 11 and 15) data and determine fire effects to vegetation. Ground reconnaissance included hiking to remote areas and recording observations on plant community types, burn mortality, non-native invasive species, and suppression damage. Much of the east and north part of the fire were not visited on the ground due to a lack of access and very high temperatures. Some locations in the northern part of the burn are only accessible by helicopter or climbing. The BAER team also visited the locations of Joint Fire Science research in Zion Canyon and recent burned areas on adjacent lands to observe post-fire response.

The park has a new vegetation map (Cogan et al., 2003) that was used for park vegetation assessments. This map has a 1 mile buffer and did not cover the entire area of the fire. A vegetation map generated from the Southwest Regional Gap Analysis Project 'PROVISIONAL' Landcover data (2004) as used to assess the whole fire rather than just the park vegetation.

Field surveys and plot data taken during the vegetation mapping effort from 2000-2003 were examined for the occurrence of cheatgrass and red brome. Twenty eight plots occurred in the burned area and about 30 plots surrounding the burn were also examined.

Zion wildlife staff visited the site of the spotted owl PAC and nest site closest to the fire on July 19, 2006.

The following is the methodology from the Soil and Watershed Assessment and describes the process used to make the soil burn severity. There was no ground truthing of this map to get thresholds for differenced Normalized Burn Ratio for vegetation. It is recommended that the park will do an extended assessment and CBI plots next summer to assess post fire burn severity for the Kolob.

1. Satellite Mapping Using Burned Area Reflectance Classification Map

A Burned Area Reflectance Classification (BARC) map is a satellite derived map of post-fire condition that classifies the burned area into unburned, low, moderate and high. The satellite image was taken by Landsat 5 on

July 8, 2006 and the image was initially classified using bands 7, 4, and 3 in positions 1, 2, and 3. The BARC map was verified by field visits and helicopter reconnaissance, and changes were made to the initial BARC classification based on GPS points and field data to produce the final soil burn severity and watershed response maps. The field forms that were used to record site specific information at seven BARC verification GPS points are included in Appendix A and also shown on the Analysis Watersheds Map in Appendix B. The watershed response map was used to predict the runoff response of the watersheds and rates of erosion.

2. Soil Burn Severity

Soil burn severity is not the same concept as fire intensity and fire severity as recognized by fire behavior specialists. Fire intensity and fire severity relate to fire behavior and fire effects on overstory and understory vegetation, respectively, while soil burn severity relates specifically to effects of the fire on soil conditions. Although soil burn severity is not primarily a reflection of fire effects on vegetation, vegetative conditions and pre-fire vegetation density are among the indicators used to assess soil burn severity.

Soil burn severity parameters include changes in litter and duff (vegetative ground cover), loss of soil structure, destruction of fine and very fine roots in the surface horizon, and development of hydrophobic (water repellent) soil surfaces. In some cases there may be complete consumption of vegetation by fire with little effect on soil. In general, the denser the pre-fire duff and litter layer and the longer the residence time of the fire, the more severe the effects are on soil. For example, deep ash after a fire usually indicates a deeper litter layer prior to the fire, which generally supports longer residence times.

C. Findings

The over-riding concern from park fire and resource staff is the spread and dominance of cheatgrass into the 10,000 plus acres that burned in park during the Kolob wildfire and the opportunity for an increase in fires in lower elevation habits due to the altered fuel loads. Without treatments to reduce cheatgrass these lower elevation site will experience a vegetative type conversion and increasing fire frequency. This thread runs throughout the findings, specifications and management recommendations.

Vegetation Communities:

The largest vegetation type in the park is Pinyon Juniper, 75% of the acres burned in the Kolob fire also burned in that type (Table 1 and Map III-E). It can be expected that cheatgrass will dominate much of this community following the fire starting a trend of increasingly frequent fires and a loss of many of the native trees, shrubs and grasses. The majority of the seedbank in the community is found under the dripline of the trees, unfortunately this is the area with the highest burn severity to both litter and soil. There is a minor to major native herbaceous component across this type that will regenerate and flourish if not out competed by cheatgrass. This native herbaceous component along with the sprouting shrubs is the vegetation that would be favored by the herbicide treatment with PlateauTM. See below in the invasive plant section for more on this herbicide and potential treatments.

The vegetation community that causes the greatest concern for natural regeneration is the Juniper Big Sagebrush woodland. The majority of this vegetation type is in the Crater Hill area. A combination of fine sandy and cindery soils, high erosion potential and little to no native herbaceous component makes this a particular challenge for post fire revegetation. From the short term watershed perspective a take over of this area by cheatgrass would provide cover and stabilize soils, but longer term the more frequent fires and associated vegetative cover reduction would cause greater erosion potential. Treatment with PlateauTM to control the cheatgrass, but the lack of native herbaceous component means that the site would potential be mostly bare and after the residual effects of PlateauTM diminishes (2-3 years) the site would be occupied by cheatgrass. Ideally, we would have like to treat with PlateauTM and seeded with native grasses and forbs from Zion. Maintaining genetic integrity is a primary concern in national parks. The park has recently started a seed increase program, but is only in its third year and there is less than 50 pounds of seed available at this time. Zion initiated a seed increase program for local grass species through an interagency agreement with the Natural Resource Conservation Service. The NRCS Plant Material Center in Los Lunas, New Mexico is currently growing out 5 grass species. They and possibly the center in Tuscon, Arizona would be tasked with increase production of bottlebrush squirreltail (*Elymus elymoides*) and sand dropseed (*Sporobolus crypthus*) two native species that do well in broadcast seeding and compete with cheatgrass.

There has been a growing awareness recently of the importance of plant genetics in revegetation projects in the National Park Service. Genetic variation within plant species can influence their long-term chances of survival and growth. An ecotype is a certain population of plants within a species that, due to different genetics, has a different form (height, leaf size, etc.), flowering time, resistance to diseases/pests or hardiness that is adapted to certain local environmental conditions. Plant ecotypes are not different species because they can still interbreed. Taking plant species that are of one ecotype and moving them to an area with different environmental conditions, such as different freezing stresses or different moisture levels, can result in poor growth or death (Falk et al., 2001).

A second alternative was to seed with a cereal grain or sterile hybrid like Regreen to provide vegetative cover and treat with Plateau™. But the mode of action for Plateau™ targets annual grasses and the planting would have been killed like the cheatgrass. Other options considered included no actions and investigation of Plateau™ resistant wheat, these were also rejected.

The preferred alternative depicted on Map V-5-A, is to plant the area with winter wheat to provide short term cover and compete with cheatgrass. Winter wheat will emerge after fall rains at the same time as cheatgrass and having the same phenology compete with cheatgrass throughout the winter and early spring. It has a low probability of self seeding and will stay on the site as residual (dead) cover for a couple of years. In the Fall of 2007 the area would be treated with Plateau™ to keep cheatgrass down while the seed increase program has a chance to grow (V-3). The last step would be to broadcast seed in the Summer of 2009.

While wetland/riparian and exotic riparian where a small acreage (193 acres) of the fire this communities provide many critical habitat functions for a number of wildlife species. Soil burn severity will be used to give an estimate of fire impact on these systems (Map III-B). In the wetland and riparian category, a small percentage of the area (2%) shows high severity (Table 4). The majority of this community is either unburned (26%) or low severity (49%). There could be some concern for the cottonwoods in these systems due to crown scorch. In the exotic riparian type all the areas are unburned or low burn severity. This should allow for more stable vegetative community during fall and winter rain events. And some recovery of these areas next growing season, baring concerns raised by the watershed analysis.

Table 4 - Kolob Wildfire – Soil Burn Severity – Acres and Percentages by plant community and by severity class

Plant Community (from NME_14CLS in GIS)	Severity											
	UNBURNED			LOW			Moderate			HIGH		
	acres	By Plant Comm	By Sev	acres	By Plant Comm	By Sev	acres	By Plant Comm	By Sev	acres	By Plant Comm	By Sev
Juniper P/J	816	10%	66%	2428	31%	69%	4561	58%	81%	76	1%	52%
Shrublands	42	6%	3%	273	38%	8%	393	54%	7%	14	2%	10%
Bare-Soil/Stone Formations	186	35%	0	212	40%	6%	124	23%	2%	7	1%	5%
Desert Shrublands	33	8%	3%	259	59%	7%	148	34%	3%		0%	0%
Mountain Shrub	85	21%	7%	68	17%	2%	196	50%	3%	46	12%	31%
Grass / Herbaceous Lands	5	2%	0%	125	54%	4%	101	44%	2%		0%	0%
Wetland / Riparian	26	14%	2%	93	49%	3%	69	36%	1%	3	2%	2%
Ponderosa Pine	20	29%	2%	22	33%	1%	24	37%	0%	1	1%	1%
Exotic Grasses	7	29%	1%	11	44%	0%	7	27%	0%		0%	0%
Slickrock	10	62%	1%	6	34%	0%	1	4%	0%		0%	0%
Exotic Riparian	1	31%	0%	2	64%	0%	0	5%	0%		0%	0%
Douglas Fir	1	35%	0%	1	44%	0%	0	20%	0%	0	1%	0%
Grand Total	1234			3500			5625			147		
	12%			33%			54%			1%		

Invasive Plants:

Within the area of the burn over 70% of the plots visited by the vegetation mapping effort showed at least trace amounts cheatgrass and red brome (See figure in appendix A) Field visits to the areas along the Kolob road show the understory almost totally dominated by cheatgrass with very little native component (see photo in appendix A). Areas in the Crater Hill area had cheatgrass as well. In the heavier clays soils in the area galleta grass (*Pleuraphis jamesii*) was already greening up from a recent rain. In the area surrounding the burn, to the east and north exotic grass occurrence was much less about 40%. Additional survey of the West Rim Trail showed only trace amounts at high elevations. Within the burn it can be expected that cheatgrass populations will explode post fire.

The area around the Kolob Terrace and Smith Mesa Road had understory vegetation that were totally dominated by cheatgrass prefire. Examining the area just up the road, near the Subway there is little visible evidence of other herbaceous native plants. There is concern about this area not having enough residual native species to occupy the site and compete with cheatgrass after the effect of the herbicide treatment fades. Therefore, Specification V-4 describes a broadcast seeding treatment for the ¼ buffers around these roads (see treatment map V-4-A) of 481 acres. This area will be treated with herbicide after planting as described in Specification V-1. As stated previously, the park does not currently have enough 'local' seed to do this treatment. But after discussions with park staff, a four seed mix of native species will be applied to this area. The four species are squirreltail, sand

dropseed, scarlet globemallow and Palmer's penstemon. All the seeds except sand drop seed have been collected within 50 miles of Zion NP and are seed sources. The sand dropseed was collected in New Mexico. A line will be drawn around the seeding area and any future seed collection from this area will only be seeded in this area and not used the rest of the park. The species chosen all have two characters in common; they establish well in broadcast seedings and are 'weedy' enough to compete with cheatgrass to occupy the site. The rate of herbicide application is matched to the tolerances for squirreltail and sand dropseed.

Research initiated by park staff, USGS scientist Matt Brooks and Lake Mead Restoration Biologist, Curt Deuser with funding from Joint Fire Science examining the effects of fire, seed and Plateau™ (Louie et al, 2005). The treatments were applied starting in the fall 2005 and are now one year post treatment. Preliminary results show that fire and fall Plateau™ treatment at a rate of 12 oz/acre are the most effective in reducing cheatgrass and allowing in situ and seeded native perennials to occupy the site. The study also shows good emergence of seeded species. Seed was broadcasted by a mechanical seed spreader and then gently raked in.

Cheatgrass control is only effective when combined with treatments that establish perennial species (Harris and Goebel 1976; Klemmedson and Smith 1964; Mosley et al. 1999). In areas where there already is a significant component of perennials present, chemicals can control cheatgrass (Mosley et al. 1999). Field trials with Plateau application show 90-100% reduction of cheatgrass for at least 2 years after fall application. Spring application of imazapic has shown mixed results (BASF, 2006). Field trials with Journey™ in Zion Canyon have shown that it works better than Plateau in spring application, but still not as effective as fall Plateau application (personal comm., Cheryl Decker). At the higher application rate, the herbicide may have an even longer residual effect. The alternative herbicide treatment would be to use Journey™ in the spring, but because of the glyphosate used in Journey™ to keep the kill the post emergence cheatgrass, this could cause damage early emerging native perennial plants.

Results of a study released in 2002 by BASF and Synergy Resource Solutions Inc. show that fire intensity can be significantly reduced in cheatgrass-infested areas treated by Plateau (Kury et al., 2002). The study found that the height of flames in treated areas can be reduced by as much as 88 percent and the rate at which the fire spreads can be lowered by as much as 95 percent, compared to untreated areas. Reducing fires to this level can allow firefighters to control blazes with hand tools and create effective firebreaks for communities in cheatgrass-infested areas.

The active ingredient in Plateau, Imazapic, is not mutagenic or teratogenic and would not be expected to have any adverse effect on big game and none game species when used as labeled. It is considered to be nontoxic to mammals, birds, fish, and aquatic invertebrates. If ingested by mammals, imazapic is rapidly excreted in the urine and feces and does not bioaccumulate in animals. In addition to the acute toxicity and irritation studies conducted with Plateau show this product to be a non-toxic and non-irritating. The potential exposure to wildlife following a labeled application of imazapic would not be expected to have any adverse effects. Imazapic is non toxic to fish and aquatic vertebrates with a 96 hour LD50 value greater than 100 mg/L (comparable to the toxicity of caffeine).

Imazapic has limited mobility in soil and soil binding is a complex function of soil pH, texture and organic matter content. The binding of imazapic to soil has been observed to increase with time. Imazapic has been shown to have little lateral movement in the soil. The major route of imazapic loss from the soil is through microbial degradation. From a total of nine soil dissipation studies conducted with imazapic, no residues were found below the 18-24 inch soil layer. After an application of imazapic, there is little potential for movement off the treated area. Imazapic is not volatile and binds moderately to most soil types once applied. Physical movement of the treated soil would be most common way for significant quantities of imazapic to move outside the treatment area.

Mitigation measures to keep imazapic out of park waters would be to minimize spray drift and leave a sufficient untreated buffer area adjacent to surface waters to prevent any potential spray drift from reaching surface water. All acreages in these proposals have a 100 foot buffer on either side of the streams. Toxicology information is found in the EPA Federal Register at the following web address:

<http://www.epa.gov/fedrgstr/EPA-PEST/1999/October/Day-06/p25842.html>
<http://www.epa.gov/fedrgstr/EPA-PEST/1996/March/Day-20/pr-615.html>

The 2005 Zion Fire Management Plan and EA allow for herbicide use by hand (backpack), ATV and truck. It also says that aerial applications of herbicides can also be used where large invasive patches occur or where other

application treatments are impractical or inefficient. But, any aerial use of herbicides will require additional NEPA compliance. We analyzed an alternative for herbicide use that is covered by the current EA, but using an application rate of 2 acres per day per person. With a two person crew it will take approximately 2 weeks to treat the roadsides, trails and routes in the fire, 29 acres. That treatment would have left 99.7% of the fire open for cheatgrass to invade, so the alternative was rejected.

Aerial application by helicopter is more accurate and precise in application rate than hand spraying. It is estimated that a helicopter can spray 50 acres per hour or about 600 acres per day (6 hours of flight time). The helicopter is recommended due to the ability to fly uneven, difficult terrain; ability fly slower allowing for prescribed water volume, increased application and local landing and refilling ability. The smallest area that we are recommending is treated 2,448 acres - roads, trails and routes with a quarter mile buffer on either side within the fire on Zion NP, would take 122 days with a 10 person crew. Much of the area would be difficult if impossible to traverse. Therefore, we are recommending that the park complete a EA with a purpose is to determine if the aerial application of herbicides within the park poses a significant risk to the human environment, and in doing so comply with the National Environmental Policy Act (NEPA) and have written a specification V-2 for it.

Three different levels of treatment of aerial application of Plateau™ are proposed (Table 5 and map V-!-A) depending on funding. The preferred alternative, Treatment 1 - NPS Fire offers the park the maximum protection on the fire behavior and ecological stability front. Reduction of flame height and rate of spread with the reduction of fine fuels from cheatgrass will give firefighters the best chance of catching fires while they are small. This should give the park a better chance to both stop fires from moving onto the park from private and BLM lands and off the park in WUI areas. The reduction of cheatgrass will also help to give the vegetation that was burned time to recover and reduce fine fuels, more frequent fire and loss of native trees, shrubs, forbs and grasses.

Treatment 2, ¼ mile buffer offers a middle of the road approach trying to maximize fire protection on the west boundary with WUI. Application along the east boundary of the fire will keep cheatgrass from invading deeper into the park and to limit its extent to the lower elevation vegetation types drawing a 'line in the sand' to keep most of the higher elevation vegetation communities intact. This treatment also buffers all roads, trails, and routes with by a ¼ mile on either side to limit the spread of cheatgrass along these major invasion corridors. From the fire behavior perspective, this may prevent human starts from these areas from moving further into the park and provide defensible space for fighting fire. Treatment 3, roads, trails and routes only provides the least protection but does buffer the roads and trails as in Treatment 2.

Table 5 – Proposed Aerial Herbicide Treatments for the Kolob Fire – All treatment have 100 foot buffer on either side of the streams to mitigate herbicide drift (Specification V-1)

Treatment	Acres	Description	Rationale
1 - NPS Fire – Preferred Alternative	8353	All NPS lands within the Kolob fire except for the Crater hill area	Minimize cheatgrass spread, reduce fire frequency, increase ability to control fire and prevent ecological type conversion
2 – ¼ mile buffer	4485	A ¼ mile buffer of the east fire perimeter, west park boundary and both sides of roads, trails & routes	Provide a buffer to cheatgrass invasion further into the park(east), minimize fire behavior and flammability on the NPS boundary, roads and trails to maximize firefighter and public safety and reduced cheatgrass infestation along these corridors
3 – ¼ mile roads, trails, & routes only	2448	A ¼ mile buffer on both sides of roads, trails and buffers	Minimize cheatgrass spread from major invasion corridors (roads and trails) and provide more easily defensible space for firefighters due to reduce flame height and rate of spread

In addition to treating for cheatgrass, there is a specification, V-6 to survey and remove other invasive plants of management concern along burned road sections, dozer line, known areas with noxious and invasive plants, retardant drops and other areas of special concern. Control measures will be applied in conjunction with monitoring and assessment in areas where invasive plants are found and are likely to spread into burned or disturbed areas. This request covers all three years following the wildfire.

MIST tactics were followed for the most part on the fire so the spread of invasive plant seeds and plant parts into the fire area by suppression activities should be limited. Spread occurs when dozers and other equipment are not cleaned of all soil and plant material before transport to a new area and by driving dozers and other equipment through infestations adjacent to the suppression efforts. There was a small section of dozer line and some fire retardant dropped in the park. Both of these locations should be checked for exotic plants.

Threatened and Endangered Species:

No owl primary activity centers (PAC) were burned during the fire and aircraft flight patterns were adjusted for PACs and their buffers. Zion park staff visited PAC and nest site closest to the fire and found the owls at the nesting site. The fire did burn within the ½ mile buffer of this PAC. This area is buffered out of the proposed aerial herbicide treatment as required by the Biological Opinion (USFW, 2005).

There was no direct impact to the Shivwits milkvetch plant populations, in either the ¾ mile buffer or proposed critical habitat. The largest concern with this population will be an increased chance of fire reaching this area with a large increase in continuous fine fuels in the area of the Kolob fire without treatment of the cheatgrass.

Sensitive Species:

Four potential peregrine falcon eyries occurred in the burn area, but due to their clifftop location impact due to fire is not expected.

Four known populations of sensitive plants were within the burn perimeter; Zion daisy, (*Erigeron sionis*), Religious daisy, (*Erigeron religiosus*) and Zion penstemon, (*Penstemon humilus* var. *obtusifolia*). Religious daisy and Zion penstemon both occur in habitats that have potential to burn. There was no attempt to examine these sites during the assessment. A specification, V-8 has been written with a purpose to determine if any of the known populations described above are present within the burn area, and if so, describe their abundance, condition, and any competitive threats that may exist from exotics that may be addressed through spot applications of herbicide.

Wildlife Habitat:

Fire can cause indirect effects to Mexican Spotted Owl habitat by altering vegetation structure and composition, thereby affecting small mammal habitat. This finding will only summarize effects to vegetation structure and composition. No direct effects will be examined. If direct effects need to be examined, a wildlife assessment can be done and amended to the plan.

From the Biological Opinion there are Reasonable and Prudent Measures (USFW, 2005); only the bullets that apply will be included below. Reasonable and Prudent Measure Number 2, states that Zion National Park shall fully implement the following measures to minimize harm to the Mexican spotted owl, California Condor, desert tortoise, or Shivwits milkvetch through destruction of their habitats, without placing firefighter personnel at risk:

- b. Rehabilitation of the burned areas shall be ensured, including seeding and planting of native perennial species if necessary. Revegetation will attempt to reconstruct the natural spacing, abundance, and diversity of native plant species.
- c. Recovery of vegetation shall be monitored, including establishment and monitoring of paired plots, inside and outside of the burned area unless Zion National Park and the Service concur that monitoring is not required.
- e. The effectiveness of suppression activities and threatened and endangered species conservation measures shall be evaluated after a fire. Procedures shall be revised as needed.

Negative effects include the initial loss of owl prey habitat components such as herbaceous cover, down logs, and snags. The effects of fire on the prey base of the spotted owl are complex and are dependent on the variations in fire characteristics and in prey habitat. Fire intensity, size, and behavior are influenced by numerous factors such

as vegetation type, moisture, fuel loads, weather, season, and topography. See discussion about changes in vegetation and ecosystem integrity in the vegetation communities' findings above.

The following discussion of vegetation burn severity is based on the soil burn severity map as described in the Soils and Watershed Assessment (Map III-B). Initial assessments of soil burn severity typically over predict vegetation burn severity. But in this ecosystem with so much bare ground and rock, I think that the extended assessment will show higher burn severity due to the inclusion of high and low severity burn in a single pixel. Zion park staff should follow up on the Kolob with an extended burn severity assessment and Composite Burn Severity plots to adjust the severity thresholds appropriately for this system.

For the purpose of evaluating habitat I will evaluate the three highest elevation vegetation types found in the fire. All acreages and percentages come from Table 4, found earlier in this assessment. Only 2.1 acres of Douglas Fir Forest occurred in the burn area. No high burn severity was recorded in this type. Most of the acreage is unburned (0.7 acres), and low (0.9 acres). Just 0.4 tenths of an acre occurred in medium soil burn severity. Even though the total acreage of Douglas fir is small, it might be a priority to look at in the extended assessment because of its value as suitable habitat. Ponderosa pine has 67 acres, with only 1 acre in high, 24.4 acres in moderate. The majority of acres is in low (22 acres) and unburned (19.6 acres). Mountain shrub includes mountain sagebrush and gamble oak vegetation associations with 394 acres in the burn perimeter. Just 12% (46 acres) was in high, with 50% (196 acres) in moderate burn severity. Low severity was 17% (68 acres) and unburned 21% (85 acres). The gambel oak association can be expected to vigorously sprout totally recovering in 5-10 years.

At the request of US Fish and Wildlife, a more specific evaluation for the intersection of the MSO PAC buffer and the Kolob fire evaluation, 40 acres has also been done. None of the PAC closest to the fire (253 acres) burned in the Kolob fire. The 'burned' portion of the buffer is 2.5% of the total PAC and ½ mile buffer (1603 acres in PAC and Buffer). In the intersection, 35% of the 'vegetation' is rock, see Table 6 below for more detailed numbers). Overall, only 30% of the intersect burned. In the low soil burn severity, 3.4 acres and moderate severity, 8.8 acres. Three vegetation types have gambel oak, associated with owl foraging; this comprises 4.6 acres or 11.5% of the area. Some of this burned as moderate severity, but gambel oak is a very strong root sprouter as stated earlier. The other area with more than an acre of moderate soil burn severity is in pinyon juniper.

Table 6 – Soil Burn Severity in acres for the intersection of Mexican Spotted Owl PAC buffer and the Kolob Fire by vegetation association from the 2003 Zion vegetation map

Vegetation Association from 2003 Zion Vegetation Map	Low	Moderate	Unburned	Grand Total
Arctostaphylos patula Shrubland Complex	0.1	0.5	3.9	4.5
Artemisia tridentata Shrubland Complex	0.3	0.8	1.3	2.4
Cercocarpus intricatus Slickrock Sparse Vegetation			0.7	0.7
Navajo Formation (Sandstone)	0.9	0.6	11.8	13.3
Pinus ponderosa / Arctostaphylos patula Woodland			0.1	0.1
Pinus ponderosa Slickrock Sparse Vegetation	0.1		1.8	1.9
Pinus spp. - Juniperus spp. Woodland Complex	1.4	4.4	3.4	9.1
Populus fremontii - Fraxinus velutina Woodland	0.0		3.2	3.3
Pinus spp. - Juniperus spp. / Quercus gambelii Woodland Complex			0.2	0.2
Quercus gambelii Shrubland Alliance	0.3	2.5	1.1	3.9
Quercus gambelii Woodland	0.2		0.3	0.5
Grand Total	3.4	8.8	27.7	39.9
	8.5%	22.1%	69.5%	100%

IV. RECOMMENDATIONS

A. Emergency Stabilization Specifications

None

B. Rehabilitation Specifications

V – 1. Aerial Herbicide - BAR

Fall aerial herbicide application of imazapic (trade name Plateau) is the best chance the park has of slowing an exponential increase of cheatgrass in the Kolob Wildfire. With most of the burn area with trace amounts of cheatgrass before the burn it is expected with the increase nutrients and bare ground that cheatgrass will dominate much of the area post fire. There is major to minor native herbaceous components throughout the burn (exceptions roadside and Crater Hill seeding specifications V-3 and V-4) that can be expected to recover and flourish after the treatment without the competition of cheatgrass. There are three treatments options in this specification, only the preferred alternative is described here. See vegetation assessment and Specification V-1 for the details of lower cost options. All options are tactical to minimize invasion of exotic cheat grass. Preferred alternative to spray whole burn inside the park save and except the, no spray zones (1520 acres) and the Crater Hill area (633 Acres) for a total spray 8353 acres (Map V-1-A).

V – 2. Environmental Compliance - BAR

Mechanical herbicide treatments are covered by the Zion Fire Management Plan EA (April 2005). Additional NEPA is required to do aerial application of herbicides. The scope and scale even the smallest herbicide treatment in Specification V-1 makes helicopter spraying the best, cheapest and most accurate option for this application. The purpose is to determine if the aerial application of herbicides within the park poses a significant risk to the human environment, and in doing so comply with the National Environmental Policy Act (NEPA).

V – 3. Native Seed Increase - BAR

Zion initiated a seed increase program for local grass species through an interagency agreement with the Natural Resource Conservation Service. The NRCS Plant Material Center in Los Lunas, New Mexico is currently growing out 5 grass species. They and possibly the center in Tuscon, Arizona would be tasked with increase production of bottlebrush squirreltail (*Elymus elymoides*) and sand dropseed (*Sporobolus cryptandrus*) two native species that do well in broadcast seeding and compete with cheatgrass. This activity is to produce a seed bank of two native grass species, *Elymus elymoides* (bottlebrush squirreltail), and *Sporobolus cryptandrus* (Sand dropseed). The seed will later be broadcast on and in the direct of vicinity of Crater Hill for a total of 21 acres of production fields of these grasses will be in production at the end of the time frame. The seed will be applied to 924 acres at Crater Hill in June of 2009. (See V-5 and Map V-5-A).

V – 4. Aerial Seeding - Roadsides - BAR

The purpose of this treatment is to reestablish native plants in areas that have in the last 2-3 years been heavily invaded by cheat grass. Without such treatment in association with herbicide application (see specification V-1), the post-fire scenario is likely to be one where cheat grass and other undesirable exotics will be outcompete at the expense of natives. The area around the Kolob Terrace and Smith Mesa Road had understories that were totally dominated by cheatgrass prefire. Examining the area just up the road, near the Subway there is little visible evidence of other herbaceous native plants. There is concern about this area not having enough residual native species to occupy the site and compete with cheatgrass after the effect of the herbicide treatment fades. Therefore, Specification V-4 describes a broadcast seeding treatment for the ¼ buffers around these roads (see treatment map with specification) of 481 acres (Map V-4-A). This area will be treated with herbicide after planting as described in Specification V-1.

V – 5. Crater Hill Revegetation - BAR

The purpose of this treatment is to reestablish native herbaceous species in areas that have in the last 2-3 years been heavily invaded by cheatgrass. Without such treatment, the post-fire scenario is likely to be

one where cheatgrass and other undesirable exotics will out compete at the expense of natives. The proposal takes a phased approach, sometime called assisted restoration. The preferred alternative is to plant the area with winter wheat to provide short term cover and compete with cheatgrass. Winter wheat will emerge after fall rains at the same time as cheatgrass and having the same phenology compete with cheatgrass throughout the winter and early spring. It has a low probability of self seeding and will stay on the site as residual (dead) cover for a couple of years. In the Fall of 2007 the area would be treated with Plateau™ to keep cheatgrass down while the seed increase program has a chance to grow. The last step would be to broadcast seed in the Summer of 2009 (Map V-5-A).

V – 6. Exotic Monitoring and Control - BAR

The purpose of this specification to survey and remove of invasive plants of management concern along burned road sections, dozer line, known areas with noxious and invasive plants, retardant drops and other areas of special concern. Control measures will be applied in conjunction with monitoring and assessment in areas where invasive plants are found and are likely to spread into burned or disturbed areas. This request covers all three years following the wildfire.

Detection of new occurrences of noxious and invasive plant species in areas burned or disturbed by suppression activity, and monitoring of known populations will be conducted to assess if further actions are required to control the spread of these plants into burned and disturbed areas. Any control will be conducted using Integrated Pest Management practices.

V – 7. Sensitive Plant Monitoring – Spot Control - BAR

The purpose is to determine if any of the known sensitive plant populations present within the burn area, and if so, describe their abundance, condition, and any competitive threats that may exist from exotics that may be addressed through spot applications of herbicide. Four known populations of sensitive plants were within the burn perimeter; Zion daisy, (*Erigeron sionis*), Religious daisy, (*Erigeron religiosus*) and Zion penstemon, (*Penstemon humilus* var. *obtusifolia*). Religious daisy and Zion penstemon both occur in habitats that have potential to burn. There was no attempt to examine these sites during the assessment.

V – 8. Treatment Effectiveness Monitoring - BAR

The combination of landscape level herbicide treatment and directions from the US Fish and Wildlife Service about vegetative recovery for critical habitat make a persuasive argument for scientifically based, statistically sound monitoring of treatment effects on the Kolob wildfire. A plot designed based on ongoing JFSP research in Zion Canyon and other work in the Great Basin combined with control areas within treatments is necessary to determine if the treatments are effective and tie the monitoring work to experimental and regional work. In addition to the plot design used in Zion Canyon, we recommend the addition of a Composite Burn Index Plot at each location and nested frequency to document the occurrence of cheatgrass and red brome at a smaller scale. Additionally as prescribed by USF&W, work both inside and outside the fire boundary needs to be examined.

At a minimum the following treatments and controls need to be monitored.

- V-1 Aerial herbicide treatment
- V-4 Aerial seeding with native grasses and forbs around the Kolob Terrace and Smith Mesa Roads. This area will be treated with both herbicide and seed.
- V-5 Crater Hill Revegetation – a phased treatment of winter wheat seeding followed by herbicide application and finally aerially applied native seed from the seed increase program.
- Inside and outside of the burn per USF&W
- Controls could be placed in the buffers for no herbicide. But it likely that given the need for paired locations of vegetation, soils and topography that other areas would not be treated.

These controls could be treated at a later date after the monitoring had concluded and been shown to be effective.

C. Management Recommendations – Non-Specification

Water quality monitoring with the current park program should be continues. It may need to take additional measurements to 'record observations of increased level of woody debris and ash entering hydrologic systems to understand the process for future fire and as park of a Burned Area Emergency Rehabilitation.', from the Biological Opinion (USFW, 2005) and to ensure no effect of herbicide treatments on aquatics.

Resource Advisor training and maps should reflect the current language of the Biological Opinion (USFW, 2005). During the annual Resource Advisor 'refresher' that is held before the prescribed and wildfire season to keep everyone current on both culture and natural resource issue and insure good coordination. Reminders about key T&E species mitigations and obligations and a review of the previous season could help facilitate 'real' world experiences and questions for less experienced Resource Advisors.

The park should do an extended assessment for Burn Severity and ground-truthing CBI plots next summer to assess post fire burn severity for the Kolob. Initial assessments of soil burn severity typically over predict vegetation burn severity. But in this ecosystem with so much bare ground and rock, the extended assessment will show higher burn severity due to the inclusion of high and low severity burn in a single pixel. Zion park staff should follow up on the Kolob with an extended burn severity assessment and Composite Burn Severity plots to adjust the severity thresholds appropriately for this system.

V. CONSULTATIONS

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Allen Bruner and Brent Hentzler, Wildlife Technican, Zion NP	(435) 772-0220

VI. REFERENCES

Barney, M.A., and N.C. Frischknecht. 1974. Vegetation changes following fire in the pinyon-juniper type of west central Utah. J. Range Manage. 17:91-96.

BASF, 2006. Plateau® Herbicide information. <http://www.vmanswers.com/products.aspx?pid=10>

Bunting, S.C. 1987. Use of prescribed burning in juniper and pinyon juniper woodlands, p. 141-144. In: R.L. Everett (ed.). Proc-Pinyon juniper conference. USDA Forest Serv. Gen. Tech. Rep. INT-215.

Campbell, R.B., Chappell, L., Greenhalgh, K. 2003. Personal communication, data from unpublished Fishlake National Forest Wildland Fire Use Plan. Table 16: Analysis by Vegetation Cover Type for the Combination of all Subsections for the Fishlake National Forest. Richfield, UT 84701 As Referenced by: Merzenich, J. and L. Frid. 2005. Projecting Landscape Conditions in Southern Utah Using VDDT. In: M. Bevers and T.M. Barrett (comps.). 2005. Systems Analysis in Forest Resources: Proceedings of the 2003 Symposium; October 7-9, Stevenson, WA. General Technical Report PNW-GTR-000. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. pp. 157-163.

Cogan, D., M. Reid, K. Schulz, and M. Pucherelli. 2004. Zion National Park Vegetation Mapping Project, Final Report and Map. Technical Memorandum 8260-03-01, Remote Sensing and GIS Group, Technical Service Center, Bureau of Reclamation, Denver, Colorado.

Everett, R. L. 1987. Proceedings--Pinyon-Juniper conference. General Technical Report INT-215. U.S. Forest Service Intermountain Research Station, Ogden. UT, 581 pp.

Falk, Donald A., Eric Knapp, Edgar O. Guerrant. 2001. An introduction to restoration genetics. <http://www.nps.gov/plants/restore/pubs/restgene/index.htm>

Harris, G.A., and C.J. Goebel. 1976. Factors in Plant Competition in Seeding Pacific Northwest Ranges. Washington State University, Agricultural Experiment Station. Bulletin 820.

Jameson, D.A., J.A. Williams, and E.W. Wilton. 1962. Vegetation and soils of Fishtail Mesa, Arizona. Ecology 43:403-410.

Klemmedson, J. O. and J. G. Smith. 1964. Cheatgrass (*Bromus tectorum* L.). Botanical Review 30:226-262.

Kury, B.K, J.D. Alexander, and J. Vollmer. 2002. Data Collection and Fire Modeling Determine Potential for the use of Plateau® Herbicide to Establish Fuel Breaks in *Bromus tectorum*-Dominated Rangelands. 2002 Association of Fire Ecology Annual Conference. San Diego , CA. December 3-5.

Louie, D.L., and M.L. Brooks, C. Deuser, and J. Passek. 2005. Evaluate Treatments to Reduce Hazardous Fine Fuels Created by Non-native Plants in Zion Canyon. A proposal for the Joint Fire Science Program, AFP 2005-2-Task 1 Project # 05-2-1-13.

Mosley, J. C., S. C. Bunting, and M. E. Manoukian. 1999. Cheatgrass in R. L. Sheley and J. K. Petroff, eds. Biology and Management of Noxious Rangeland Weeds. Oregon State University Press, Corvallis.

USDI, USFWS. 1995a. Recovery Plan for the Mexican Spotted Owl: Vol. 1. Albuquerque, New Mexico.

USFW, 2005. Formal Section 7 Consultation for the Environmental Assessment for the Zion National Park Fire Management Plan. Utah Field Office US Fish and Wildlife Service, Ecological Services, West Valley City, Utah.

USDI, NPS. 2001d. Zion National Park. Peregrine falcon management and monitoring information.

USDI, NPS, 2005. Wildland Fire Management Plan and EA. Zion National Park, Springdale, Utah.

UDWR. 2003. Baseline Virgin Spinedace (*Lepidomeda mollispinis mollispinis*) Population Demographics in an Area Proposed for Floodplain Restoration and a Reference Reach, North Fork of the Virgin River, Zion National Park, Fall 2002.

West, N.E., and W.C. Loope. 1977. Annual report to Zion National Park on studies of fire frequency in backcountry ecosystems of Zion National Park. Zion National Park, Utah.

Zouhar, Kris. 2003. Tamarix spp. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: <http://www.fs.fed.us/database/feis/> [2006, July 20].

Kara Paintner, NPS, Fort Collins, CO

970-267-2121

Appendix A – Figures and Photos for Vegetation Assessment

Figure with locations of vegetation plots from the 2004 vegetation map. Stars are plots where cheatgrass or red bromes were observed

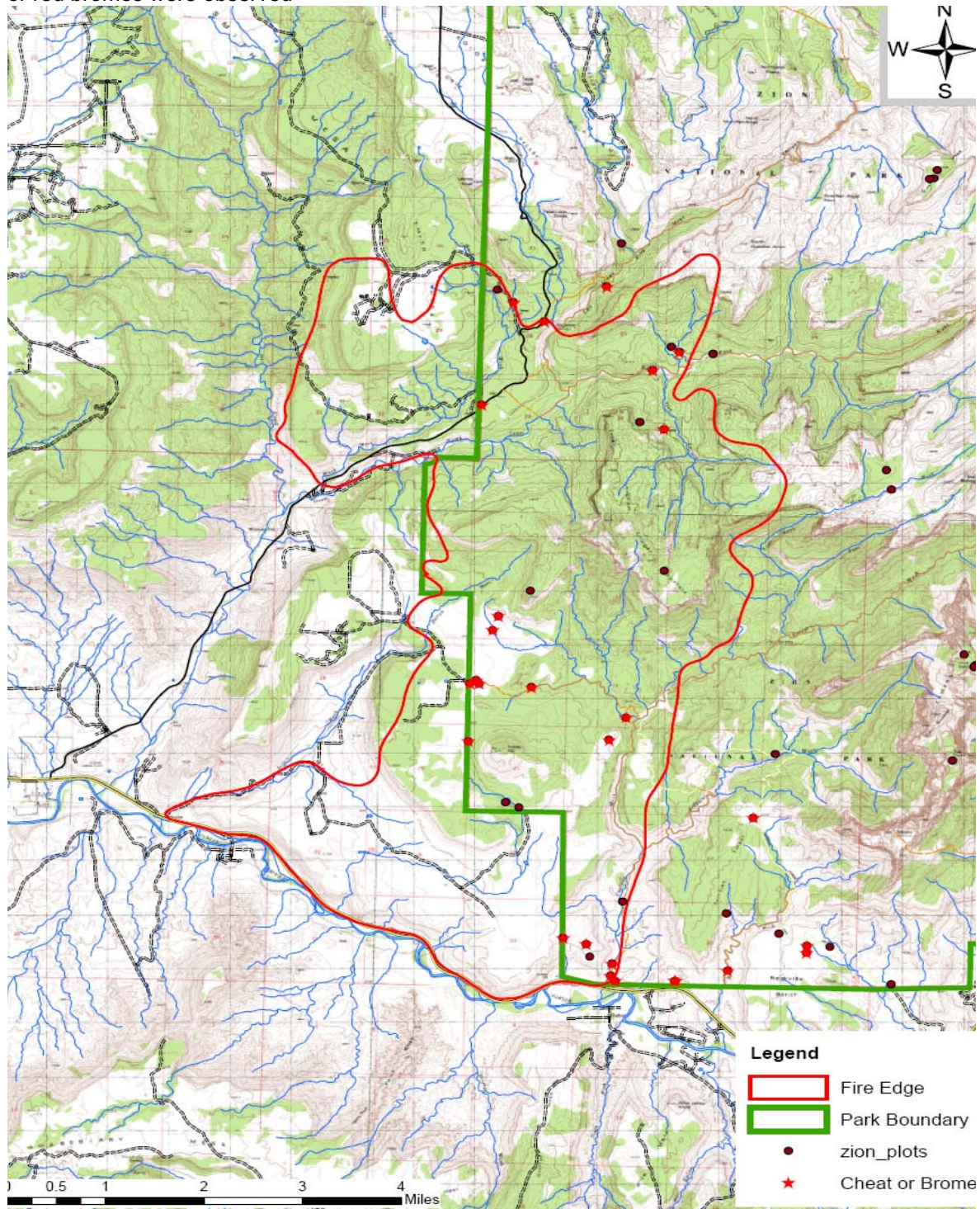


Photo taken near Subway July 15, 2006 – all the yellow grass is cheatgrass. Very few native herbaceous plants were observed.



BURNED AREA EMERGENCY STABILIZATION AND REHABILITATION PLAN

KOLOB FIRE

I-D: OPERATIONS RESOURCE ASSESSMENT

I. OBJECTIVES

- Identify, inventory, and map fire and suppression impacts to park facilities and infrastructure
- Identify and evaluate post-fire effects to facilities and infrastructure
- Prescribe measures as needed to mitigate fire and suppression impacts as well as those post-fire effects that may potentially affect facilities and infrastructure
- Take measures to protect cultural and natural resources during treatment implementation

II. ISSUES

A burned fenceline along portions of the southwestern park boundary has led to the identification of the following issues:

- Cattle Trespass
- Trespass by recreational ATV users
- Destruction of numerous park boundary signs

III. OBSERVATIONS

A. Background – The Kolob Fire, located within Zion National Park, as well as some lands managed by the Bureau of Land Management, State Trust lands, and private parcels was first called in at 08:30 on June 26th 2006. The fire was started through human caused ignition that is still under investigation. Brunner's Type II team was called in to manage the incident on June 26th. Ground support was assisted by heavy helicopter water drops in the NE and E portions of the fire perimeter and fixed wing retardant drops along the N, NW, and Western fire perimeter. Low relative humidity (2-5%) and south driven winds of 20-30 mph created conditions that pushed the fire from approximately 2000 acres by day two to 10,516 acres burned within the park at the time of containment on June 30th. The incident was turned over to a Type III team on July 5th. Minimum Impact Suppression Techniques (MIST) ensured minimum ground disturbance.

B. Reconnaissance Methodology and Results – A reconnaissance survey and inventory of the burned fenceline was carried out by BAER team members. Resource advisors, Thomas Fuller and Jeremy Pribyl (2006) provided GPS derived coordinate information used to map the burned fence segments. Their observations of fire and suppression impacts by division are that:

- Division "A" showed little evidence of suppression impacts. What few impacts were identified, mostly around trailheads, had been rehabbed by July 3rd. Fire impacts included the destruction of 12 wooden posts and 40 wooden post supports.
- Division "B" Suppression impacts include fireline cut around approximately 12 trees north of Crater Hill that was later rehabbed. Park boundary fence was extensively damaged as well as many park boundary signs. Outside of the park structure losses were identified that include a cabin, a house under construction, a utility building, a shed, an outhouse, a small trailer and a truck. Historic NPS boundary cairns (unrecorded) show slight evidence of fire damage through charring of construction materials. A previously unknown prehistoric rock shelter is exposed from the removal of surrounding vegetation, but did not sustain effects from the fire or fire suppression activities.
- Division "C" fire effects include the loss of approximately 300 fenceposts, exposure of a previously recorded rockshelter by the removal of vegetation, and down burned trees across sections of the Chinle Trail that were later removed by fire crews. There were no fire suppression impacts of consequence.
- Division "Z" impacts, both fire and suppression, were minimal.

Findings –

- The employment of MIST ensured that fire suppression impacts were minimal, thus reducing the necessity for intensive rehab efforts.
- No facilities inside the park boundary were lost due to the fire.
- Approximately 4 miles of park boundary fence sustained fire damage.
- Approximately 201 park boundary signs were damaged as the result of fire impacts.

IV. RECOMMENDATIONS

Based on the results of the above observations:

C. Emergency Stabilization – Fire Suppression Repair

None

D. Emergency Stabilization

None

E. Rehabilitation

Boundary Fence Replacement: Replace barb wire boundary fence. The Kolob Fire incident resulted in approximately 4 miles of park boundary fenceline that sustained damage. This included 1175 burned posts, 54 damaged stays and 4 miles of damaged barb wire. The task is to replace burned wooden posts with metal T-posts, the damaged stays, and wire.

F. Management Recommendations – Non-Specification Related

201 park boundary signs were burned over during the fire incident. It is recommended that the park replace these signs as soon as possible for the purposes of boundary identification as well as a deterrent to trespass or unauthorized use of park lands.

V. CONSULTATIONS

VI. REFERENCES

Fuller, Thomas L. and Jeremy Pribyl
2006 *READ (Resource Advisor) Assessments on Kolob Fire 6/26/06-7/30/06.* Zion National Park.

KOLOB Fire Operations Assessment prepared by

H. Dan Hall, Bureau of Indian Affairs, Pacific Region (916) 978-6041

**Kolob Fire
Burned Area Emergency Rehabilitation Team
Operations Assessment**

Appendix A



Burned out fence post and damaged barbed wire

Tree used a fence post that has now become a hazard





Burned post and damaged barbed wire at KT Road

Undamaged fenceline in mosaic part of the burn



Fire consumed wooden post looking north towards Dalton Wash trail head.



Burned utility pole above Coalpits Wash

Scorched Sign at Park Boundary along KT Road



APPENDIX II - ENVIRONMENTAL COMPLIANCE

The Intermountain BAER team did not order an Environmental Compliance Specialist for the Kolob BAER plan. Kezia Neilson, Environmental Compliance Specialist, Zion National Park has started the screening form for two of the specifications – aerial herbicide application(V-1) and fence replacement(O-1) – those draft screening forms are included in the electronic documentation package. The table below lists all the specifications and potential compliance. This form is filled out below but in DRAFT form, by Kara Paintner, Vegetation Specialist on the BAER team. It will need to be completed by the park.

REHABILITATION ACTIVITIES - KOLOB Fire

Spec #	Title	Type	Potential NEPA
C-1	Hydromulch Cultural sites	Cultural	Programmatic agreement with SHPO covering BAER activities
I-1	Boundary Fence Replacement	Infrastructure	
O-1	Implementation Leader	Overhead	Not Applicable
V-1	Aerial Herbicide – Kolob Fire	Vegetation	Not covered by FMP EA – EA need see V-2
V-2	NEPA Compliance	Compliance for V-1	Not Applicable
V-3	Seed Increase	Vegetation	Not Applicable
V-4	Aerial seeding – KT Road (Natives)	Vegetation	FMP/EA or HFI BAER categorical exclusion
V-5	Crater Hill Revegetation	Vegetation	FMP/EA or HFI BAER categorical exclusion
V-6	Exotic plant monitoring and control	Vegetation	FMP/EA
V-7	Sensitive plant and spot treatment monitoring	Vegetation	FMP/EA
V-8	Treatment Effectiveness Monitoring	Vegetation	FMP/EA

Federal, State, and Private Lands Environmental Compliance Responsibilities

All projects proposed in the KOLOB Burned Area Rehabilitation Plan that are prescribed, funded, or implemented by Federal agencies on Federal, State, or private lands are subject to compliance with the National Environmental Policy Act (NEPA) in accordance with the guidelines provided by the Council on Environmental Quality (CEQ) Regulations (40 CFR 1500-1508); Department of the Interior and NATIONAL PARK SERVICE. This Appendix documents the Burned area emergency response team considerations of NEPA compliance requirements for prescribed rehabilitation and monitoring actions described in this plan for all jurisdictions affected by the KOLOB Fire.

Related Plans and Cumulative Impact Analysis

ZION NATIONAL PARK Burned Area Rehabilitation Plan (*approval date*). The ZION NATIONAL PARK Fire Burned Area Rehabilitation Plan was reviewed and it was determined that actions proposed in the Kolob Fire Burned Area Rehabilitation Plan within the boundary of the ZION NATIONAL PARK Fire are consistent with the management objectives established in the Comprehensive Conservation Plan. The Comprehensive Conservation Plan NEPA compliance process specifically addresses:

Cumulative Impact Analysis

Cumulative effects are the environmental impacts resulting from the incremental impacts of a proposed action when added to other past, present, and reasonably foreseeable future actions, both Federal and non-Federal. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time. The rehabilitation treatments for areas affected by the KOLOB Fire, as proposed in the KOLOB Fire Burned Area Rehabilitation Plan, do not result in an intensity of impact (i.e. major ground disturbance, etc.) that would cumulatively constitute a significant impact on the quality of the environment. The treatments are consistent with the above jurisdictional management plans and associated environmental compliance documents and categorical exclusions listed below.

Applicable and Relevant Categorical Exclusions

The individual actions proposed in this plan for ZION NATIONAL PARK are Categorically Excluded from further environmental analysis as provided for in the *specify relevant departmental and agency Categorical Exclusions*. All applicable and relevant Department and Agency Categorical Exclusions are listed below. Categorical Exclusion decisions were made with consideration given to the results of required emergency consultations completed by the Burned area emergency response team and documented below.

Applicable Department Categorical Exclusions

List

Applicable NATIONAL PARK SERVICE Categorical Exclusions

List

Statement of Compliance for the KOLOB Fire Burned Area Rehabilitation Plan.

This section documents consideration given to the requirements of specific environmental laws in the development of the KOLOB Fire Burned Area Rehabilitation Plan. Specific consultations initiated or completed during development and implementation of this plan are also documented. The following executive orders and legislative acts have been reviewed as they apply to the KOLOB Fire Burned Area Rehabilitation Plan:

- \$ National Historic Preservation Act (NHPA).
- \$ Executive Order 11988. Flood Plain Management.
- \$ Executive Order 11990. Protection of Wetlands.
- \$ Executive Order 12372. Intergovernmental Review.
- \$ Executive Order 12892. Federal Actions to Address Environmental Justice in Minority and Low-income Populations.
- \$ Endangered Species Act.
- \$ Secretarial Order 3127. Federal Contaminated
- \$ Clean Water Act.
- \$ Clean Air Act.

CONSULTATIONS

- \$ *List partners and neighbors consulted*

NEPA Checklist: If any of the following exception applies, the Burned Area Rehabilitation Plan cannot be Categorically Excluded and an Environmental Assessment (EA) is required.

(Yes) (No)

- ☐ ☒ Adversely affect Public Health and Safety
- ☐ ☒ Adversely affect historic or cultural resources, wilderness, wild and scenic rivers aquifers, prime farmlands, wetlands, floodplains, ecologically critical areas, or Natural Landmarks.
- ☐ ☒ Have highly controversial environmental effects.
- ☐ ☒ Have highly uncertain environmental effects or involve unique or unknown environmental risks.
- ☒ ☐ Establish a precedent resulting in significant environmental effects.
- ☒ ☐ Relates to other actions with individually insignificant but cumulatively significant environmental effects.
- ☐ ☒ Adversely effects properties listed or eligible for listing in the National Register of Historic Places
- ☐ ☒ Adversely affect a species listed or proposed to be listed as Threatened or Endangered.
- ☐ ☒ Threaten to violate any laws or requirements imposed for the "protection of the environment" such as Executive Order 11988 (Floodplain Management) or Executive Order 11990 (Protection of Wetlands).

National Historic Preservation Act

Ground Disturbance:

- ☒ None
- ☐ Ground disturbance did occur and an archeologist survey, required under section 110 of the NHPA will be prepared. A report will be prepared under contract as specified by the Burned Area Rehabilitation Plan.

A NHPA Clearance Form:

- ☐ Is required because the project may have affected a site that is eligible or on the national register. The clearance form is attached. SHPO has been consulted under Section 106 (see Cultural Resource Assessment, Appendix I).
- ☒ Is not required because the Burned Area Rehabilitation Plan has no potential to affect cultural resources (initial of cultural resource specialist).

Other Requirements

(Yes) (No)

- ☐ ☒ Does the Burned Area Rehabilitation Plan have potential to affect any Native American uses? If so, consultation with affiliated tribes is needed.
- ☒ ☐ Are any toxic chemicals, including pesticides or treated wood, proposed for use? If so, local agency integrated pest management specialists must be consulted.

I have reviewed the proposals in the KOLOB Fire Burned Area Rehabilitation Plan in accordance with the criteria above and have determined that the proposed actions would not involve any significant environmental effect. Therefore it is categorically excluded from further environmental (NEPA) review and documentation. Burned area emergency response team technical specialists have completed necessary coordination and consultation to insure compliance with the National Historic Preservation Act, Endangered Species Act, Clean Water Act and other Federal, State and local environment review requirements.

Burned Area Emergency Response Team Environmental Protection Specialist	Date
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Project Leader, Big Bend National Park	Date
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APPENDIX III - MAPS