24 Command Fire
Burned Area Emergency Stabilization and Rehabilitation (BAER) Plan
Final Accomplishment Report for 2000-2003 Treatments

AGENCY/UNIT: U. S. Fish and Wildlife Service
Hanford Reach National Monument/Saddle Mountain National Wildlife Refuge
LOCATION: Richland, Washington

DATE: July 14, 2003

Submitted by:_____Date:_____
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List of Preparers

This document has been prepared in conformance with final reporting requirements outlined in the Department of Interior Departmental Manual, Part 620: Wildland Fire Management; Chapter 3: Burned Area Emergency Stabilization and Rehabilitation.

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TABLE OF CONTENTS

Acronyms and Abbreviations

ALE - The Fitzner-Eberhardt Arid Lands Ecology Reserve (a 77,000 acre unit of the Hanford Reach National Monument)

ANOVA - Analysis of Variance

BAER - Burned Area Emergency Rehabilitation

CGS - Contracting and general services (U.S. Fish and Wildlife Service Region 1)

DOE - U. S. Department of Energy

ESR - Emergency stabilization and rehabilitation

EFR - Emergency Fire Rehabilitation

GIS - Geographic information system

GPS - Global positioning system

HRNM - Hanford Reach National Monument/Saddle Mountain National Wildlife Refuge

IMT - Incident management team

LIGO - Laser interferometer gravitational wave observatory

LPN - Lucky Peak Nursery (U.S.D.A. Forest Service)

NIFC - National Interagency Fire Center

MSC - Microbiotic soil crust

NRS - Natural resources specialist

PLS- Pure Live Seed

TNC - The Nature Conservancy

USFWS - U. S. Fish and Wildlife Service

U.S. DEPARTMENT OF THE INTERIOR
BURNED AREA EMERGENCY REHABILITATION TEAM

PART A FIRE LOCATION AND BACKGROUND INFORMATION

Fire Name	24 Command	**Date Controlled**	2 July 2000
Fire Number	P68272/ Rehab Acct. # 13700-9262-1357	**Jurisdiction**	**ACRES**
Agency Unit	FWS & DOE Hanford Reach NM	**FWS - ALE**	78,732
Region	FWS - Region 1	**DOE**	60,254
State	Washington	**BLM**	980
County(s)	Benton	**State**	3,633
Ignition Date/Manner	6/27/00 / Auto Accident	**FWS - McGee Riverlands**	60
Zone	Pacific Northwest	**Private**	20,225
Date Contained	1 July 2,000	**TOTAL ACRES**	163,884

PART B NATURE OF PLAN

I. Type of Plan (check one box below)

	Short-term Rehabilitation (Complete Parts A, B, C, and H only)
	Long-term Rehabilitation (Complete all parts)
	Both Long and Short-term Rehabilitation (completed all parts)

II. Type of Action (check one box below)

	Initial Submission
	Updating or Revising the Initial Submission
	Supplying Information for Accomplishment to Date on Work
	Different Phase of Project Plan
√	**Final Report (To Comply with the Closure of the EFR Account)**

EXECUTIVE SUMMARY- Final Accomplishment Report

Fire Background

The 24 Command Fire (also known as the Two Forks Fire and the SR 24 MP 36 Fire) began at about 1330 hours on Tuesday, June 27, 2000, as the result of a fatal motor vehicle accident on State Route (SR) 24, about 2 miles west of the intersection with SR 240. The lands in the vicinity are managed as the Arid Lands Ecology Reserve (ALE) and the Hanford Reach National Monument by the US Fish and Wildlife Service, under permit from the US Department of Energy. Driven by high winds and temperatures and low humidity, the fire quickly spread over the next two days and consumed 163,884 acres of Federal, state, and private lands. The fire also burned 11 residences and a number of other structures in and around Benton City. Burned acreage included: US Fish and Wildlife Service - 78,732 acres; Department of Energy-Hanford Site - 60,254 acres; private lands - 20,225 acres; State - 3,633 acres; Bureau of Land Management - 980 acres.

A Type III Incident Management Team (IMT) was assigned to the fire on June 27 at 1800 hours. A Type II IMT was requested on June 28 at 0400 hours and a Type I IMT was requested at 2300 hours. A Unified Command took charge consisting of the Type I and II teams and local Fire Chiefs. The fire was contained on July 1 and controlled on July 2, 2000.

The U.S. Fish and Wildlife Service and the Department of Energy each requested a Burned Area Emergency Rehabilitation (BAER) Team. The Department of the Interior BAER Team, Northern States (Gasser) responded. The BAER Team arrived on June 30 and began field reconnaissance. Upon arrival at the 24 Command Fire, the BAER Team was requested to prepare a BAER plan to address potential effects of the fire and fire suppression impacts to all jurisdictions affected by the fire. There were 18 people on the BAER Team with an additional six Resource Advisors to assist in the field assessment. In addition, a number of resource specialists from DOE and their contractors assisted in providing resource information.

On July 7, the BAER Team conducted an agency debriefing in Richland, Washington, providing preliminary findings and identifying proposed treatments. The BAER Team, tasked with evaluation of short and long-term rehabilitation needs, developed this plan to address the following issues:

- Facilities or improvements impacted by the fire or the suppression of the fire.
- Cultural and natural resource values impacted by the fire or fire suppression actions.
- Rehabilitation requirements established by Federal law, policies, and relevant Department of the Interior resource management mandates.
- Rehabilitation requirements established by state laws, policies, and regulations.
- Implementation of treatments in a timely manner, prior to the first damaging rains.

Resource Damages and Threats to Human Safety and Resources

The 24 Command Fire burned 163,884 acres, on public and private lands within a perimeter of 255 square miles. Fire suppression impacts included: approximately 41 miles of dozer line, dirt roads graded wider, fence cuts, retardant drops on LIGO Tunnel and springs, 1 burned-over engine, and a backfire of 9,698 acres.

Almost all plant and litter cover that was present in the burn area was consumed by the fire. The loss of vegetative cover exposed fine sandy and silty soils to ablation. Nearly all soils within the burn area had a fairly high risk of wind erosion, however, certain soils within the burn area were especially susceptible. Because of this, there were safety issues that occurred impacting drivers traveling on roads in and around the burn area during periods of dust storms crossing roads creating low visibility. Hanford weather station began posting blowing dust warnings on daily weather reports immediately following the fire and did not discontinue these warnings until February of 2003.

Emergency Fire Rehabilitation Treatments prescribed by the BAER Team included:

- Hire BAER Implementation Leader
- Conduct cultural resource damage assessment of known/documented sites
- Protect cultural sites
- Install warning safety signs for dust storms and elk crossings
- Make 3 ground hazards safe (large holes)
- Control unburned non-native invasive plants
- Replace sagebrush plantations as critical habitat for T&E species
- Plant 80,000 sagebrush plants in fall of 2000
- Collect seed from sagebrush, bitterbrush, bunchgrass and greasewood populations
- Monitor vegetative recovery
- Install drift fencing along identified roadways
- Increase law enforcement patrols for safety and resource protection
- Monitor and control invasive plant species
- Monitor fire effects to T&E species
- Inventory mortality and monitor recovery of microbiotic soil crust
- Follow-up consultation/review by BAER Team members
- Conduct public information dissemination

Specifications were developed for all actions meeting the requirements of fire suppression or Emergency Fire Rehabilitation (EFR) funding.

Supplemental Funding Request

An internal review at the Hanford Reach National Monument headquarters was conducted in October, 2001 to assess 24 Command BAER plan implementation and damage assessment results, and to determine the need for amendments, especially under new direction and guidance provided in the 620 DM 3 policy. The review indicated a need for additional emergency treatments to address ongoing critical vegetation, cultural resources, infrastructure and operational needs within the 24 Command Fire burned area.

The primary objectives of this amendment were:

- To report monitoring results, as prescribed by initial specifications, aimed at identifying sites with the highest potential for successful emergency stabilization treatments.

- To identify additional needs, strategies and treatments for emergency stabilization and rehabilitation which were not recognized in the original 24 Command BAER plan, and to implement treatments in accordance with new policy and all relevant federal, state and local laws and regulations.

The original BAER plan was submitted as an initial funding request for Emergency Fire Rehabilitation (EFR) funds according to the 1998 policy. Initial specifications were designed to include follow-up treatments based on assessment results. Assessment results indicated greater impacts to vegetation, cultural resources, infrastructure and operations than were initially detected in the BAER plan. In addition, unanticipated drought and severe wind events affected post-fire site recovery and stabilization processes. This amendment prescribed additional Emergency Rehabilitation treatments, including:

- Non-native invasive plant control
- Revegetation - seeding
- Monitoring of revegetation seeding effectiveness
- Revegetation - shrub planting
- Monitoring of shrub planting effectiveness
- Stabilization of damaged cultural resource sites
- Oral histories for stewardship of Traditional Cultural Properties
- Repair and replacement of fire damaged fence and access gates

- Monitoring of suppression impact rehabilitation as required for accomplishment reporting
- Hire project Implementation Leader

Approval Time Period

Many rehabilitation treatments on the 24 Command Fire were delayed by up to one year due to delays in the approval of amendment requests. On December 4, 2000 an amended Emergency Stabilization and Rehabilitation (ESR) plan was submitted for consideration and approval to the Regional and National ESR Coordinators. On June 1, 2001 the FWS Regional Fire Coordinator reviewed and prepared the amendment for the Regional Director's signature. The next action on the 24 Command Fire amendment request came, as described previously, after an internal audit was conducted for 24 Command ESR expenditures on October 22, 2001. Based on the findings of the internal review, in December of 2001 a second amendment was sent forward from the Monument to the Regional Office and forwarded to the Washington Office for action requesting an additional 10.7 million dollars. On March 28, 2002 the ALE ESR Amendment was approved for $6.67 million dollars. Due to the extensive delays in funding this ESR project and the short time frame for implementation, a waiver of the DOI BAER implementation time frame policy was submitted in June of 2002 requesting an additional year for implementation. This request was subsequently denied in August, 2002. Supporting documentation has been included within Appendix C concerning funding approval time frames.

In accordance with National Policy guidelines for the ESR program, all funds allocated for emergency stabilization and rehabilitation work had to be implemented no later than July 2, 2003 to comply with the three year funding window for ESR treatments. Therefore, during the winter of 2002 and spring of 2003 the majority of treatments prescribed in the 24 Command Plan Amendment were implemented but at significantly lower levels than requested. Most stabilization treatments were implemented in a compressed one year time frame due to funding delays. Had approval processes and funding been more timely, additional rehabilitation treatments would have been implemented to rehabilitate critical shrub-steppe habitats and control non-native invasive species.

Cultural Resources Summary

During the period between November 20 and December 18, 2002, personnel from the Hanford Reach National Monument, U. S. Fish and Wildlife Service (USFWS), along with personnel of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and the Wanapum, conducted a cultural resource inventory on 2,300 acres slated for manual sagebrush planting and mechanical drill seeding on the Hanford Reach National Monument, Fitzer-Eberhardt Arid Lands Ecology Reserve Unit (ALE).

An additional phase of the project was completed between April 21 and May 29, 2003, with personnel from the USFWS and the CTUIR performing the pedestrian survey of 2836 acres in the herbicide spraying area in the Cold Creek area of the ALE.

The cultural resource investigation was completed in order to ensure compliance with Section 106 of the National Historic Preservation Act in accordance with 36 CFR 800 regulations. In addition, the BAER Rehabilitation Treatment Plan stipulates in Specification C-1-c that all ground disturbing activities undertaken in conjunction with rehabilitation projects would require cultural resource investigations commensurate with the proposed activity. The cultural resource survey, conducted prior to the planting and seeding activities, determined that potential adverse effects to all cultural resources within the project boundaries would be mitigated primarily through avoidance strategies. The additional purpose of the Class III inventory was to identify and incorporate previously unrecorded cultural resources into the existing regional archaeological database.

The short turn-around between approval and the funding and implementation deadlines precluded the development of a research design prior to conducting field work. Consequently, the Section 106 compliance process had virtually no lead time to even complete the fieldwork with sufficient time to complete site evaluations prior to commencement of ground disturbing activities. As a result, mitigation

strategies were limited to avoiding the sites and surveying additional areas to modify proposed planting areas and relocate rehabilitation plots in areas without cultural material.

Fieldwork has been completed recently so draft site forms and documentation of the investigation will be forthcoming by the end of 2003. Preliminary results suggest expansion of the existing cultural resource database and refinement of the chronologies and function of the ALE in cultural historic terms. About 48 new sites (30 historic, 18 prehistoric) were located, ranging from domestic debris scatters and historic roads to lithic flake scatters and isolated tools including projectile points.

Summary of Treatments Implemented

Emergency stabilization and rehabilitation treatments conducted through the 24 Command ESR Plan include:

- Protection of 136 culturally significant sites
- Stabilization of 103 recorded cultural sites
- Acquisition of tribal oral histories on lands within the fire area
- Identification of 48 new cultural resource site previously unrecorded
- Treatment of approximately 10,300 acres of lands impacted by nonnative invasive species
- Stabilization of 1713 acres of shrub steppe habitat through shrub plantings
- Stabilization of 9840 acres of shrub steppe habitat through native grass seeding
- Stabilization of 1,000 acres through drill seeding of native species
- Replacement of 30 miles of boundary fence
- Approximately 145 lbs. of native seed collected
- Approximately 880,750 shrub plants grown from native seed collection for stabilization planting efforts
- Rehabilitation of 1.5 miles of dozerlines and handlines
- 53 inventory plots were established to measure seeding and planting effectiveness resulting in an additional 10 treatment recommendations

Total funds allocated through the 24 Command ESR Plan was $7,074,734 with a total of $5,666,527 expended for stabilization and rehabilitation treatments.

Outlined in the following pages are more descriptive narratives relating to each individual specification. We have attempted to capture the most significant accomplishments for each treatment, describe methodologies and document variances between planned activities and implemented treatments. A summary table of expenses has been provided for each specification in order to document actual costs for implementation. In accordance with BAER guidelines, we have shared the information within this report with many organizations and groups over the past six months. Presentations have been made to the Native Plant Society, International Society for Ecological Restoration, National Soil Erosion Control Association, Hanford Reach Federal Advisory Committee, and the Northwest Research Natural Area Committee. It is our hope that this report will serve as a reference for others undertaking similar rehabilitation efforts and provide valuable baseline information in the costs associated with long-term restoration of shrub-steppe habitat in the Columbia Basin.

PART E- SUMMARY OF ACTIVITIES- COST SUMMARY TABLE- 24 COMMAND FIRE- HANFORD REACH NATIONAL MONUMENT			***FWS Acreage= 78,732***			
Part E- Line Item	**Treatment Unit**	**# of Units**	**Approved ESR Plan Expenditures**	**Total Expenditures**	**Cost per Unit**	**Implementation Method**
S-1b- Drift Fence- Soil Stabilization			Not funded			
S-1d Elk Monitoring			Not funded			
S-2b Elk Crossing Hazard Signs			Not funded			
N-1a Protection of T&E species			Not funded			
N-1b Monitor Fire Effects on Listed Bird Species			Not funded			
S-1c Mine Shaft Hazard Stabilization			Charged to suppression account			
F-1 Handline and Dozerline Rehab			Charged to suppression account			
F-3a Infrastructure Repair- Repair/Replace Fence			Charged to suppression account			
F-5 Fire Engine Removal			Charged to suppression account			
O-2 Followup BAER Team Consultation			Funding Denied at Implementation			
C-1a Cultural Resource Damage Assess.	acres	150	$ 76,872.00	$ 54,000.00	$ 36.00	C
C-1b Cultural Resource Damage Assess.-Suppression	acres	100	$ 3,262.00	$ 3,262.00	$ 32.62	P
C-1c- Stabilization of recorded cultural sites	acres	2300	$ 6,370.00	$ 6,370.00	$ 2.77	C
C-2 Conduct Tribal Oral Histories	acres	2300	$ 6,660.00	$ 6,660.00	$ 2.87	C
N-2 Non-native invasive species control	acres	150	$ 8,500.00	$ 8,094.00	$ 53.96	P
N-2a Non-native invasive species control	acres	10150	$ 1,829,250.00	$ 633,355.00	$ 62.40	P,C
N-3a Ecological Stabilization: Sagebrush Plantings *			$ 85,880.00	$ 47,128.00		P,C
N-3b Ecological Stabilization: Sagebrush Outplanting*	acres	413	$ 108,970.00	$ 49,000.00	$ 233.00	P,C
N-3c Ecological Stabilization: Seed Collection	lbs	145	$ 6,820.00	$ 4,500.00	$ 31.00	P
N-4a Revegetation- Native Seeding	acres	10,555	$ 4,026,936.00	$ 3,863,996.00	$ 366.08	C
N-4b Revegetation- Sagebrush Planting	acres	1300	$ 383,750.00	$ 403,727.00	$ 310.55	P,C
M-1a Monitoring Invasive Plant Species	acres	25,500	$ 26,900.00	$ 26,900.00	$ 1.05	P,C
M-1b Microbiotic Crust Monitoring	acres	25,500	$ 13,450.00	$ 13,450.00	$0.53	C
M-2a Monitor Revegetation and Seeding Effect.	acres	10,555	$ 63,506.00	$ 63,506.00	$ 6.01	C
M-2b Monitor Big Sagebrush reveg effectiveness	acres	1713	$ 35,228.00	$ 35,228.00	$ 20.56	C
S-1a Protect Cultural Resources- Law Enforcement	task	1	$ 13,100.00	$ 13,100.00	$ 13,100.00	C
F-1a Monitor reveg effective. on suppression sites	sites	3	$ 4,680.00	$ 4,680.00	$ 1,560.00	C
F-3b- Boundary Fence Replacement	miles	30	$ 182,100.00	$ 269,000.00	$ 8,967.00	C
O-1 Implementation Leader	task	1	$ 38,700.00	$ 38,700.00		C
O-3 Implementation Leader	task	1	$ 153,800.00	$ 121,871.00		P
TOTALS			**$ 7,074,734.00**	$ 5,666,527.00		
P= Agency Personnel C= Contract *=Cumulative Total for specs N3a&b						

24 Command Fire

Burned Area Emergency Rehabilitation Treatments
Final Implementation Report
Specification C-1-a Cultural Resource Damage Assessment-

Fire Overview

In July of 2000, the Cultural Resource Team (CRT) in the Regional Office (RO) assembled a cadre of archaeologists to research existing cultural resource records and plan field investigations. A total of 136 sites had previously been recorded. Sites consisted of prehistoric (46) and historic (45) sites plus another 12 sites with both historic and prehistoric components. Several isolated finds were also represented with 18 prehistoric and 15 historic sites. Historic site types included Euro-American homesteading and ranching activities, sheep herding, and transportation systems. Artifacts and features associated include rock cairns, and domestic debris scatters, cisterns, gas wells, and ditches. Prehistoric site types consist of rock cairns, lithic scatters, isolated project points and other tools. Cultural resource damage was minimal as a result of the fire.

I. **Purpose of Treatment Specification:** Identification, evaluation, protection of existing known cultural resources and mitigation as necessary to determine impacts to the sites as the result of fire.

II. **General Description:** The burned area contains both Native American and Euro-American sites that have been previously recorded. Follow-up after the fire requires survey and monitoring of these sites to determine amount of damage, current condition and potential stabilization or mitigation necessary to protect and preserve these sites in accordance with 36 CFR 800. The Cultural Resource Team (CRT)of the Regional Office (RO), Region 1 of the U.S. Fish and Wildlife Service designed, conducted, and reported the fieldwork discussed here for 200 and 2001.

III. **Design/Construction Specification(s):**

A. Initiate Tribal Coordination and Consultation

B. Hire Cultural Resource Manager at the Monument

C. Monitor burned area to relocate recorded sites and determine site condition

IV. **Accomplishments:**

A. Initiate Tribal Coordination and Consultation

Tribal contact was made by the RO CRT immediately after notification of the fire and have been involved in planning and implementation of the BAER plan. Other interested parties and agencies were also consulted. A consultation log is included in the formal report in the appendix. Discussion topics ranged from information sharing, meeting notification, invitation to participate in fieldwork, design of forms, treatment plans, research design and field methodologies. Participation by these many voices added to the success of this aspect of the specification and the product achieved.

Several Tribal archaeologists aided fieldwork during the two field sessions: October 16-19, 2000 and March 27-30, 2001. Usually, the field archaeologists divided into teams of two people each and conducted the site assessments independently of other two-person teams. Group meetings at the beginning and end of each day ensured a consistent approach to data gathering and site descriptions.

Table 1. Cultural Resource personnel who participated in the fieldwork.

U. S. Fish and Wildlife Service	Confederated Tribes of the Umatilla Indian Reservation	Nez Perce Tribe	Wanapum	Yakama Nation
Anan Raymond	Julius Patrick	Clifford Lawyer	Rex Buck Jr.	Leah Aleck
Nick Valentine	Toby Patrick	Lilisa Moses		
Alex Bourdeau	Gideon Farrow	Rico Cruz		
Jon Daehnke	Lloyd Barkley	Vera Sonneck		
Jenna Gaston	Jason Butler			
Norm Henrikson	William Sigo			
	Shane Britton			

B. Hire Cultural Resource Manager at the Monument

An archaeologist was hired at the Monument in June 2001 to coordinate and implement the cultural resource management program for BAER activities. Initial tasks undertaken include consulting with affected agencies such as the DOE and sovereign nations (Tribes) in accordance with 36 CFR 800.12 (b) (2) regulations and developing and implementing all BAER related activities including tribal liaison, coordination and on-going BAER projects such as the restoration and rehabilitation efforts.

In the fall of 2001 the Monument Cultural Resource manager surveyed about 1500 acres of proposed sagebrush plantings in nine separate plot locations. Two of the nine plots were not surveyed as DOE projects had cleared these areas for cultural resources. These two plots, #7and #8, were planted in lieu of plot #4, which has a high probability to contain cultural material as a known site is recorded immediately adjacent. Two cultural resource sites were found during the field investigation: an historic road and a lithic scatter. In both cases the boundaries of the plots were adjusted or the areas restricted from planting activities so no impacts occurred to the sites.

C. Monitor and relocate known sites

Methodology

Members of the RO Cultural Resource Team conducted initial reconnaissance on the project early in July, 2000 as soon as possible after the fire was controlled. Initial assessment of the area resulted in mapping, photographing and evaluating the cultural resources damaged by the fire. The site records and maps at the Pacific northwest National Laboratory (PNNL), a DOE contractor, were obtained for field investigations. GPS technology was used primarily to relocate sites.

Field survey included completion of a “Post Fire Inspection Form” specifically designed to identify and evaluate site damage and aid in determination of mitigation of the fire on the resource. The form was a collaborative effort utilizing CR assessment principles from the BAER Handbook, comments from the CR Northen BAER team advisor and personnel at PNNL, a CR form developed in the Southwest on BAER projects, and Tribal CR personnel. The form allowed for collection of basic data for each relocated site

including UTM coordinates, site contents, severity and effects of burn, suppression impacts and erosional threats. We finalized drafts of the form with PNNL archaeologists, who also used the information for their inventory of DOE land burned by the 24 Command Fire. Upon arrival at each relocated site, the form was completed to provide initial observation on site condition. The data gathered on the post-fire inspection forms was ultimately logged into a computer database. Artifacts and other material samples were not collected.

In addition to the initial assessment immediately after the fire, two subsequent field investigations were undertaken for damage assessment on October 16-19 2000 and March 27-30 2001. The Post-Fire Inspection Form (Figure 1) and associated fieldwork involved collection of basic data about each relocated site including: UTM coordinates derived form a GPS receiver, site contents, burn severity, fire impacts, suppression impacts, and erosional threats. At least two photos were taken at each site to record the damage and to use as a future monitoring baseline for both relocating and assessing site conditions. Sites records were not updated or evaluated for eligibility under National Register of Historic Places criteria due to time and money constraints.

Previously unrecorded sites, noted in conjunction with this survey to assess existing sites, were recorded as time permitted. No specific survey was undertaken to survey the entire burned area to identify new sites revealed as a result of the burn. It was not in the scope of the BAER cultural resource specifications to re-record or update site records beyond the data called for by the Post-Fire Inspection Form. Therefore, updated site records, new sketch maps, or evaluations for eligibility to the National Register of Historic Places were not done. However, as previously unrecorded archaeological sites were encountered in survey transects, they were recorded, as time permitted, using the PNNL/Hanford Cultural Resources Laboratory archaeological site inventory form.

Results

The 24 Command Fire did not have a significant impact on the cultural resources of the ALE. Wind drove the flames quickly through the cheatgrass, sagebrush and greasewood. Rarely did it dwell long enough to damage cultural resources or to create extensive hydrophobic soils. As Table 2 indicates the majority of the sites were not directly affected by the fire as the burn severity at most sites is low. Only those sites (7 total) containing wood features were impacted by the burning. Field conditions and surface visibility were excellent because the 24 Command Fire burned off vegetation that otherwise obscures the surface, including artifacts. Subsequent wind erosion and possibly alluvial deposition will degrade and impact the exposed sites. As a result, erosional effects constitute the largest threat to the 46 prehistoric sites.

Table 2

FIRE IMPACTS	SITE DESIGNATION
FIRE IMPACTS:	
None	3-127, 3-123, 3-128, 3-129, 3-132, 3-135, 3-136, 3-137, 3-138, 3-139, 3-141, 3-142, 3-143, 3-146, 3-147, 3-148, 3-22, 45BN172, 45BN173, 45BN445, 45BN457, 45BN467, 45BN468, 45BN469, 45BN473, 45BN475, BN-460, BN175, H3-463, HT-99-062, H3-464, HI-98-031, HI-98-032, Hodges Ranch, HT-88-003, HT-89-003, HT-89-005, HT-89-006, HT-89-007, HT-89-010, HT-89-087, HT-90-018, HT-90-019, HT-90-021, HT-90-023, HT-91-021, HT-92-002, HI-92-001, HI-92-002, HT-92-005, HT-92-007, HT-94-007, HT-96-006, HT-96-007, HT-96-009, HT-97-008, HT-99-001, HT-99-002, HT-99-003, HT-99-005, HT-99-009, HT-99-010, HT-99-015, HT-99-016, HT-99-017, HT-99-042, HT-99-048, HT-99-063, HT-99-067, New ALE #1,2,3,4
Burned wood, lumber	3-124, 3-130, 3-134, 3-140, 3-145, BN170/171, HT-94-006,
Melted plastic	3-149
Soot damage to metal, concrete, etc.	H3-121, HI-89-012
Blackening/soot damage to stone artifacts	HT-99-012, HT-99-043
EROSIONAL THREATS:	
None	3-124, 3-130, 3-135, 3-143, 45BN445, 45BN457, 45BN467, 45BN468, 45BN469, BN175, H3-463, HT-99-062, H3-464, HI-89-012, HI-98-031, HI-98-032, HT-89-005, HT-89-006, HT-89-007, HT-89-087, HT-90-023, HT-91-021, HT-92-007, HT-94-006, HT-96-006, HT-96-007, HT-97-008, HT-99-001, HT-99-009, HT-99-010, HT-99-016, HT-99-017, HT-99-042, HT-99-048, HT-99-063, New ALE #1,2,3,4
Aeolian	3-127, 3-128, 3-129, 3-132, 3-136, 3-138, 3-139, 3-140, 3-141, 3-142, 3-145, 3-146, 3-147, 3-148, 3-149, BN-460, H3-121, HT-88-003, HT-94-007, HT-96-009, HT-99-002, HT-99-003, HT-99-015
Active gullying, rilling, scouring	3-134, 3-137, Hodges Ranch, HT-92-002, HI-92-001, HI-92-002, HT-99-043
Animal	3-22, 45BN172, 45BN173, 45BN473, 45BN475, BN170/171, HT-90-018, HT-90-019, HT-90-021, HT-99-067
Other (weather)	HT-89-003, HT-92-005,
BURN SEVERITY None to low with exception of the following which had moderate:	3-134, 3-140, BN170/171, HT-99-003,
RECOMMENDED TREATMENT None, with exception of monitoring these sites:	BN170/171, HT-99-003,

Results

A total of 136 sites were recorded in the fire area however, 67 of them could not be relocated, despite attempts to do so. There are three reasons for this: 1) the existing site record has vague or confusing

location information, 2) the site is too small and contains too few artifacts ("isolated finds") that it escaped detection despite accurate return to its mapped location, and 3) erosion or sedimentation has covered a formerly exposed site. Tables 3 &4 show the sites reviewed and those which could not be located.

Table 3. RELOCATED SITES

3-127	3-132	3-139	3-146
3-123	3-134	3-140	3-147
3-124	3-135	3-141	3-148
3-128	3-136	3-142	3-149
3-129	3-137	3-143	3-22
3-130	3-138	3-145	
45BN172	45BN457	45BN469	BN-460
45BN173	45BN467	45BN473	BN170/171
45BN445	45BN468	45BN475	BN175
H3-121	H3-463	H3-464	
HI-89-012	HT-88-003	HI-92-001,	HT-99-005
HI-98-031	HT-89-003	HI-92-002	HT-99-009
HI-98-032	HT-89-005	HT-92-005	HT-99-010
	HT-89-006	HT-92-007	HT-99-012
	HT-89-007	HT-94-006	HT-99-015
	HT-89-010	HT-94-007	HT-99-016
	HT-89-087	HT-96-006	HT-99-017
	HT-90-018	HT-96-007	HT-99-042
	HT-90-019	HT-96-009	HT-99-043
	HT-90-021	HT-97-008	HT-99-048
	HT-90-023	HT-99-001	HT-99-062
	HT-91-021	HT-99-002	HT-99-063
	HT-92-002,	HT-99-003	HT-99-067

Table 4. SITES NOT RELOCATED

3-125	HI-89-005	HI-94-032	HT-94-008
3-126	HI-89-006	HI-94-036	HT-94-029
3-131	HI-89-007	HI-94-037	HT-95-335
3-133	HI-89-008	HI-99-004	HT-96-005
3-144	HI-89-009	HI-99-042	HT-98-088
BN177	HI-89-010	HI-99-043	HT-98-089
BN230	HI-89-011	HI-99-044	HT-99-006b
BN478	HI-90-005	HT-89-008	HT-99-011
BN487	HI-90-006	HT-89-010	HT-99-066
BN580	HI-90-007	HT-89-011	HI-89-011
HI-88-005	HI-90-008	HT-89-012	HT-91-047
HI-88-006	HI-90-009	HT-89-013	HT-98-088
HI-88-019	HI-90-010 HI-90-012	HT-90-015	H3-470
HI-89-003	HI-90-013	HT-90-017	H3-465
HI-89-004	HI-93-011	HT-90-020	

V. Expenditure Summary:

Contract Expenses	Personnel	Supplies/ Materials	Total	Acres Surveyed	Cost per Acre
	$54,000		$54,000	1500	$ 36.00

24 Command Fire

Burned Area Emergency Rehabilitation Treatments
Final Implementation Report
Specification C-1-b Cultural Resource Damage Assessment-Suppression

In July of 2000, the cultural resource team assembled a team of archaeologist to research existing cultural resource records and plan field investigations. A total of 136 sites had previously been recorded. Sites consisted of prehistoric (46) and historic (45) sites plus another 12 sites with both historic and prehistoric components. Several isolated finds were also represented with 18 prehistoric and 15 historic. Historic site types included Euro-American homesteading and ranching activities, sheep herding, and transportation systems. Artifacts and features associated include rock cairns, and domestic debris scatters, cisterns, gas wells, and ditches Prehistoric site types consist of rock cairns, lithic scatters, isolated project points and other tools. Cultural resource damage was minimal as a result of the fire.

I. **Purpose of Treatment Specification:** Identification, evaluation, protection of existing known cultural resources and mitigation as necessary to determine impacts to the sites as the result of fire as well as associated suppression activities.

II. General Description: The burned area contains both Native American and Euro-American sites that have been previously recorded. Follow-up after the fire requires survey and monitoring of these sites to determine amount of damage, current condition and potential stabilization or mitigation necessary to protect and preserve these sites in accordance with 36 CFR 800 regulations. The cultural resource team of Region 1 of the U.S. Fish and Wildlife Service designed, conducted, and reported the fieldwork discussed here.

III. Design/Construction Specification(s):

A.. Conduct Field investigation on Suppression Activities

B. Complete Damage Assessments

C. Consult with affected Agencies and Tribes

D. Prepare Site treatment Plans

IV. Accomplishments:

A. Conduct Field Investigation on Suppression Activities

Because of the speed at which this fire spread, few new fire breaks were created. Some existing roads were grubbed slightly to provide potential fire lines. Consequently, no cultural resource survey was undertaken in the road surfaces however known sites in the vicinity of suppression activities were visited to ensure no impacts had occurred. Approximately 100 acres were inventoried through this specification. Only one location within the 24 Command Fire sustained significant fire suppression disturbance. A Dozer line was cut as a fire break in the area of upper Snively Basin. This is the only area dozed outside of existing roads.

The road was approximately a half mile long and a dozer blade (about 4m) wide. A cultural resource survey of the bladed fire break was undertaken a few months after it was constructed. Cultural resource personnel walked two parallel transects, using a 2 meter transect interval. The earth berm piled on the firebreak shoulders was also examined, to identify any cultural material disturbed during excavation.

Snively Basin contains a known historic ranch from the early 20th century so moderate potential exists to locate cultural resources. Snively Basin is also part of a National Register of Historic Places Archaeological

District. Survey of the fire break revealed 100% surface visibility and sub surface exposure to a depth of 30 cm. No cultural resources were found in association with the firebreak. Consequently, the fire suppression activities associated with the fire did not impact any cultural resources.

B. Complete Damage Assessments

A "Post Fire Inspection Form" was created for use in assessing fire related damage to sites. Each previously recorded site that was relocated during field survey was evaluated on this form for initial condition documentation. See C-1-a. "Methodology" for additional details.

C. Consult with affected Agencies and Tribes

Consultation and involvement with other parties is on-going. Additional field work incorporated members of the Yakama Indian Nation, Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and the Wanapum. A contract for field investigations was undertaken with the Cultural Resource Protection Program of the CTUIR to assist in survey for the restoration and rehabilitation project. See C-1-c for details.

D. Prepare site Treatment Plans

There was no direct damage to sites so no treatment plans were necessary as mitigation. The proposed vegetation restoration will help with the indirect threats such as erosion.

V. Expenditure Summary:

Contract Expenses	Personnel	Supplies/ Materials	Total	Acres	Cost per Acre
	$3,262		$3,262	100	$32.62

24 Command Fire

Burned Area Emergency Rehabilitation Treatments
Final Implementation Report
Specification C-1-c Stabilization of Recorded Cultural Sites

The Monument Cultural Resource Manager reviewed the proposed restoration plan with the Monument Natural Resource staff and biologists to determine the level of field work necessary for each restoration activity. Prior to ground disturbing activities associated with restoration activities**,** a field survey was undertaken. Individual site treatment plans were reviewed and appropriate action taken based on the significance of the resource and potential level of disturbance. Areas that received minor surface disturbance, such as the aerial herbicide spray areas and aerial seeding applications were surveyed if time allowed, since there would be low potential for disturbance of cultural resources. Initial assessment of the fire area resulted in mapping, photographing and documenting the cultural resources damaged by fire suppression activities

I. **Purpose of Treatment Specification**: Identification, evaluation of cultural resources and mitigation of impacts to cultural resources within the proposed restoration and rehabilitation of the proposed project area in accordance with federal regulations.

II. **General Description:** All ground disturbing activities associated with rehabilitation and restoration treatment activities required compliance with applicable federal regulations such as the National Historic Preservation Act , 36 CFR 800 regulations, including consideration of Traditional Cultural Properties (TAPS). Cultural resource investigations consist of pre-field review, field survey to identify any CR in the project area, evaluation of the significance of the site, determination of potential impacts as the result of rehabilitation undertakings and mitigation of adverse affects on CR.

III. **Design/Construction Specification(s):**

A.. Conduct Field investigation on Restoration and Rehabilitation sites

B. Consult with affected Agencies and Tribes

C. Provide Mitigation Plans for impacted sites

IV. **Accomplishments**

A. **Conduct Field investigation on Restoration and Rehabilitation sites**.

The level of survey and methodology was determined by the type of rehabilitation treatment undertaken. Treatments ranged from aerial herbicide spraying and seeding, firebreak lines , mechanical seeding to hand dug sagebrush plantings. Additional areas with potential impact to CR that were associated with these activities, such as staging areas, access roads and plant dipping locales, were also checked.

Initial pre-field research was conducted for previously recorded site locations and descriptions. This information was overlaid on the proposed rehabilitation and treatment area. This review revealed that little of the prosed project area had been previously surveyed to identify any cultural resources. Given the sensitive nature of the ALE for cultural resources and the known occurrences of previously recorded sites in or adjacent to the treatment areas, a complete survey of all planting and mechanical seeding areas was undertaken.

In November and December of 2002 a total of 2300 ac. were surveyed; 1000 ac. of mechanical seeding/firebreak discing and 1300ac. of sagebrush starts planted. In addition, areas receiving aerial herbicide application to reduce invasive plant populations, such as cheatgrass, were surveyed in the spring of 2003 after the cheatgrass growth had diminished and native grasses were just emerging. This timing allowed maximum surface visibility for cultural resource observation. Time constraints limited the acreage surveyed to 2836 of the total 8200 acres sprayed.

Survey Procedures

Field methods applied during both phases of the cultural resource inventory required the survey crews to walk transects spaced at 20 meter intervals within the project areas from boundary to boundary. The 2002 inventory of the project consisted of pedestrian surveys of 10 distinct units of varying acreage, plus the survey of the linear firebreak corridor which is about 30 km long by 100 meters wide. The 2003 session earmarked three separate units divided by Cold Creek to the north and Dry Creek in the southern portion. Again, survey crews walked 20 meter interval transects in generally E-W or N-S directions between unit boundaries.

Cultural resources encountered during the survey were assigned a temporary field number and recorded as either a “site” or an “isolated find.” According to the parameters established for Hanford Reach National Monument cultural resource recording procedures, sites are defined as five or more artifacts in a discrete concentration separated from other such concentrations by distance or topographic features such as ridges, intermittent stream channels. The designation of sites and isolated finds is not always clear-cut, however these determinations dictate eligibility evaluations for the National Register of Historic Places and ultimately whether or not mitigation procedures will be required. For example, in some cases the site designation can be extended to “sites” with less than five artifacts if they are located in a geographical context that shows the possibility of subsurface cultural deposits, such as accreting aeolian sediments. This is a cautionary measure taken to ensure the protection of a possible buried site, although one is not implied by the surface assemblage. All isolated finds encountered were considered mitigated after initial recording and are not subject to further avoidance/mitigation measures. All sites were recorded on PNNL/Hanford Cultural Resource Laboratory/Pacific Northwest Laboratory Archaeological Site Forms and U.S. Fish and Wildlife Service isolate forms. Plots containing sites were modified to exclude the cultural resources to ensure that cultural resources would not be impacted by project activities. A buffer zone outside of the actual site boundaries was demarcated as necessary to protect the sites from ground disturbing activities. Extensive site areas required relocation of proposed planting plots to other areas with no sites to accommodate the reduced planting acreage.

Scaled planimetric site maps were completed to have a spacial record of the extent of the site plus the artifacts and features within the site boundaries. Diagnostic artifacts such as projectile points, and cultural features, were photographed and sketched. No artifacts were collected. All sites and isolated finds were plotted on USGS Topographic 7.5 minute quadrangle maps using GPS data recorded in the field.

Project Results

The documentation and site form preparation is still in process for both the 2002 and 2003 fieldwork. The following preliminary information is a cursory synopsis of the cultural resources found. Completion of the records is anticipated by the end of 2003.

A total of 21 new cultural resources were located and identified during the 2002 inventory phase of the 24 Command Fire. Of the total, 17 have been designated as sites, and the remaining four are described as isolated finds. There are four prehistoric cultural resources (2 sites, 2 isolates), and 17 historic cultural resources (9 sites, 8 isolates). Many of the historic cultural resources are military sites containing fox holes and other features associated with the military presence on the ALE during 1950s and 1960s. Other historic sites encountered are historic roads and remnants of farming and stock raising evidenced by general debris scatters of cans, glass, and domestic household items. The two prehistoric sites are lithic scatters of predominantly tool-making flakes.

During the 2003 phase of the cultural resource inventory, a preliminary count of an additional 27 sites and isolates were located and recorded in the Cold Creek area of the ALE. There are 13 historic cultural resources (10 sites, 3 isolates), and 12 prehistoric cultural resources (9 sites, 3 isolates). Two sites have both prehistoric and historic components.

The current total of both fall and spring cultural resource inventories for BAER is 48 new cultural resources sites. The total includes 19 historic sites, 11 prehistoric sites, 2 prehistoric/historic sites; 11 historic isolates, 5 prehistoric isolates.

B. Consult with Affected Agencies and Tribes

Tribal consultation had been implemented and was on-going through this phase. See also C-1-a. In addition, in conjunction with the existing DOE Cultural Resource Monitoring program, the Monument Cultural Resource Manager conducted the scheduled monitoring of sites in the Rattlesnake Springs (45BN170/171) area within the BAER project in August 2002. Tribal participation consisted of representatives from the Nez Perce Tribe, Yakama Indian Nation and Wanapum. Noted impacts to the sites in the area as a result of the fire included both soil ablation and accretion.

C. Provide Mitigation Plans for impacted Sites

Preliminary assessment of the fire impact under C-1-a Table 2 recommended that no treatments were necessary for any sites except monitoring of three sites. Two of those were monitored in 2002 (See B. Above).The proposed project to restore shrub-steppe habitat to the burned area through seeding and planting is a mitigation for the erosional threats identified as one of the main impacts to cultural resources under C-1-a. The mitigation for sites identified as being potentially affected in the course of the rehabilitation project survey consisted primarily of avoidance as discussed in C-1-c. No other formalized mitigation plans were developed primarily due to time constraints.

V. Expenditure Summary:

Contract Expenses	Personnel	Supplies/ Materials	Total	Acres Surveyed	Cost per Acre
	$6,370		$6,370	2300	$ 2.77

A complete accounting of BAER funds that were requested and expended for each specification can be located in Table E on page 6. Photo documentation of fire damage, implementation actions and accomplishments can be found within Appendix A.

24 Command Fire

Burned Area Emergency Rehabilitation Treatments
Final Implementation Report
Specification C-2 Tribal Consultation/Oral Histories

I. Purpose of Treatment Specification: Use tribal monitors during restoration activities as necessary to prevent inappropriate procedures, disturbance of sacred areas etc.

II. General Description: Natural resources destroyed by the fire were used both in the past and present by Native American groups in the area. Oral histories need to be conducted to obtain tribal perspectives on resource use and TCP's. This ties into proposed vegetation planting/habitat restoration as tribes consider natural resources integral to cultural resources. Partnering with Tribes to determine location for planting, types of vegetation, methodology and so forth will enhance restoration efforts.

III. Design/Construction Specification(s):

A.. Incorporate pertinent information into specifications, restrictions etc. for restoration activities.

B. Conduct oral interviews with Native Americans versed in traditional use of the cultural landscape.

C. Utilize tribal monitors during planting or other ground disturbance in sensitive areas.

IV. Accomplishments

A. Incorporate Pertinent Information into Restoration Activities

As discussed in C-1-c, the methods employed for mitigation involved site avoidance so having specifications in the contracts for protection were unnecessary. Cultural Resource staff coordinated with Natural Resource staff and planters in the field to adjust plot boundaries to provide cultural resource protection. For the fire break and mechanical seeding activities, sites were delineated on maps and in the field for personnel to avoid during ground disturbing activities. Cultural resource staff monitored progress to ensure sites were not inadvertently damaged during these restoration events.

B. Conduct Oral Histories with Native Americans on Traditional Use of the area

An ethnographic background and oral history component was inserted as part of the contract with the Confederated Tribe of Umatilla Indian Reservation Cultural Resource Protection Program for the BAER project. The research is on-going and no documentation has been provided. A draft of the write -up is anticipated by the end of 2003.

C. Utilize Tribal Monitors during Ground Disturbance in Sensitive areas

No sensitive areas had been identified prior to or during the cultural resource investigation for the rehabilitation project. Having the tribal contract for cultural resource survey provided this knowledge and awareness and made field decisions more efficient if questions or concerns over Native American issues arose.

V. Expenditure Summary

Contract Expenses	Personnel	Supplies/ Materials	Total	Acres Treated	Cost per Acre
$6,600			$6,600	2,300	$2.87

A complete accounting of BAER funds that were requested and expended for each specification can be located in Table E on page 6. Photo documentation of fire damage, implementation actions and accomplishments can be found within Appendix A.

24 Command Fire

-Burned Area Emergency Rehabilitation Treatments-
Final Implementation Report
Specification N–2 Non-native Invasive Plant Control

I. **Purpose of Treatment Specification**: Protect the ecological integrity and site productivity of shrub-steppe plant communities within the ALE in accordance with established management plan guidelines**.**

II . **General Description:** Control noxious weed infestations remaining within the 24 Command fire area prior to seed-set and maturation. Current weed species observed include Rush skeleton weed, knapweed (diffuse, spotted, russian), kochia and canadian thistle. Utilize integrated pest management techniques (herbicides, biological, mechanical and cultural control methods) as appropriate to prevent the spread and establishment of noxious weeds within the fire area.

III. **Design/Construction Specification (number and describe each task):**

A. Control noxious weeds as identified in FWS and DOE monitoring surveys prior to seed set in accordance with guidelines contained within ALE and DOE management plans and approved Environmental Assessments.

B. Follow-up control in subsequent years on all new infestation sites as identified through noxious weed monitoring surveys.

IV. **Accomplishments:**

***A. Control noxious weeds as identified in FWS and DOE monitoring surveys prior to seed set in accordance with guidelines contained within ALE and DOE management plans and approved Environmental Assessments*:**

This task was accomplished using HRNM staff. The Maintenance staff and Biological staff provided greater than 1000 person/hours per year in 2000-2003 to accomplish weed control within the fire area.

All roads have been treated with glyphosate herbicide (Roundup®Pro or similar) for weed control post-fire. This activity has been conducted at least annually (2000-2003) on the ALE unit of the National Monument. Roads have also been mowed annually in the late spring to reduce vegetation along roads and to create fuel breaks. Because glyphosate is a non-selective herbicide that kills only actively growing weeds, the on-going annual treatments will be required to maintain roads in a weed free condition, and to maintain fuel breaks throughout the fire area. The total acres sprayed along roadways totals 43 acres. Over 2800 gallons of chemical have been applied over this three year period.

Known populations of Russian knapweed, rush skeletonweed, diffuse knapweed, puncturevine, and Canada thistle were sprayed. In addition, new populations were identified and mapped. The primary herbicide treatments used were clopyralid (Transline®),and 2-4,D which are a broadleaf herbicides. Volunteers from the Washington Native Plant Society, Columbia Basin Chapter and the Lower Columbia Basin Audubon spent an average of 280 person/hours mapping, hand pulling and treating rush skeleton weed on ALE in spring of 2001 and 2002. Following this volunteer effort the Refuge Operations Specialist, Biological technician, and Maintenance workers used ATV with spraytank, backpack sprayers, and spray truck to treat all newly mapped rush skeletonweed plants. Russian knapweed has been treated annually using ATV and backpack sprayers. Diffuse knapweed was also treated using backpack sprayers. Total acres treated is in excess of 50 acres.

Equipment/material employed in this project have included herbicide, backpack sprayers, weed whackers, mower blades, spray truck parts, tyvek suits, wicks, rubber gloves, eye protection, and all PPE (personal protective equipment).

Mapping has taken place on more than 10,000 acres in an attempt to document all known noxious weeds on ALE. This effort has been conducted cooperatively with The Nature Conservancy of Washington. Updated maps of noxious weed locations are included in Appendix B-Figure 6 7 of this report.

The "# of units" treated was in excess of 100 acres, which was the acreage identified for treatment in the BAER plan.

B. Follow-up control in subsequent years on all new infestation sites as identified through noxious weed monitoring surveys:

As stated above, the noxious weed monitoring program has been on-going within the fire area since 2000. New infestations are recorded using GPS and are being entered into a noxious weeds data base that is GIS compatible and can be displayed on topographic maps. The database and maps are then used to guide treatment priorities throughout the burned area. In 2003, the database has become fully operational with the acquisition of GIS capability at the HRNM headquarters. An 'Integrated Pest Mangement Plan' draft is being developed with much of the data that has been gathered on weed locations. The IPM plan will encompass weed treatment histories and weed treatment schedule for annual operations to continue to control weeds within this area.

Concern over the spread of noxious weeds and invasive plants was used to develop the Amendment of the 24 Command fire BAER plan. Please see accomplishment report for Specification N-2a.

V. **Expenditure Summary:**

Contract Expenses	Personnel	Supplies/ Materials/ Rentals	Acres Treated	Cost per Acre
		$ 8,094	150	$53.96

A complete accounting of BAER funds that were requested and expended for each specification can be located in Table E on page 6. Photo documentation of fire damage, implementation actions and accomplishments can be found within Appendix A.

24 Command Fire

-Burned Area Emergency Rehabilitation Treatments-
Final Implementation Report
Specification N-2a Non-native Invasive Plant Control

I. Purpose of Treatment Specification: To prevent or reduce the spread of non-native plants and to reduce the competition for recovering native vegetation and to promote the establishment of seeded vegetation.

II. General Description: To prevent or reduce the spread of undesirable non-native invasive plants, e.g., cheat grass, Russian thistle, etc., on the Arid Lands Ecology Reserve and to assist in the establishment of native shrubs, grasses, and forbs.

III. Design/Construction Specification(s):

a. Qualitatively assess invasive species densities within rehabilitation target areas during Winter, 2002. Approximate total rehabilitation acreage is 10,000 acres. Approximately 50-70% of this area will require treatment.
b. Control cheat grass in late February, 2002 – then again in late Fall, 2002 prior to seeding during Winter 2002-2003.
c. Prioritize invasive corridors for weed control during Spring-Summer 2002. Initiate treatments during Fall, 2002.
d. Recommended herbicide for cheatgrass control is Roundup® (glyphosphate). Application at low concentrations (3.5 – 6.0 oz./ acre) during late winter – early spring will minimize injury to desirable native plants.
e. Russian thistle must be controlled with midsummer, 2002, application of a selective broadleaf herbicide approved for rangeland use. A second application, if necessary, may be applied during midsummer, 2003, provided target areas have not been seeded or planted with broad-leafed species.
f. There should be a buffer zone of 25 feet between treatment areas and open water or wetland areas. This includes creeks, springs, irrigation ditches, and ponds. If it is necessary to get closer to open water or wetland areas for cheatgrass control then the glyphosphate formulation Rodeo® should be used.
g. The application method can be by hand sprayer or tractor/ATV mounted sprayer. Aerial application may be employed if environmental conditions permit.
h. The area to be sprayed should be posted.
I. Winds in the area to be sprayed should be less than 3 miles per hour.
j. Applicator or person supervising the application should be state certified.

IV. Accomplishments:

a.***Qualitatively assess invasive species densities within rehabilitation target areas:*** Rehabilitation areas were assessed during spring 2001 and 2002. Results are published in *Short Term Impacts of the 24 Command Fire on Vegetation of the Fitzner-Eberhardt Arid Lands Ecology Reserve, Hanford Reach National Monument: Synthesis of Findings, 2001-2002-The Nature Conservancy* (October 2002) and was utilized to delineate treatment areas. Because the Amendment to the 24 Command fire was not approved until March of 2002, no winter (Jan/Feb) 2002 surveys were conducted. However, during late autumn of 2002, TNC shrub-steppe ecologist and biologists from HRNM met to conduct field reconnaissance of the planned treatment area. Biologists examined the phenology of native plants in the area and also the abundance and growth stage of cheat grass. A 9,555 (95% of rehabilitation acres) acre area was delineated for treatment. The autumn of 2002 was an unusually dry. Drought conditions existed from September through November with only 0.5 inches of rain. This amounts to only 28% of average normal rainfall for similar autumn periods recorded at the Hanford Weather Station (http://etd.pnl.gov:2080/HMS/). The first measurable precipitation was received on ALE on November 7, 2002. Cheatgrass usually greens up under the first rains of the fall and green-up started approximately 5 days later. Because of the drought

conditions, the flush of cheatgrass was below average. Nevertheless, it was determined that there was a presence of cheatgrass that could be vulnerable to spray treatment. A contract was developed to conduct aerial spraying to reduce the amount of cheatgrass in the target rehabilitation area. Aerial application of herbicide, Round-up® at 3.5 ounces per gallon, began on November 14, 2002. Fourteen consecutive days of fog extended aerial applications until December 10, 2002 (See part b). Brief breaks in the weather allowed some applications to be made, however fog or wind closed out operations early each day. The benefit to these delays included continued favorable weather conditions for cheatgrass germination. Therefore a larger percentage of cheatgrass was treated in early December than would have been in late November.

b. ***Control cheat grass in late February, 2002 – then again in late Fall, 2002:*** No treatments were conducted within the rehabilitation area during February 2002, because the Amendment containing this specification was not approved until March 2002. During March 2002, field visits indicated that native plants were already green and growing and no herbicide treatments could be conducted. A contract was developed to have a cheatgrass control treatment applied during fall of 2002. An RPF # 101813R002 was issued from the Contracting and General Services Division of The FWS Regional Office for Region 1, Portland, Oregon. The contract (# 101813C002) was issued to Aerotech, Inc. of Clovis, New Mexico after a competitive bid process. During late Fall, November/December 2002, an aerial application of Roundup® was completed under contract by Aerotech, Inc. (see parts a & d).

c. ***Prioritize invasive corridors for weed control during Spring-Summer 2002. Initiate treatments during Fall, 2002.*** Invasive corridors were discussed by TNC shrub-steppe ecologist and HRNM biologists. Treatments were modified to create a large buffer between low quality areas dominated by invasives and high quality vegetation areas, encompassing several of the corridor areas. Treatment of the large blocks were conducted during the aerial application of Roundup®. Many of these corridors are areas that are at risk of periodic disturbance due to high run off, and therefore these corridors will be mapped and incorporated into Integrated Pest Management plan currently under development at HRNM office. These areas will continue to be monitored to determine if invasive plants are spreading into high quality plant communities from these corridors.

d. ***Recommended herbicide***: Roundup® was used in a light dose, 3.5 ounces/acre during aerial spraying operations conducted November/December 2002. Aerial application of herbicide began on November 14, 2002. Fourteen consecutive days of fog extended aerial applications until December 10, 2002. Brief breaks in the weather allowed some applications to be made, however fog or wind closed out operations early each day. The benefit to these delays included continued favorable weather conditions for cheatgrass germination. Therefore a larger percentage of cheatgrass was treated in early December than would have been in late November. The first treatment was followed up with a second treatment of another light dose of Roundup® in February 2003. Another RFP was issued (# 101813R004) and through the competitive bid process, Aerotech, Inc. was again award the contract for the second treatment (contract # 101813C004). The second treatment was preceded by field reconnaissance to determine phenology of native plants. Because native plants were emerging in some areas, the second spray treatment was conducted on a smaller number of acres in areas with a higher density of cheatgrass. This second treatment covered an 8,000 acre sub-set of the original 9,555 acres treated.

e. ***Russian thistle must be controlled with midsummer, 2002, application of a selective broadleaf herbicide approved for rangeland use. A second application, if necessary, may be applied during midsummer, 2003, provided target areas have not been seeded or planted with broad-leafed species:*** No treatments for broad-leafed species were conducted in 2002. These treatments were precluded due to the fact that many native species that are desirable are also actively growing and green during this time period. A spray for broad-leafed species cannot be conducted without harming native species that are desirable. Further, the seed mix that was planted during winter 2002 contained broad-leafed species. These broad-leafed forbs were planned to be in the native grass seed mix because forbs have deep roots that develop relatively

quickly and begin to increase the nutrient cycling in the soil. It is hoped that when seeded natives emerge and begin to grow, the abundance of some of the non-native broad-leafed species will decrease.

f. ***Buffer zone between treatment areas and open water or wetland areas:*** Buffer zones greater than 25 feet were maintained around all water and wetland areas. The Pesticide Use Proposal (PUP) that must be filled out for a pesticide to be used on FWS Refuge lands recommends a 500 foot buffer from all water or wetland areas. A buffer of greater than 500 feet was maintained around the Rattlesnake springs area during the aerial spraying operations. Additionally, all existing sagebrush stands, and new sagebrush plantings were buffered by 500 feet as well during spraying operations. Rodeo®, as prescribed in the amended BAER plan was not used as the spray applications and seeding operations were designed to maintain this buffer around the wetland areas.

g. ***The application method can be by hand sprayer or tractor/ATV mounted sprayer. Aerial application may be employed if environmental conditions permit:*** As stated above, aerial application was chosen as the method for treatment due to constraints presented by the terrain over the majority of the area. The terrain and soils prevented us from using tractors or heavy equipment. Further, the large size of the treatment area precluded conducting the entire spray using hand sprayers or ATV's which are less efficient at covering large acreage. A smaller 43 acre area along roads was sprayed using ground application equipment.

h. ***The area to be sprayed should be posted:*** The treatment area was entirely within the boundary of the Arid Lands Ecology Reserve unit of the HRNM. This is a limited entry area that requires a entry permit and entrance through locked gates. All gates were posted with signs indicating that spray operations were being conducted (see photo documentation Appendix A). Additionally, a general press release was issued to the local media, and a more specific Hanford Site wide memo was issued through an e-mail notification for all DOE employees and Hanford contractors.

I. ***Wind conditions:*** Weather, including wind, must be monitored and recorded during any spraying operation (see below for legal requirement of applicator). The spraying operation was cancelled due to weather conditions several times and required the plane and operators to remain on "stand-by" in order to get the work competed under conditions favorable to the herbicide application. Droplet size was also adjusted so that the larger droplets of herbicide would be less likely to drift. Aerial application of herbicide, Round-up® at 3.5 ounces per gallon, began on November 14, 2002. Fourteen consecutive days of fog extended aerial applications until December 10, 2002. Brief breaks in the weather allowed some applications to be made, however fog or wind closed out operations early each day. The benefit to these delays included continued favorable weather conditions for cheatgrass germination. Therefore a larger percentage of cheatgrass was treated in early December than would have been in late November.

j. ***Applicator or person supervising the application should be state certified:*** In order to be granted a PUP to conduct this operation on National Wildlife Refuge System lands, it is required to follow state licencing and certification requirements. The application was conducted by contractor, which had all of the legal permits and requirements to conduct this type of work in Washington state.

V. Expenditure Summary:

Contract Expenses	Personnel	Supplies/ Materials/ Rentals	Total	Acres Treated	Cost per Acre
$300,470	$219,181	$113,704	$633,355	10,150	$ 62.40

24 Command Fire

-Burned Area Emergency Rehabilitation Treatments-
Final Implementation Report
Specification N-3a Ecological Stabilization - Sagebrush *Plants*

I. **Purpose of Treatment Specification**: Protect the ecological integrity and site productivity of shrub-steppe plant communities within the ALE and DOE lands in accordance with established management plan guidelines. Comply with directives established in FWS BAER policy for the protection of ecosystem health, T&E species and Native American cultural values.

II. **General Description**: Replace sagebrush plantations (*Artemisia spp.)* lost during backfire operations on the 24 Command fire to protect ecological integrity of ALE lands.

III. **Design/Construction Specification (number and describe each task):**

1. Relocate boundaries of plantation sites. Utilize seed now in stock to grow container stock for outplanting in 2001 for the replacement of impacted plantations.

2. Establish photo monitoring plots within each planting site and GPS boundaries of planting locations. Supervise planting and provide maintenance support.

3. During the spring of 2002, conduct survival survey to determine success of outplantings. Determination of survival rate should be documented with findings incorporated into greenhouse growing operations, management guidelines for sage restoration, agency protocols, and annual budget submissions.

IV. Accomplishments:

Note: Due to the late date of approval of the plan, no seedlings could be produced for outplanting in 2000. This specification was combined with N - 3b for implementation purposes. Please see write up for N-3b which addresses the accomplishments for the combined specifications.

1. ***Relocate boundaries of plantation sites:*** The original plantation areas were used by the Pacific Northwest National Laboratory during winter 2000, immediately following the fire, for plantings they were conducting as mitigation for habitat destruction on Central Hanford locations. These mitigation plantings were agreed upon by FWS. Plots were relocated during 2000. In order to keep separate mitigation plantings conducted by PNNL and rehabilitation plantings conducted by FWS, and because these areas were planted by PNNL, new areas were chosen as plantation locations. See accomplishment report of N-3b.
2. See accomplishment report of N-3b.

3. See accomplishment report of N-3b.

24 Command Fire

-Burned Area Emergency Rehabilitation Treatments-
Final Implementation Report
Specification N-3b Ecological Stabilization - Sagebrush Outplanting

I. **Purpose of Treatment Specification**: Protect and restore the ecological integrity and site productivity of shrub-steppe sagebrush plant communities within the ALE and DOE lands in accordance with established management plan guidelines.

II. **General Description:** In the fall of 2000, plant 80,000 sagebrush (*Artemisia spp.)* seedlings within the fire area to rehabilitate impacted shrub-steppe plant communities that serve as critical habitat for T&E species.

III. **Design/Construction** Specification (number and describe each task):

1. Select planting locations in accordance with guidelines contained within ALE and DOE management plans and approved Environmental Assessments.

2. Establish photo monitoring plots within each planting site and GPS boundaries of planting locations. Supervise planting and provide maintenance support.

3. During the spring of 2001, conduct survival survey to determine success of outplantings. Determination of survival rate should be documented with findings incorporated into greenhouse growing operations, management guidelines for sage restoration, Agency protocols, and annual budget submissions.

IV. **Accomplishments:**

Note: Due to the late date of approval of the plan, no seedlings could be produced for outplanting in 2000. This specification was combined with N - 3a for implementation purposes during 2001.

1. ***Select planting locations:*** Prior to the planting, the biological staff set up 9 plots totaling about 500 acres for the sage planting. This was done by placing fiberglass fence posts approximately 100-200 m apart around the perimeter of each plot. The range finder was used for the spacing of the posts and a GPS waypoint was taken at each post. Each post was marked with colored flagging, and the corner posts were double high. The GPS way points were then entered into the GIS program to produce maps and acreage of each plot. The biological staff spent a considerable amount of time choosing sites. Sites were chosen using the criteria developed for previous planting efforts. These criteria are as follows:
   - Sites should have pre-existing under story characteristics that contain significant proportions of native vegetation so that they will develop into high quality habitat capable of supporting wildlife populations
   - Sites should be relatively large (>20 acres) so that larger blocks of habitat will develop over time
   - Sites should attempt to bridge gaps between existing blocks of shrub-steppe habitat OR should attempt to replace sagebrush into areas that had mature sage stands prior to the “24 Command Fire”
   - Sites should be near established roads on ALE to minimize disturbance to this Research Natural Area.
   - All sites will be cleared for planting through the cultural resource program, such that planting will not disturb any culturally significant sites.

   Each plot was examined by the cultural resource specialist for cultural resources before the planting began. Any areas of significance located during the cultural resource survey were marked and avoided.

Seed Collection: Raw seed from Monument lands was confiscated from illegal collectors during November 2000. Seed was sent to Lucky Peak Nursery (LPN), Boise, Idaho for cleaning. LPN is a U.S.D.A. Forest Service nursery with the technical capability and equipment to process this type of native seed. Approximately, 60 pounds of raw seed was cleaned. Cleaned seed totaled approximately 1.9 pounds. Seed was sewn in April/May 2001 with LPN contracted to grow 250,000 bare root plants and Buffaloberry native plant nursery contracted to grow 40,000 container stock (4" and 10" tublings).

Plant Production: The original 2000 order of plants from LPN experienced some problems during production. The production short fall was caused by low germination of seed provided to LPN by FWS. During 2000, a large amount of seed was collected from the Wahluke slope illegally. FWS confiscated the seed, and used it for production of plants. However, the seed was collected early {mid-November} and had probably not matured enough to be viable. This was potentially the problem with germination that caused the short-fall in the FWS order. Due to this short fall, plants that were available from Bitterroot restoration from an Eastern Washington source were purchased. These plants were offered for a competitive price under the stipulation that Bitterroot crews would also conduct the planting of the seedlings provided. With the purchase of these additional plants, a total of 173,348 sagebrush plants were supplied (Buffaloberry Nursery provided 19,200 - 10" tublings and 20,111 - 4" tublings. Lucky Peak Nursery provided 51,980 bare root plants, Bitterroot Restoration provided 75,000 - 4" tublings). However, this total number of plants was significantly less than the 250,000 that FWS had originally ordered from LPN to complete the restoration project as specified in the BAER plan. Due to the short fall of plants during production at Lucky Peak Nursery, (LPN) the project still required approximately 85,000 bare root plants. FWS collected seed during late December 2001, and contracted with LPN to produce the 85,000 additional plants for planting in fall/winter of 2002. This completed the project as described in the BAER specification. Please refer to accomplishment report for Specification N-4a from the BAER plan Amendment for details regarding the planting of the remaining 85,000 plants.

2. ***Establish photo monitoring plots within each planting site and GPS boundaries of planting locations. Supervise planting and provide maintenance support:***

GPS maps of planting plots were developed (see above) and photo plots established.
Planting operations: Frank A. Maduzia Jr., Forestry contractor, Littlerock, Washington was hired to complete the planting of the ~ 90,000 plants ordered from Lucky Peak Nursery and from Buffaloberry farm. Maduzia's crew began planting on Monday, December 3, 2001 and continued through Saturday, December 8,2001 planting a total of 94,917 plants (the additional plants were provided at no cost through a volunteer community project). The crew from Bitterroot Restoration planted all of the plants provided by their company. They began on Wednesday, December 5, 2001 and finished on Wednesday, December 12, 2001 planting a total of 75,000 plants,. The final totals and maps for each plot are included in Appendix C.

3. ***During the spring of 2001, conduct survival survey to determine success of outplantings:***

Monitoring plots were established in late winter/early spring of 2002. The plots were to assess the planting at time 0, with the assumption that all seedlings were alive at planting. A total of 20 - 100 meter long x 10 meter wide transects were established with the goal of capturing at least 100 plants per transect for monitoring. This contains a sample of approximately 1% of the total plants that were planted. The beginning point for each transect was randomly placed in the planting plot. A 100 meter tape was laid from this randomly selected origin and laid out in a straight line (using a compass azimuth). Using this tape as the mid-line a 5 meter area on either side was systematically mapped. Each plant along the transect was recorded with an X coordinate, which was the distance from the origin, and a Y coordinate which was the distance from the transect tape (up to 5 meters left or right of the tape). These plants were then revisited during the height of the summer (when they are most stressed in this system). Plants were recorded as being 0-dead, 1-sick, 2-alive. These categorical data were clearly defined for field personnel, with "dead" being a brittle, dried stem, "sick" being a plant with some green foliage but some brittle dried stems, and "healthy" being a green vigorous plant.

Results: A total of 1991 seedlings were monitored. Of those, a total of 822 (41.3%) were documented as healthy, 694 (34.9%) were documented as sick, 370 (18.6%) were documented as dead, and 105 (5.2%) were missing or not relocated. We assume that the "sick" plants have a 50:50 chance of survial, so that one half of those plants could be counted preliminarily as moving into the healthy category. Assuming this is an accurate assumption, a total of 1169 plants (59%) survival could be assumed. These plants will be re-monitored in 2003, and 2005. Following the final monitoring, a report will be written to document the success of this effort. Additionally, data exists on the different stock types, and will be analyzed in the future to determine which stock types had the best overall survival. We will also initiate a economic analysis to determine the greatest survival for the least cost. These reports will be shared with nursery operators, agency personnel, and land managers, and NIFC/FEIS to improve sagebrush restoration techniques.

V. Expenditure Summary

Contract Expenses	Personnel	Supplies/ Materials/ Rentals	Total	Acres Treated	Cost per Acre
$83,384	$9,000	$1,872	$96,128	413	$233

A complete accounting of BAER funds that were requested and expended for each specification can be located in Table E on page 6. Photo documentation of fire damage, implementation actions and accomplishments can be found within Appendix A.

24 Command Fire

-Burned Area Emergency Rehabilitation Treatments-
Final Implementation Report
Specification N-3c Ecological Stabilization: Seed Collection

I. **Purpose of Treatment Specification:** Protect the ecological integrity and site productivity of shrub-steppe plant communities within the ALE and DOE lands in accordance with established management plan guidelines. Comply with directives established in FWS BAER policy for the protection if ecosystem health, T&E species and Native American cultural values

II. **General Description:** Collect native seed from shrub-steppe plant communities remaining within the proximity of the 24 Command fire for the establishment of rehabilitation plant materials for rehabilitation treatments on suppression related impacts(backfire areas and dozer/fireline rehabilitation).

III. **Design/Construction Specification (number and describe each task):**

1. Identify collection sites within the project area for native seed collection.

2. Develop collection protocols to ensure genetic quality and the protection of collection sites from over-harvest.

3. Collect adequate seed in CY00 to meet long-term rehabilitation needs in years 2000-2002.

4. Process and clean collected seed to obtain useable material for nursery growing operations.

IV. **Accomplishments:**

1. ***Identify collection sites within the project area for native seed collection.*** Sites were identified on the HRNM for native seed collection. Mature sagebrush stands approximately 10 miles north of the fire area were selected because there were ample seed-producing plants available. The area also has both gray and green rabbitbrush available making harvest of these three shrub species very efficient. This area is part of the HRNM within the Saddle Mountain NWR unit of the Monument. Native shrub and grass seed was also collected from the Wahluke Unit northeast of the fire area.

During 2000, a group of contract seed collectors were discovered collecting sage seed off of Monument lands (Wahluke unit). Because collecting of any resources off of the Monument is illegal, all of the raw seed was confiscated, which totaled nearly 1500 bulk pounds (See article in Appendix). The seed was eventually cleaned for the Monument to use. This seed was collected during November, which is fairly early for sage seed development, so there was some concern over it's viability. The cleanest seed (about 60 lbs.) was sent to USDA Forest Service Lucky Peak Nursery, Boise, Idaho in March of 2001 for grow out (See 4). The remainder of the bulk seed was scattered back into the area that had been damaged from the intense collection of seed.

During the 2001 season, the station biologist and biological technician spent 160 person hours conducting native shrub and grass seed collection. In December 2001 and January 2002, 60 bulk lbs. of sagebrush seed were collected, and nearly 25 bulk lbs. of gray and green rabbit brush were collected. After cleaning, it was determined that more sagebrush seed was needed and additional seed was ordered from SunMountain Native Seeds to supplement the production needs for the 2002 season. A eastern Washington, Columbia

Basin source identified seed was required for the plant production.
During the 2002 season additional native species seed collection took place. In July of 2002, approximately 20 lbs. of Bitterbrush seed was collected. During July and August 2002, Needle-and-thread grass and Indian rice grass were collected for grow out and propagation. Approximately 10 bulk pounds of each grass seed species was collected. Additionally, the Youth Conservation Corp crew assisted in the effort adding another 160 person/hours. In December 2002 and January 2003, and additional 25 pounds of bulk sage seed was collected by the biological technician in approximately 36 person hours.

2. ***Develop collection protocols to ensure genetic quality and the protection of collection sites from over-harvest.*** Collection protocols were developed by HRNM staff to ensure genetic compatibility with rehabilitation sites, and to protect sites from over-harvest. Protocols outline guidelines for seed collection whereby no more than 10% of the seed off of any one plant, and not more than 10% of seed from any one population or area of plants can be collected. This ensures seed remains in the general area for natural propagation, and that several plants will have to be harvested to make the total seed collection. Thus, the genetics of many individual plants are represented within the collection.

3. ***Collect adequate seed in CY00 to meet long-term rehabilitation needs in years 2000-2002.*** Seed of native shrubs, sagebrush, rabbit brush, and others are extremely small. In general, these seeds do not remain viable for more than one season. Due to the phenology of these desert plants, the small size and limited viability of the seeds produced, seed must be collected each year. Further, seed storage issues are another reason that seed must be collected each season. Seeds do not remain viable in fluctuating temperatures or humidities. Adequate seed storage must be in temperature and humidity controlled conditions. Currently, few facilities exist to store seed for use at HRNM. Small areas of space at the Washington State University seed lab have been obtained at no cost through cooperative partnerships, however, this site can only store limited amounts of seed, for limited time frames, as the facility is mostly used for seed crops.

4. ***Process and clean collected seed to obtain useable material for nursery growing operations.***

   Bulk seed as collected was sent to professional seed cleaning operations. In general, USDA Forest Service Lucky Peak Nursery(LPN) conducted seed cleaning operations for sagebrush seed. LPN also produced all bareroot sagebrush seedlings for planting in 2001 and 2002 (See Specifications N-3a, N-3b, and N-4b). Buffaloberry Farm Native Plant Nursery in McCall, Idaho cleaned the gray rabbit brush, green rabbit brush and bitterbrush seed. This nursery has produced the tubling stock of sagebrush in 2001 and 2002 (See Specifications N-3a, N-3b, and N-4b), and rabbit brush and bitterbrush for outplanting in 2003. The native grass seed was cleaned and de-awned by L & H seeds. A portion of each seed was then sent to Buffaloberry farm for grow out into grass plugs, while a portion was also retained by L & H for sewing into grass production fields at their native grass seed farm facilities in Connell, Washington.

V. Expenditure Summary:

Contract Expenses	Personnel	Supplies/Materials	Total	lbs. Acquired	Cost/lb.
	$4,500		$4,500	145	$31.00

A complete accounting of BAER funds that were requested and expended for each specification can be located in Table E on page 6. Photo documentation of fire damage, implementation actions and accomplishments can be found within Appendix A.

24 Command Fire

-Burned Area Emergency Rehabilitation Treatments-
Final Implementation Report
Specification N-4a- Revegetation- Native Seeding

I. **Purpose of Treatment Specification:** Prevent non-native species invasion and expansion into native shrub-steppe plant communities. Promote ecological recovery of native shrub/steppe ecosystem.

II. **Description:** Based on monitoring conducted under the original BAER Plan, stabilize the soil, prevent non-native invasive species invasion or reinvasion, and promote ecological recovery of native shrub-steppe ecological community.

III. **Design/Construction Specification(s):**

A. Control cheatgrass and other invasive species within target areas during February and Fall, 2002. See specification 'Non-native Invasive Plant Control'.

B. Seed Mixture Selection and Certification: The seed mix should be tested for purity and germination rates. Before accepting delivery of seed shipment the contractor must provide written evidence (seed label and letter) to the refuge manager that the seed conforms to the purity and germination requirements in the specification. Test methods specified in *Rules for Testing Seeds, Proceedings of the Association of Official Seed Analysts* will be acceptable for determining the germination rate. Seed shall conform to specifications outlined within "Request for Formal Bid for Seed" contained in Appendix III.

Seed Mix: low elevations (< 800'): 6050 acres/ 2440 hectares; PLS= Pure Live Seed

Thickspike wheatgrass, *Agropyron dasystachyum* [=*Elymus lanceolatus* var. *lanceolatus*]	6 lbs/acre PLS	33 %
Indian ricegrass, *Oryzopsis* [=*Achmenoides*] *hymenoides*	4 lbs/acre PLS	22 %
Sandberg's bluegrass, *Poa sandbergii* [= *P. secunda*]	5 lbs/acre PLS	28 %
Squirreltail, *Sitanion hystrix* [= *Elymus elymoides*]	2 lbs/acre PLS	11 %
Needle and thread, *Stipa* [= *Hesperostipa*] *comata*	0.5 lbs/acre PLS	3 %
Wyoming big sagebrush, *Artemisia tridentata ssp. tridentata*	0.1 lbs/acre PLS	
Grey rabbitbrush, *Chrysothamnus nauseosus*	0.1 lbs/acre PLS	
Green rabbitbrush, *Chrysothamnus viscidiflorus*	0.1 lbs/acre PLS	
Yarrow , *Achillea millefolium* ssp. *lanulosa* var. *lanulosa*	0.2 lbs/acre PLS	1 %

Seed Mix: higher elevations (750-1500'): 5274 acres/ 1710 hectares

Bluebunch wheatgrass, *Agropyron* [= *Pseudoroegneria*] spicatum	8 lbs/acre PLS	48 %
Sandberg's bluegrass, *Poa sandbergii* [= *P. secunda* ssp. *secunda*]	5 lbs/acre PLS	30 %
Squirreltail, *Sitanion hystrix* [= *Elymus elymoides*]	3 lbs/acre PLS	18 %
Wyoming big sagebrush, *Artemisia tridentata ssp. tridentata*	0.1 lbs/acre PLS	
Grey rabbitbrush, Chrysothamnus nauseosus	0.1 lbs/acre PLS	
Green rabbitbrush, Chrysothamnus viscidiflorus	0.1 lbs/acre PLS	
Yarrow , *Achillea millefolium* ssp. *lanulosa* var. *lanulosa*	0.2 lbs/acre PLS	1 %

IV. Accomplishments:

A. Control cheatgrass- Results from *Short Term Impacts of the 24 Command Fire on Vegetation of the Fitzner-Eberhardt Arid Lands Ecology Reserve, Hanford Reach National Monument: Synthesis of Findings, 2001-2002-The Nature Conservancy* was utilized to delineate treatment areas for native seeding. High burn severity areas were examined and targeted for native seeding to protect the ecological integrity of shrub/steppe plant communities and reduce the invasion of non-native invasive species such as cheatgrass (*Bromus tectorum)*. The FWS and TNC delineated 10,000 acres in four primary blocks within the high burn severity sites. A contract was issued to aerially

spray cheatgrass prior to native seed distribution. The first measurable precipitation was received on ALE on November 7, 2002. Cheatgrass green-up started approximately 5 days later. Aerial application of herbicide, Round-up® at 3.5 ounces per gallon, began on November 14, 2002. Fourteen consecutive days of fog extended aerial applications until December 10, 2002. Brief breaks in the weather allowed some applications to be made, however fog or wind closed out operations early each day. The benefit to these delays included favorable weather conditions for cheatgrass germination. Therefore a larger percentage of cheatgrass was treated in early December than would have been in late November. An 802 A-Air Tractor was utilized and was equipped with a SATLOC global positioning system, 67 Pratt and Whitney turbine engine and an 800 gallon hopper. During aerial herbicide applications the hopper was refilled on average once every 1.5 hours and treated approximately 800 acres. During aerial seeding, the hopper was able to hold 2,000 pounds of seed per load and treat 100 acres per turn. An on-board SATLOC GPS system was key in this operation. The FWS provided GIS shapefiles to the contractor which were then uploaded into the navigational GPS system on the aircraft. The pilot then used the GPS-directed guidance system to deliver seed exactly to the targeted treatment area. All flight paths and treatment passes were recorded by the SATLOC system and final shapefiles were provided back to the FWS for inclusion into their GIS system. Final treatment areas have been mapped and provided within Appendix B. Additional discussion on non-native invasive species control can be found in the Specification N-2a- Non-native Invasive Species Control Report.

B. <u>Seed Mixture Selection and Certification</u>:

1. July 18, 2002- Request for Proposal Number 10181-2-P049 (VR) was issued by FWS Contracting General Service-Portland, Oregon. Proposals were due on July 26, 2002 and award was made on September 11, 2002. L&H Seed Inc. of Connell, WA. was awarded the contract for approximately 200,000 pounds of native seed.
2. October 31, 2002- November 8, 2002- Seed certification was conducted on all lots of seed for the 24 Command Rehabilitation Mix. At the request of Hanford Reach National Monument staff, an independent inspector from the State of Washington Ag Services division collected samples and conducted independent analysis on all seed lots. All lots of seed conformed with contract specifications for purity, germination and inert matter. Only one sample came back negative and was cleaned and resampled prior to inclusion into the final mixes for the project. A complete record or all laboratory tests for each seed lot is on file at the HRNM offices.
3. November 15, 2002- HRNM biological staff met with L&H Seed Inc. to formulate final mixes for aerial applications. The staff expressed concern regarding the potential effects of rabbitbrush seed and sagebrush seed being incorporated into the two seed mixes. Rabbitbrush inclusion into the mixes could potentially make them light and bulky enough that they would not feed properly through the aircraft. Sagebrush seed incorporated into the high elevation grass seed mix could be negatively impacted by aerial spraying operations in the spring to treat cheatgrass and non-native invasive species. If sagebrush were to germinate and then be treated with Roundup®, benefits derived from the seeding would be lost.

   L&H Seed recommended mixing a small amount of grass and rabbitbrush seed and testing it through the aircraft before mixing large quantities for delivery. Between December 2 and December 11, The natural resource specialist worked with L&H on their mixing floor to derive test mixes for application with rabbitbrush included. The test mixtures were delivered to the site on December 4, 2002 and tested in the aircraft on December 11, 2002. As expected, the nature of the rabbitbrush seed prevented grass seed from feeding effectively out of the aircraft. It was decided to deliver all rabbitbrush seed separately and apply this seed with hand crews rather than with aerial applications.

   It was decided to not mix the sagebrush seed with the high and low elevation grass seed mixes and make a third mix for shrubs. A one thousand (1,000) acre block was delineated above the 1200 foot road on ALE to apply the sagebrush/grass seed mix.

This area would not be treated with chemical and would achieve rehabilitation goals to stabilize the ecological integrity of these sites.

4. December 4-16, 2002; Seed shipments were delivered by L&H Seed to the air base on ALE in transport vans. Seed was packaged in 50 lb. sacks and palletized for handling ease.

C. Aerial Seeding Operations:

1. November 21, 2002- Contract Number 10181-3-C004 was issued to Aero Tech Inc. of Clovis, New Mexico for aerial seeding operations on ALE.
2. December 9, 2002- Staff arrive for initiation of seeding operation. Air operations safety briefing is conducted with loading and ground crews by FWS staff.
3. December 11, 2002- January 03, 2003- Native seeding operations were conducted on 9,555 acres of high burn severity areas within the 24 Command Fire. Air operations began on December 11 to test various seed mixtures and their flow rates through the fixed-winged aircraft. Native grass seeding rates were calibrated and seed mixtures finalized for shrub seeding operations. Air operations commenced on December 11 and concluded on January 02, 2002. Weather conditions and Christmas holiday interrupted operations intermittently.

   An 802A-Air tractor was utilized and was equipped with a SATLOC global positioning system, 67 Pratt and Whitney turbine engine and an 800 gallon hopper. The hopper was able to hold 2,000 pounds of seed per load and treat 100 acres per turn. An on-board SATLOC GPS system was key in this operation. The FWS provided GIS shapefiles to the contractor which were then uploaded into the navigational GPS system on the aircraft. The pilot then used the GPS-directed guidance system to deliver seed exactly to the targeted treatment areas. All flight paths and treatment passes were recorded by the SATLOC system and final shapefiles were provided back to the FWS for inclusion into their GIS system. Final treatment areas have been mapped and provided within Appendix B-Figure 5 5.

D. Drill Seeding Operations:

1. December 10- 18, 2003. Drill seeding operations were conducted by the Monument maintenance staff inside the ALE boundary fence along State Highway 240. Approximately 1000 acres (30 feet wide by 20 miles long) were drill seeded along a 20 mile stretch of the highway using a rented 36 foot rangeland drill followed by a cultipacker. This area was seeded at a rate of 12 PLS pounds per acre. The 1000 acres was also aerially broadcasted at a rate of 10 PLS pounds per acre and a cultipacker was utilized behind the drill seeding operation to achieve good seed to soil contact. This operation was conducted with native bunchgrasses and forbs in order to restore the ecological integrity of the site, provide vegetation cover to reduce blowing dust hazards to the general public, and establish a “green strip” of native vegetation along the Monument boundary and highway right-of-way. The secondary benefit of this operation was to re-establish a native bunchgrass community along the highway corridor in order to slow man-caused fire spread from the highway right-of-way and protect native seeding and shrub plantings in upland areas. A map of the drill seeding operation is provided within Appendix B-Figure 5 5.

E. Expenditure Summary:

Contract Expenses	Personnel	Supplies/Materials	Total	Acres	Cost/Ac.
Aerial- $3,756,808	$57,775	$14,835	$ 3,829,418	9,555	$400.78
Drill Seeding $9,000	$24,000	$1,578	$ 34,578	1,000	$34.58
Total- $ 3,765,808	$81,775	$16,413	$3,863,996	10,555	$366.08

A complete accounting of BAER funds that were requested and expended for each specification can be located in Table E on page 6. Photo documentation of fire damage, implementation actions and accomplishments can be found within Appendix A.

24 Command Fire
-Burned Area Emergency Rehabilitation Treatments-
Final Implementation Report
Specification N-4b Revegetation Sagebrush Planting

I. Purpose of Treatment Specification: To reestablish Wyoming big sagebrush in areas where it existed prior to the 24 Command Fire. Big sagebrush is a keystone species in the shrub-steppe ecosystem of the Columbia Basin and plays critical roles in ecosystem structure and function for native plant and wildlife habitat. Optimal establishment of big sagebrush from seed requires invasive species control and some form of tillage. Bare root seedlings are an option where topography precludes the use of agricultural equipment for seedbed preparation, or in sensitive areas (e.g., where microbiotic surface crusts are in good condition) that warrant protection from mechanical disturbance.

II. Description: Reestablish Wyoming big sagebrush in areas where it was removed by the 24 Command Fire through the planting of nursery grown bare-root seedlings.

III. Design/Construction Specification(s):

1. Collect Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) from Columbia Basin sources and supply to contract grower.
2. Survey planting areas for non-native invasive plant species and control invasives where necessary. See specification 'Non-native Invasive Plant Control.'
3. Plant during December 2002. Each seedling will be dipped in Terra Sorb® hydrogel prior to planting to enhance moisture retention in the rooting area. Seedlings will be treated with endomycorrhizal innoculant either in nursery or in the field prior to planting.

IV. Accomplishments:

1. ***Collect Wyoming big sagebrush:*** Wyoming big sagebrush seed was collected on site from the Saddle Mountain Unit of the Hanford Reach National Monument. The biological technician on staff spent 7 days (45 person hours) during December 2001/January 2002 collecting raw sage seed. The raw seed was shipped to Lucky Peak Nursery (LPN) in Boise, Idaho. LPN is a U.S.D.A. Forest Service nursery and has technical facilities to conduct seed cleaning, and seedling production. The 2001 season experienced drought conditions and less than average precipitation, therefore some seed was also purchased from SunMountain Native seed company for plant production. An Eastern Washington, Columbia Basin source identified seed was purchased for augmentation of seed collection. Approximately 40 pounds of seed was cleaned at LPN. LPN was contracted to produce bareroot sage seedlings. Additional contracts were placed with Bitterroot Restoration to produce container stock. Sage seed was sewn in April/May 2002 with lift and pack scheduled for November 2002. Plants were hardened off into dormancy, packed and delivered for planting. Plants were delivered December 2, 2003. LPN produced and delivered 357, 252 bareroot seedlings (some of which were to complete original specification N-3a and N-3b see accomplishment reports for those specifications), Bitterroot Restoration produced and delivered 300,000 plants. An extra 4,000 plants were added at no cost to make up for low quality plants that did not meet contract specifications in first shipment.

2. ***Survey planting areas:*** Prior to the planting, the biological staff set up 10 plots totaling about 1300 acres for the sage planting. This was done by creating planting plots. They placed fiberglass fence posts approximately 100-200 m apart around the perimeter of each plot. The range finder was used for the spacing of the posts and the Trimble Pro-XR GPS unit was used to map the boundary of each plot. Each post was marked with colored flagging, and the corner posts were double high. The GPS data was downloaded into Pathfinder software where acreage was determined and shapefiles were created. These shapefiles were sent to the regional office in Portland where a GIS technician created maps of the planting areas. See Maps section (Appendix B-Figure 6 6).

Plot sites were chosen using the following criteria developed for previous planting efforts.

- Sites should have pre-existing under story characteristics that contain significant proportions of native vegetation so that they will develop into high quality habitat capable of supporting wildlife populations
- Sites should be relatively large (>20 acres) so that larger blocks of habitat will develop over time
- Sites should attempt to bridge gaps between existing blocks of shrub-steppe habitat OR should attempt to replace sagebrush into areas that had mature sage stands prior to the "24 Command Fire"
- Sites should be near established roads on ALE to minimize disturbance to this Research Natural Area.
- All sites will be cleared for planting through the cultural resource program, such that planting will not disturb any culturally significant sites.

Because these criteria were implemented, few of the planting sites needed invasive species control as a pre-treatment.

Each plot was examined by The cultural resource specialist, members of the Wanapum people and Umatilla tribe for cultural resources before the planting began. Any areas of significance located during the cultural resource surveys were marked and avoided.

3. ***Plant during December 2002:*** Planting was conducted December 3, 2002 through December 19, 2003. Three planting contracts were issued to accomplish the planting effort. The three contractors could work simultaneously, making the total number of plants planted per day extremely efficient. Contractors were Frank A. Maduzia, Littlerock, Washington, Wildlands Inc., Richland, Washington, and Bitterroot Restoration, Corvallis, Montana. All bareroot stock was treated with Terra Sorb™ hydrogel prior to planting to enhance moisture retention in the rooting area. Additionally, seedlings were treated with endomycorrhizal innoculant (see Appendix C) mixed into the Terra Sorb™ hydrogel prior to planting. Stations were set up to dip the bare root plants in mycorrhizal and hydrogel solutions. Container stock provided by Bitterroot Restoration was treated with endomycorrhizal innoculant at the nursery. Materials present at each dipping station included: Rental moving truck to hold boxes of plants, 2 tables, 4 tubs, water, Mule 4 wheeler for transport, and buckets of root gel mixture prepared the night before so that it could set prior to being used, and at least 4 staff members and/or volunteers to dip and transport plants. Detailed reports of daily planting totals are attached in an excel spread sheet.

V. Expense Summary:

Contract Expenses	Personnel	Supplies/Materials	Total	Acres	Cost/Ac.
$378,187	$9,000	$16,540	$403,727	1300	$310.55

A complete accounting of BAER funds that were requested and expended for each specification can be located in Table E on page 6. Photo documentation of fire damage, implementation actions and accomplishments can be found within Appendix A.

24 Command Fire

-Burned Area Emergency Rehabilitation Treatments-

Final Implementation Report

Specification M-1a Monitoring: Invasive Plant Species

I. **Purpose of Treatment Specification:** Protect the ecological integrity and site productivity of shrub-steppe plant communities within the ALE and DOE lands in accordance with established mission statements and management plan guidelines.

II. **General Description:** Monitor vegetative recovery within the burned area in order to detect the invasion of invasive/noxious weeds on roads, dozerlines, handlines and other disturbed areas within the 24 Command fire area.

III. **Design/Construction Specification (number and describe each task):**

1. Conduct short-term monitoring (2 years) on areas disturbed within the fire and on historic populations of known noxious weed populations to determine spread of invasive species and noxious weeds.

2. Monitoring protocols will be established by each jurisdiction and will be implemented in accordance with current management plans.

3. Photo-document and GPS new weed occurrences within disturbed lands.

4. Initiate Agency approved control measures on new weed occurrences where monitoring demonstrates the establishment or expansion of known weed populations that threaten the natural regeneration of native vegetation or establishment of effective ground cover.

5. Prepare final report of findings for submission to NIFC for inclusion in fire effects data base.

IV. **Accomplishments:**

1. ***Conduct short-term monitoring (2 years) on areas disturbed within the fire and on historic populations of known noxious weed populations to determine spread of invasive species and noxious weeds:*** The Nature Conservancy (TNC) of Washington was contracted to conduct field survey and monitoring for invasive species throughout the ALE. TNC had pre-fire data on vegetation communities from the "Biodiversity Inventory and Analysis of the Hanford Site" conducted from 1994-1999. Non-native and invasive plant species encroachment was assessed effectively by using these pre-fire data to analyze trends in native plant communities and invasive species pre- and post fire.

2. ***Monitoring protocols will be established by each jurisdiction and will be implemented in accordance with current management plans:*** Eighty historical vegetation plots/transects were relocated and re-surveyed post-fire. An additional 32 newly created plots were established during 2001 to monitor patterns of non-native and invasive plant expansion within the fire area. All plots/transects have been photo-documented and located with GPS coordinates.

3. ***Photo-document and GPS new weed occurrences within disturbed lands:*** Photos of vegetation and invasive species have been taken at each plot location. Invasive species have been mapped and entered into a GIS data base at the HRNM Headquarters in Richland, Washington. Data collected under this specification is being incorporated into an Integrated Pest Management plan that is being developed for the HRNM. This plan will incorporate both weed control measures and recommendations for timing of various actions to prevent expansion of non-native species. This plan includes; spraying

herbicides, mechanical controls, such as mowing, and the potential to use biological controls. Each chemical treatment has to be approved through the FWS Pesticide Use Proposal process and approved by the Regional or Washington D.C. office prior to application of pesticide. Biological controls would have to be evaluated under a similar process prior to being released on ALE which is a Research Natural Area.

4. ***Initiate Agency approved control measures on new weed occurrences where monitoring demonstrates the establishment or expansion of known weed populations that threaten the natural regeneration of native vegetation or establishment of effective ground cover:*** Monitoring results of the short-term monitoring were published as *Short Term Impacts of the 24 Command Fire on Vegetation of the Fitzner-Eberhardt Arid Lands Ecology Reserve, Hanford Reach National Monument: Synthesis of Findings, 2001-2002-The Nature Conservancy* in October 2002. The findings of this report were used to develop an Amendment for the 24 Command Fire BAER plan. The Amendment contained additional control and rehabilitation measures identified as Specifications N-2a, N-4a, M-2a, N-4b, and M-2b, further information about the implementation fo these treatments to prevent the spread of non-native invasive species, and to ensure the regeneration of native vegetation, is found in the accomplishment reports for those specifications.

5. ***Prepare final report of findings for submission to NIFC for inclusion in fire effects data base:*** This report, as well as the report referenced above produced by The Nature Conservancy, will be provided to NIFC as close as possible to the three year anniversary of the date that the 24 Command Fire was controlled.

V. Expenditure Summary:

Contract Expenses	Personnel	Supplies/Materials	Total	Acres	Cost/Ac.
$26,900			$26,900	25,500	$ 1.05

A complete accounting of BAER funds that were requested and expended for each specification can be located in Table E on page 6. Photo documentation of fire damage, implementation actions and accomplishments can be found within Appendix A.

24 Command Fire
-Burned Area Emergency Rehabilitation Treatments-
Final Implementation Report
Specification M-1b - Monitoring: Microbiotic Soil Crust

I. **Purpose of Treatment Specification:** To stabilize soil types prone to wind erosion which can cause dust storms on downwind roads creating a public safety hazard. To determine the degree and extent of microbiotic soil crust (MSC) mortality, natural recovery and need the to inoculate burn areas with microbiotic soil specimens. To increase knowledge and understanding of the effects of fire on MSC.

II. **General Description:** Inventory MSC mortality and monitor recovery within the burn area to determine the degree and extent of mortality. The inventory and monitoring should be conducted during the first three years and the information made available to DOE/FWS to determine whether or not mitigation action is necessary. Mitigation would be to inoculate dead zones with microbiotic soil specimens composed of similar species collected from an unburned area with the same soil types.

III. **Design/Construction Specification (number and describe each task):**

1. Obtain the services of a specialist in MSC research to design a MSC mortality inventory study and monitoring plan.

2. Implement the inventory and monitoring plan.

3. Based on the results of the inventory, the management agencies will determine if mitigation is necessary and if so, to what degree and by what method. Any mitigation will be submitted as a supplemental funding request.

IV. **Accomplishments:**

1. ***Obtain the services of a specialist in MSC research to design a MSC mortality inventory study and monitoring plan:*** The Nature Conservancy (TNC) of Washington was contracted to conduct field surveys and monitoring for microbiotic soil crusts (MSC) throughout the ALE. TNC has pre-fire data on MSC from the "Biodiversity Inventory and Analysis of the Hanford Site" conducted from 1994-1999. The MSC can be assessed effectively by using these pre-fire data to analyze trends in crust abundance (% cover) and frequency.

2. ***Implement the inventory and monitoring plan:*** Field surveys have been conducted during spring/summer 2001 and 2002, with additional information being collected currently for 2003.

3. ***Results of the inventory:*** The findings associated with the MSC are presented in the report entitled *Short Term Impacts of the 24 Command Fire on Vegetation of the Fitzner-Eberhardt Arid Lands Ecology Reserve, Hanford Reach National Monument: Synthesis of Findings, 2001-2002-The Nature Conservancy* (October 2002)(Appendix C). Although it was determined through the monitoring effort that a decline in abundance of MSC had occured post-fire, and that this decline was likely significant, recommendations regarding active crust management or restoration were not put forward in the Amendment of the 24 Command BAER plan. At present, no proven techniques exist for the restoration of MSC at a landscape scale. Management of MSC will be indirect through management activities focused on restoring native vegetation, reducing invasive species, and fire management. By protecting areas with remaining MSC from further disturbance, the long term process of gradual succession and natural regeneration of crust can begin.

V. Expenditure Summary:

Contract Expenses	Personnel	Supplies/Materials	Total	Acres	Cost/Ac.
$ 13,450			$13,450	25,500	$.53

A complete accounting of BAER funds that were requested and expended for each specification can be located in Table E on page 6. Photo documentation of fire damage, implementation actions and accomplishments can be found within Appendix A.

24 Command Fire
-Burned Area Emergency Rehabilitation Treatments-
Final Implementation Report
Specification M-2a Monitor Seeding Effectiveness

I. **Purpose of Treatment Specification:** To ensure establishment of planted and seeded species for maintaining ecosystem structure and function as native wildlife and plant habitat, for prevention of noxious weed establishment, and to facilitate the vegetative recovery to native shrub-steppe plant communities.

II. **General Description:** Conduct monitoring of planting and seeding projects in first year following treatments to determine success of rehabilitation efforts on the 24 Command Fire on the Arid Lands Ecology Reserve.

III. **Design/Construction Specification (number and describe each task):**

1. Sampling plots shall be established in areas representing the range of major plant community types and important environmental variables (topographic variations, soil types, etc.) within the seeded areas. Where available, existing permanent plots will be utilized (see Vegetation Monitoring Report, 2001). In areas lacking existing plots, new plots will be established to ensure adequate coverage.
2. Sampling methodology will determine native species composition and percent cover, seedling density/ m^2 and vigor, and presence and abundance of invasive non-native plants,.
3. Additional observations will be documented to record other factors such as herbivory, surface erosion, etc.
4. Sampling will be conducted during May-June of the first year to capture initial establishment, and during October (at the end of summer drought) to capture ultimate first year survival.
5. A minimum seedling establishment of 4 plants of large bunchgrass species and 10 plants of Sandberg's bluegrass per square meter should be present in seeded areas at the end of the first growing season. If seedling establishment does not meet this requirement then a second application of seed should be applied.
6. Abundance of cheatgrass (Bromus tectorum) or other invasive non-native species exceeding 10% cover during the first year following seeding will trigger appropriate action to control the invasives. If intensive mechanical or herbicide treatment of invasive species is indicated, the effected area may require reseeding after treatment.
7. A second year's monitoring is necessary to confirm survival of seedings, and in the event that a second seeding is applied.
8. A final report shall be published that documents sampling methodologies, techniques, areas sampled, and summary of findings.

IV. **Accomplishments:**

Native grass seed mixes were aerially applied to 5 polygons covering 9,555 acres in December 2002 and January 2003 (See Specification N-4a). Elevation in the treatment areas varies from approx. 650-1000' a.s.l. Average annual precipitation varies from about six inches per year at the lower elevations to about eight inches per year at the higher elevations.

Twenty-seven plots were established in December 2002 to monitor seed dispersal and seedling establishment and survival. Previously established permanent transects, which have pre- and post-fire vegetation cover, and post-fire cheatgrass density data, were used where available. Previously established plots were augmented by new plots established in December 2002. New permanent transects were randomly positioned as described in Specification M-2b. All new transects run 100m north from randomly selected origins. Polygons were stratified to assure dispersion of plots across each polygon and placement of new plots into areas not covered by previously established permanent transects.

The number of transects within polygons was determined by a combination of factors including polygon size, landscape and cover type diversity, and access. The largest polygon, P3, was also the most diverse in terms of topography, vegetation and landscape condition, and had a large array of previously established permanent plots (w/ associated pre-treatment data). P4 was also large, but was relatively

monotonic, had no previously established vegetation plots within its boundaries, and was the most remote from access points.

Three 20 cm x 20 cm seed traps were randomly located along each new 100m transect and selected pre-existing transects in December 2002 (Table 2). Traps were collected following seeding operations in December 2002 and January 2003. Trapped seeds were counted by species for comparison to seed mix specifications. Vegetation data was collected from all plots during spring 2003. Existing plots were established using several methodologies (Table 3). Newly established plots utilize twenty 20 x 50 cm microplots arrayed randomly within 5m stratifications along the transect for vegetation sampling. Density of cheatgrass (*Bromus tectorum*) was sampled within the 20 x 20cm portion of each microplot nearest to the baseline. Every second microplot along each vegetation transect was sampled for seedling emergence density and preliminary survival. During October-November 2003 vegetation plots will be revisited and resampled to estimate first year seedling survival/establishment.

All other permanent plots within the project area were sampled for vegetation cover, cheatgrass density, and seedling emergence during spring 2003. More than 50 additional permanent plots are established on ALE outside of the current project area. Their characteristics are summarized in Table 3. Vegetation and cheatgrass density were sampled at 40 of these plots and will serve as comparisons for changes in these parameters. Seedling emergence was sampled in eight of these plots in comparable areas adjacent to project areas in order to serve as controls for emergence in treatment plots.

Data analysis will assess first year emergence and establishment/ survival and compare to sampled seeding density, as well as between plots and polygons. ANOVA will be used to determine between-plot differences. Significant differences indicated by ANOVA will be investigated using t-tests or similar comparison tests.

Table 2. Summary of aerial seeding polygons and seed and vegetation transects within the project area. Vegetation, seedling emergence, and cheatgrass density were sampled in all plots. Numbers in parentheses indicate plots used for seed trapping.

Polygon	Size (Acres)	Soil Type	Seed Mix (Elev.)		Number of permanent Transects in Polygon (# used as seed plots)				
			High	Low	New	BRMaP	Biodiversity	SIT	T plots
1	865	Loam		X	3 (2)		2 (1)		
2	696	Sand		X	3 (1)	5 (2)			
3	3609	Loam	X	X	6 (6)	5 (2)	3 (1)	2 (2)	4 (3)
4	3047	Loam		X	3 (3)				
SS	1369	Loam	Shrub Seed Mix		2 (2)	1 (1)			1 (1)
Totals					17 (14)	11 (5)	5 (2)	2 (2)	5 (4)

V. Expenditure Summary:

Contract Expenses	Personnel	Supplies/Materials	Total	Acres	Cost/Ac.
$ 63,506			$63,506	10,840	$5.86

24 Command Fire

-Burned Area Emergency Rehabilitation Treatments-

Final Implementation Report

Specification M-2b Monitor Sagebrush Planting

I. **Purpose of Treatment Specification:** To ensure establishment of planted material for maintaining ecosystem structure and function as plant and wildlife habitat.

II. **General Description:** Monitor survival and health of big sagebrush plantings.

III. **Design/Construction Specification (number and describe each task):**

- Sample 100 m x 10 m permanently marked plots bisected lengthwise by a 100 m baseline. Position of individual sagebrush plants will be recorded in terms of distance along baseline from a marked zero point, and distance from baseline at that point. Position right or left of the baseline will be recorded as plus (+) or minus (-) respectively.
- Seedling survival and health will be recorded for each observed seedling during May/ June, and during October, 2003 following breaking of the summer drought.
- Survival of fewer than 70% of seedlings in any area or community type will require replacement of dead individuals within the effected area.

IV. **Accomplishments:**

Approximately 700,000 seedlings of Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) were planted in late November through mid- December, 2002 (See Specification N-4b). Seedlings were planted at a specified stocking rate of 450/acre in 12 dispersed polygons covering ~1300 acres (ranging in size from 33 acres to 600 acres). Polygons were similar in readily observable environmental variables (slope, aspect, elevation, soil type, vegetation type and cover, expected annual precipitation). Variation exists in stock condition (bare root [BR] or tube container), application or non-application of a mycorrhizal inoculum to BR plants, size of bare root plants, and planting contractor.

During winter 2002-2003, a total of 26 plots were established to monitor the survival of outplanted big sagebrush nursery stock. Plot locations within polygons were determined randomly using GIS. Three plots were installed in each of seven polygons; an eighth polygon, 3-4 times the size of the next largest polygon, received 5 plots. All polygons were stratified into three segments of roughly equal size in order to assure a minimum dispersion of plots across the polygons.

Monitoring methodology follows protocols established by Monument personnel for monitoring shrub seedling survival for plantings in previous years (primarily 2001). Sample plots consist of a 100 m x 10 m belt transect bisected lengthwise by a 100 m baseline. Baseline transects run due magnetic north from the randomly selected origins. The position of individual sagebrush plants was recorded in terms of distance along the baseline from the origin, and perpendicular distance from the baseline at that point. Position right or left of the baseline was recorded as plus (+) or minus (-) respectively. The aim was to capture approximately 100 seedlings within the belt transect. Actual plots contained a total of 2814 seedlings or 108.2 (± 13.8 SD) seedlings / plot.

Seedling survival and health will be recorded again for each seedling during October-November, 2003 and compared to time-zero records to determine percent survival. Fall sampling will be repeated during 2004. Sagebrush plantations installed in 2001 and currently monitored by FWS according to the same protocols will also be available for comparison. Differences between plots, treatments, and years will be explored using ANOVA. Significant differences indicated by ANOVA will be investigated using t-tests or similar comparison tests.

V. Expenditure Summary:

Contract Expenses	Personnel	Supplies/Materials	Total	Acres	Cost/Ac.
$ 35,228			$35,228	1713	$20.56

A complete accounting of BAER funds that were requested and expended for each specification can be located in Table E on page 6. Photo documentation of fire damage, implementation actions and accomplishments can be found within Appendix A.

24 Command Fire

-Burned Area Emergency Rehabilitation Treatments-

Final Implementation Report

Specification S-1A Protection of Cultural Resources through Law Enforcement

I. **Purpose of Treatment Specification:** To protect exposed sensitive historic and prehistoric cultural resources and deter looters. This will be a temporary measure until sufficient green-up occurs to conceal some cultural materials, and until field inventory and assessment work is completed.

II. **General Description:** Patrol selected historic and prehistoric archaeological sites and localities to monitor site looting and vandalism. Take action on artifact collectors and looters.

III. **Design/Construction Specification (number and describe each task):**

1. Coordinate law enforcement patrols and actions with Agency archaeologists and cultural resource personnel.

2. Undertake random patrols, make contact as appropriate, and take action against violators.

3. Consult with Tribal governments and cultural resource programs regarding law enforcement patrols.

IV. **Accomplishments:**

In April of 2001, a temporary law enforcement officer was hired to coordinate law enforcement patrols and actions with agency archaeologists and cultural resource personnel on the 24 Command fire area. The refuge officer began patrols in April of 2001 and continued these until departure in December of 2002. Significant accomplishments were achieved through this action including the protection of visible historic and pre-historic resources during the 2001 and 2002 growing seasons. Due to extended drought conditions, vegetation recovery was slow thereby increasing the risk of resource loss through trespass and looting. The main fenceline along State Highway 240 (see Specification F-3b) was down in many places and contributed to a significant amount of trespass onto the Arid Lands Ecology Reserve (ALE). The law enforcement officer, through this plan was effective in:

- Fostering cooperative working relationships with adjacent landowners, the County Sheriff's Offices, Hanford Patrol, Washington State Patrol, Washington Department of Fish and Wildlife, Department of Energy and others for the mutual watch and protection of resources within the fire area
- Establishing a monitoring, reporting and documentation protocol for trespass on the ALE
- Conducting daily, random patrols and making contact as appropriate for action against violators
- Consulting with local archaeological staff and Tribal governments regarding patrols and findings

Because of this effort, secondary loss of cultural resources to looting and inadvertent damage within the fire area was averted.

V. Expenditure Summary:

Contract Expenses	Personnel	Supplies/Materials	Total	Acres	Cost/Ac.
	$13,100		$13,100	77,000	$.17

A complete accounting of BAER funds that were requested and expended for each specification can be located in Table E on page 6. Photo documentation of fire damage, implementation actions and accomplishments can be found within Appendix A.

24 Command Fire

-Burned Area Emergency Rehabilitation Treatments-
Final Implementation Report
Specification F-1a Suppression Damage Rehabilitation Evaluation

I. Purpose of Treatment Specification: To evaluate the suppression impacts rehabilitation for it's success.

II. Description: Native seeding was conducted on suppression impacted areas. The re-vegetation of bulldozer lines should be evaluated for it's effectiveness.

III. Design/Construction Specification(s):

Establish monitoring plots to determine the effectiveness of seeding.

1. Monitoring will evaluate seeded species establishment, and recovery of native vegetation as well as invasion by non-native plants or noxious weeds.
2. Sampling will be conducted in May or June of 2002.
3. A minimum establishment of 10 plants of seeded species per square meter should be present, and an absence of non-native plants or noxious weeds (< 2 % cover) would be considered a successful restoration effort.

IV. Accomplishments:

INTRODUCTION

During the 24 Command wildfire of June-July 2000, a short (1/4 mile) bulldozer fireline was cleared in otherwise high-quality vegetation in upper Snively Basin (See specification F-1). The site is on silt loam soils on a moderate (10^{o}-15^{o}) NE-facing slope in upper Snively Basin between 2200-2500' elevation. To rehabilitate the site, bulldozer berms were restored to natural contours and seed of Sandberg's bluegrass was broadcast by FWS personnel and volunteers during spring 2001.

METHODS

During May 2003 the following measures were applied in order to assess the effectiveness of restoration methods and the recovery of this area. Three 48 m transects were installed down the center of the rehabilitation area in locations that appeared to approximate the range of variation in vegetation. Vegetation percent cover and cheatgrass density data were collected within six pairs of 20 cm x 50 cm microplots placed randomly within 8 m stratifications along the transect. One microplot of each pair was located within the center of the disturbed area while the other microplot of the pair was located a distance of 6 m from the baseline in grassland that had not been affected by the suppression efforts. These 'external' microplots alternated from side to side up the baseline transect. Statistical comparisons between vegetation in the rehabilitated suppression area and adjacent undisturbed vegetation were made using paired sample t-tests.

RESULTS AND DISCUSSION

Total vegetation was statistically similar between the disturbed and rehabilitated suppression swath (76.6% ± 25.8 SD) and adjacent undisturbed areas (74.1% ± 10.1 SD; $P = 0.659$) in 2003. Factoring in microbiotic crust cover did not appreciably alter this relationship (Table 1). However, substantial cover in the suppression swath was furnished by cheatgrass (*Bromus tectorum*), rough chickweed (*Holosteum umbellatum*), and other invasive non-native annual species. Percent cover of native vegetation in the suppression swath (46.6% ± 19.7) was significantly less than native cover in the surrounding area (69.4% ± 9.2 SD) after two years ($P < 0.001$). Considering microbiotic crust cover in the surrounding area only increased this differential (Table 1).

Although total vegetation cover was similar, percent cover of bare ground was significantly greater in the suppression swath (19.3% ± 21.8 SD) compared to the surrounding area (8.8% ± 6.5 SD; $P = 0.047$).

Percent cover of cheatgrass was significantly higher within the suppression swath (23.3% ± 21.9 SD) compared to 1.4% (± 2.1 SD) in the surrounding area (P < 0.001). Cheatgrass density was also significantly higher in the suppression swath (482.5 stems m^2 ± 437.5 SD) compared to the adjacent area (30.0 stems/ m^2 ± 57.5 SD; P < 0.001). The frequency of cheatgrass occurrence in microplots was also higher in the suppression swath (Table 1).

Microbiotic crust in the undisturbed area, burned during the 24 Command Fire, averaged only 6.2% (± 7.3 SD). No microbiotic crust was detected within microplots within the suppression swath (Table 1).

Percent cover of native perennial bunchgrasses was significantly less in the suppression area (12.6% ± 14.7 SD) compared to the undisturbed area (40.2% ± 11.3 SD; *P* < 0.0001). Percent cover of Sandberg's bluegrass (*Poa sandbergii*), which was seeded into the suppression swath as part of rehabilitation efforts in 2001, was only significantly lower in the disturbed area (6.6 % ± 6.1 SD) in 2003, compared to the surrounding vegetation (11.4 % ± 8.6 SD; P < 0.030).

CONCLUSIONS

Two years after rehabilitation efforts were implemented, the fire suppression line in upper Snively Basin is still significantly different from the surrounding vegetation. Percent cover of native vegetation is considerably less than in the relatively undisturbed vegetation surrounding the impacted area. Microbiotic crusts are absent from the affected area, and perennial bunchgrasses are greatly reduced.

The suppression line is a swath through a high-quality bluebunch wheatgrass (*Agropyron spicatum*) – Sandberg's bluegrass native grassland. The swath is visible from across Snively Basin, largely because of the high cover and density of invasive species, especially cheatgrass, in the swath compared to the surrounding area.

Native vegetation may not recover fully so long as cheatgrass and other invasive species are present in large numbers. These species are likely to persist and expand if not controlled. The presence of such an inoculum of invasive species within an otherwise very high quality area is a cause for concern over the potential spread of invasives from the disturbed swath further into the native plant community.

A narrow swath through high-quality native grasslands can likely be reseeded naturally from surrounding sources. However, cheatgrass is capable of outcompeting the seedlings of most native species, and the potential for cheatgrass to increase throughout the suppression swath represents a threat to the surrounding vegetation. Control of cheatgrass within the suppression area for at least 1-2 years will be necessary to allow native vegetation to recover whether or not further seeding is applied. Chemical treatments should be applied during late winter or very early spring, when cheatgrass is active, but most native perennial herbaceous species are not. Recovery of native vegetation within the suppression swath should reduce the threat of cheatgrass increasing in abundance throughout this important high-quality habitat.

Table 1. Sample values from monitoring of bulldozer suppression swath on the Arid lands ecology reserve, 2003.

	Suppression Swath	(+/-SD)	Surrounding Vegetation	(+/-SD)	*P* value
Total vegetation (% Cover)	76.7	(25.8)	74.1	(10.1)	0.659
MSC (% Cover)	0.0	(0.0)	6.2	(7.3)	0.002
Total Vegetation + MSC (% Cover)	76.7	(25.8)	80,2	(10.9)	0.557
Native Bunchgrasses (% Cover)	12.6	(14.7)	40.2	(11.3)	< 0.0001
Sandberg's Bluegrass (% Cover)	6.3	(6.1)	11.4	(8.6)	0.030
Cheatgrass (% Cover)	23.3	(21.9)	1.4	(2.1)	< 0.001
Cheatgrass (% Frequency)	83.3	(9.6)	50.0	(33.3)	0.157
Cheatgrass Density	19.3	(17.5)	1.2	(2.3)	< 0.001

V. Expenditure Summary:

Contract Expenses	Personnel	Supplies/Materials	Total	Sites	Cost/Site
$4,680			$4,680	3	$1,560

A complete accounting of BAER funds that were requested and expended for each specification can be located in Table E on page 6. Photo documentation of fire damage, implementation actions and accomplishments can be found within Appendix A.

24 Command Fire
-Burned Area Emergency Rehabilitation Treatments-
Final Implementation Report
Specification F-3a- Infrastructure Repair- Repair/Replace Fence

I. Objectives

- Identify, inventory and map fire suppression impacts on jurisdictions affected by the fire.
- Specify rehabilitation measures to mitigate fire suppression impacts.
- Protect natural and cultural resource values during rehabilitation efforts

II. Issues

- Protection of critical cultural and natural resources
- Damage to fences within fire perimeter associated with fire effects and fire suppression actions.

III. Methodologies

A more comprehensive review of the boundary fence around the ALE showed that fire intensity weakened the wire tensile strength of approximately 30 miles of boundary fence thus requiring replacement. Initial specifications for Operations in the "24 Command Fire" BAER plan identified repairs and maintenance needs that were immediately apparent following the fire. All of these specifications have been completed as they were originally prepared. However, new policy allows for certain minor facilities to be repaired and replaced when destroyed by wild land fire. Additionally, damage to some existing infrastructure that was not immediately apparent became noticeable in the days and weeks following control of the "24 Command Fire". Of primary importance is the boundary fence surrounding the Fitzner-Eberhardt Arid Lands Ecology Reserve. The intensity of the "24 Command" fire weakened the tensile strength of existing fence wire. The wire is now beginning to "sag" in many areas. Additional replacement of barbed wire is needed to protect the integrity of the fence, and to keep the boundary secure, particularly because this area is not open to the public. Further, the majority of the access gates for ALE have wooden posts supporting the gate. During the "24 Command Fire" many of these wooden posts were charred and weakened. These gates need to be replaced to keep the ALE boundary secure. A supplemental funding request for fence replacement was requested in December of 2000 and approved in March of 2002.

I. **Purpose of Treatment Specification:** To maintain the boundary and to protect resources from public access.

II. **Description:** Replace 30 miles of damaged boundary fence and all associated access gates.

III. Design/Construction Specification(s):

A. Replace 4-strand fence with single strand barbless wire. Design is intended to stop public trespass and damage to resources while allowing for tumbleweeds to pass under and over wire to reduce fire hazards along ALE.
B. Remove and dispose of burned wire and wooden posts
C. Replace gates (7)

IV. Accomplishments:

A. June 2002-October 2002- Establish contracts for fence removal and reconstruction. Tri-City Fence awarded contract after 3 months of delays.
B. November 11, 2003 - March 15, 2003; Replacement of 30 miles of fence and 7 gates along Highway 24, Highway 240 and Highway 225 on the perimeter of ALE .

V. Expenditure Summary:

Contract Expenses	Personnel	Supplies/Materials	Total	Miles	Cost/Mile
$269,000				30	$8,967

A complete accounting of BAER funds that were requested and expended for each specification can be located in Table E on page 6. Photo documentation of fire damage, implementation actions and accomplishments can be found within Appendix A.

24 Command Fire
-Burned Area Emergency Rehabilitation Treatments-
Final Implementation Report
Specification O-1 & O-3- Implementation Leader/Admin. Support

I. ***Purpose of Treatment Specification:*** The purpose is to provide quality control over project implementation and to ensure a comprehensive plan implementation.

II. ***Description:*** Hire a project implementation leader and administrative support position to coordinate and oversee the implementation of the 24 Command Fire BAER Plan on both U.S. Department of Energy and U.S. Fish and Wildlife Service administered lands.

III. Design/Construction Specification(s):The Project Implementation Leader is responsible for the over-site of the BAER Plan implementation for the jurisdictions for which they were hired. The Leader will coordinate with each of the involved agencies on cross jurisdictional projects to achieve efficient use of funds, personnel, equipment, and contracts. The Leader specifically will oversee implementation, monitoring, program review, proposed plan revisions, and supplemental funding requests. The Leader completes annual accomplishment reports. The administrative support position will assist implementation leader and tracks EFR budgets.

IV. Accomplishments:

A. ***Implementation Year- 2001:*** During the calendar year 2001, a full-time implementation leader was not obtained or assigned by the Agency for implementation action. The Monument staff in partnership with Nature Conservancy of Washington (TNC) developed and implemented the BAER plan and tracked implementation progress. Due to a hiring "freeze" initiated with the change of the Presidential Administration and subsequent bottleneck of fire staffing during this period, the Monument started implementation in a timely and effective manner through a force account contract with TNC. Specific accomplishments during this time period included:

- FWS Monument staff and TNC worked with local jurisdictions, including Washington State Department of Fish and Wildlife and Department of Energy contractors throughout implementation.
- TNC coordinated the monitoring of invasive plants and microbiotic soil crust.
- Cultural resource specifications were handled by FWS cultural resource staff in coordination with local jurisdictions and Native American Tribes and DOE.
- Sagebrush restoration was coordinated by the FWS Monument Wildlife Biologist.
- Weed control, fence repair, safety hazards, road maintenance and rehabilitation of bull dozer lines was coordinated by FWS Monument Refuge Operations Specialist, Engineering Equipment Operator, and Wildlife Biologist.

B. ***Implementation Year-2002:*** In March 2002 the 24 Command Fire Plan Amendment was approved by the FWS Washington Office. The amendment included $153,800 for administrative support services and an Implementation Leader. In order to quickly initiate emergency stabilization actions, the Supervisory Natural Resource Specialist (NRS) position was assigned as the Implementation lead. The NRS reported for duty on June 2, 2002. With the assistance of the biological staff, the administrative support staff, the fire staff and the cultural resources staff contracts for services and supplies were immediately initiated. A total of 14 contract requests were prepared and sent to Contracting and General Service (CGS) during the months of June, July and August for plant materials, native seed, planting crews, archaeological services, aircraft services, and fencing services. Implementation actions during calendar year 2002 and 2003 included:

- Native seed collected and sent to nurseries for 2002 plant grow-outs
- Section 106 compliance inspections on 2,850 acres
- Non-native invasive species treatments on approximately 10,000 acres
- Native grass seeding on 10,000 acres through aerial applications
- Native grass drill seeding on 1,000 acres
- 30 miles of boundary fence replaced
- 1,300 acres of native sagebrush planted (700,000 plants)

- 8,000 acres of non-native invasive species re-treated in February of 2003
- Monitoring of seeding operations on 10,000 acres and 1,300 acres of sagebrush plantings
- Mechanical and chemical treatment of approximately 25 miles of roadways infested with noxious weeds
- Volunteer coordination for sagebrush plantings
- Maintain cuff account of all expenditures, rectify budgets and respond to all data calls on BAER funding needs
- Write interim and final BAER accomplishment reports
- Provide administrative and budget support for 14 contracts, equipment maintenance and project materials and supplies

The accomplishments listed above enlisted the services of all Monument staff in some capacity during the months of November and December. FWS volunteers contributed over 200 hours of service to the sagebrush planting project. The emergency stabilization effort also enlisted the services of FWS Regional Office staff for budget reconciliation; contract review, initiation, and award.

C. Expenditure Summary:

Contract Expenses	***Personnel***	***Supplies/Materials***	***Task***	***Cost/Ac.***
Spec O-1: $38,700			1	$38,700
Spec O-3:	$121,784	$87		$121,871

A complete accounting of BAER funds that were requested and expended for each specification can be located in Table E on page 6. Photo documentation of fire damage, implementation actions and accomplishments can be found within Appendix A.

APPENDIX A

BAER TREATMENTS

PHOTO DOCUMENTATION

24 Command Fire
BAER Implementation Photo Documentation
Specification N-2a Non-native Invasive Plant Control

Spray truck equipped with GPS technology
for accurate recording of treatment areas

Roadside treatment of non-native
invasive species

Spot treatment of non-native invasive species

24 Command Fire
BAER Implementation Photo Documentation
Specification N-2a Non-native Invasive Plant Control

Spot spraying Rush Skeletonweed

Using ATV with boom sprayers to control non-native invasive species

ATV with boom sprayers controlling Rush Skeletonweed

Signs posted for notification of aerial spraying operations

Herbicide mixing station, Aero Tech Inc.

24 Command Fire
BAER Implementation Photo Documentation
Specification N-2a Non-native Invasive Plant Control

Monitoring of herbicide mixing by AeroTech Inc.

Loading plane with RoundUp® herbicide

Plane spraying RoundUp® herbicide at 3.5 oz. per acre for non-native invasive species control

24 Command Fire

BAER Implementation Photo Documentation

Specification N-3a Ecological Stabilization: Sagebrush Plantings & N-3b Ecological Stabilization: Sagebrush Outplantings

Using GPS technology to map and install boundaries of sage brush planting plots

Installing fiberglass rods to mark boundary of sage brush planting areas

Installing fiberglass rod to mark boundary of sagebrush planting plot

Flagging corner post of sagebrush monitoring plot

24 Command Fire

BAER Implementation Photo Documentation

Specification N-3a Ecological Stabilization: Sagebrush Plantings & N-3b Ecological Stabilization: Sagebrush Outplantings

Loading boxes of sagebrush plants into rental van for transport out to planting area

Volunteer and FWS staff member dipping bareroot plants into mycorrhizal root gel

Wildlands crew using hoedads to plant bareroot sagebrush plants

Frank Maduzia's crew members using planting shovels to plant bareroot sagebrush plants

Newly planted sagebrush seedling

24 Command Fire

BAER Implementation Photo Documentation

Specification N-3c Ecological Stabilization: Native Seed Collection

Sage seed collection on the Saddle
Mountain National Wildlife Refuge

Indian Rice Grass Collection on ALE

Needle and Thread Grass collection on ALE

24 Command Fire

BAER Implementation Photo Documentation

Specification N-4a Revegetation: Native Seeding

High elevation seed mix

Removing seed sacks from tractor trailer

Loading 1000 lb seed sacks containing shrub seed mixture into hopper via conveyor belt

Emptying seed sacks into hopper

Loading plane with auger truck at Richland Airport

Loading plane with auger truck on ALE

24 Command Fire
BAER Implementation Photo Documentation
Specification N-4a Revegetation: Native Seeding

Dust from sage seed mixture while loading plane on site

Plane spreading high elevation seed mixture

Plane spreading high elevation seed mixture

Example of seed dispersal from aerial seeding

Low-impact track vehicle and rangeland drill

Tractor with cultipacker following rangeland drill

24 Command Fire

BAER Implementation Photo Documentation

Specification M-2a Monitor Revegetation and Seeding Effectiveness

Rangeland drill applied grass seedlings emerging 20 March 2003

Range drill applied grass seedlings surviving June 2003

24 Command Fire

BAER Implementation Photo Documentation

Specification M 2-b Monitor Big Sagebrush Revegetation Effectiveness

Volunteers assisting with summer 2002 monitoring of 2001 sagebrush plantings

FWS employee conducting sagebrush monitoring in summer 2002

TNC and volunteers conducting initial winter monitoring of 2002 sagebrush plantings

24 Command Fire

BAER Implementation Photo Documentation

Specification F-3b Boundary Fence Replacement

Post Fire Impacts

Fence line weakened by fire and pushed over by wind and tumbleweeds along Hwy 240

Vehicle trespass through damaged fence

Extensive fence line damage resulting in secondary impacts through trespass

Gate and fence prior to replacement and repair

24 Command Fire

BAER Implementation Photo Documentation

Specification F-3b Boundary Fence Replacement

Post Fire Impacts

New single strand, smooth wire fence with reinforcement at gates

New gate at 117 road

New single strand, smooth wire fence

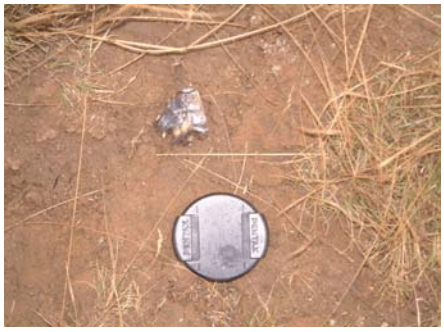
24 Command Fire

BAER Implementation Photo Documentation

Specification C-1a Cultural Resource Damage Assessment

A rock carin feature

Cluster of 1950's Coca Cola bottles



Corner notched projectile point

Unopened military can of practice fuse, mine powder

Military blank ammunition casings found near fox hole site

Native American survey crew recording a historic scatter

24 Command Fire

BAER Implementation Photo Documentation

Specification C-1a Cultural Resource Damage Assesment

Native American crew recording a historic artifact

Native American crew recording a military fox hole

Native American crew recording a rock alignment feature

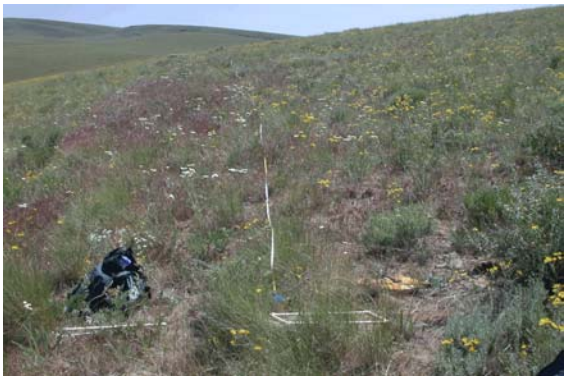
24 Command Fire

BAER Implementation Photo Documentation

Specification F-1a Monitor revegetation effectiveness on suppression sites

Scar from bull dozer line invaded by non-native species

Vegetation transect used to collect data on rehabilitation effort

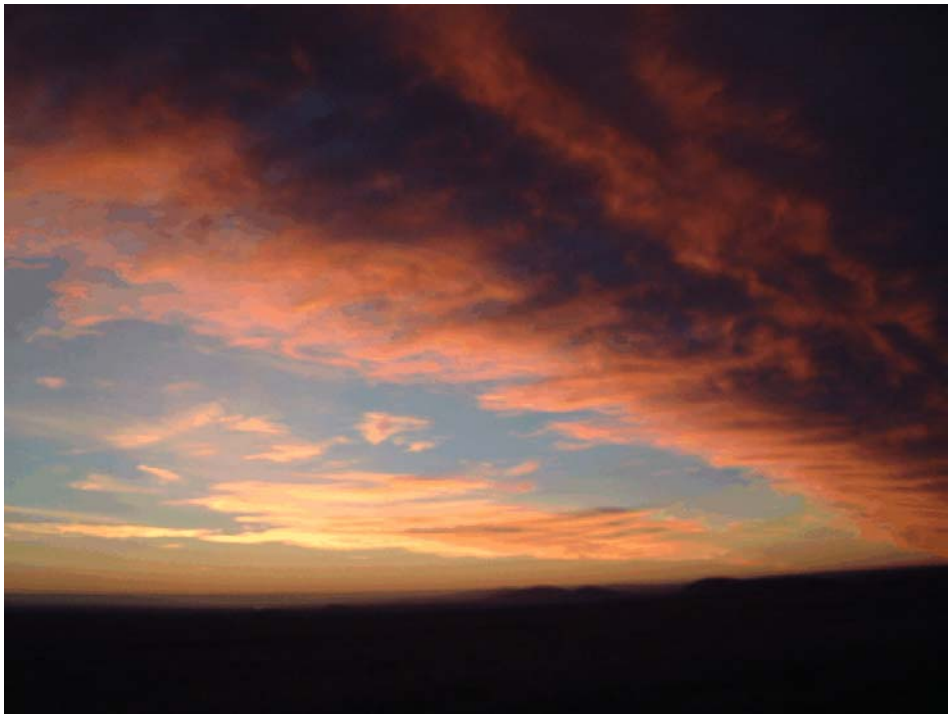


Vegetation recovery within bull dozer line

Presence of non-native species within area disturbed by dozer

Appendix B

TREATMENT MAPS



Appendix B- Figure 1

Planned Rehabilitation Treatments
2001 & 2002

Hanford Reach National Monument
Arid Lands Ecology Reserve

Legend

- Roads
- Streams
- Waterbodies
- Monument Boundary
- 2001 BAER Planted Plots
- 2002 BAER Planted Plots
- Drill Seeding
- Native Grass Seeding
- Shrub Seeding

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

Hanford Reach National Monument
Saddle Mountain National Wildlife Refuge

Kilometers
0 1 2 3

Miles
0 1 2

N

243
24
240

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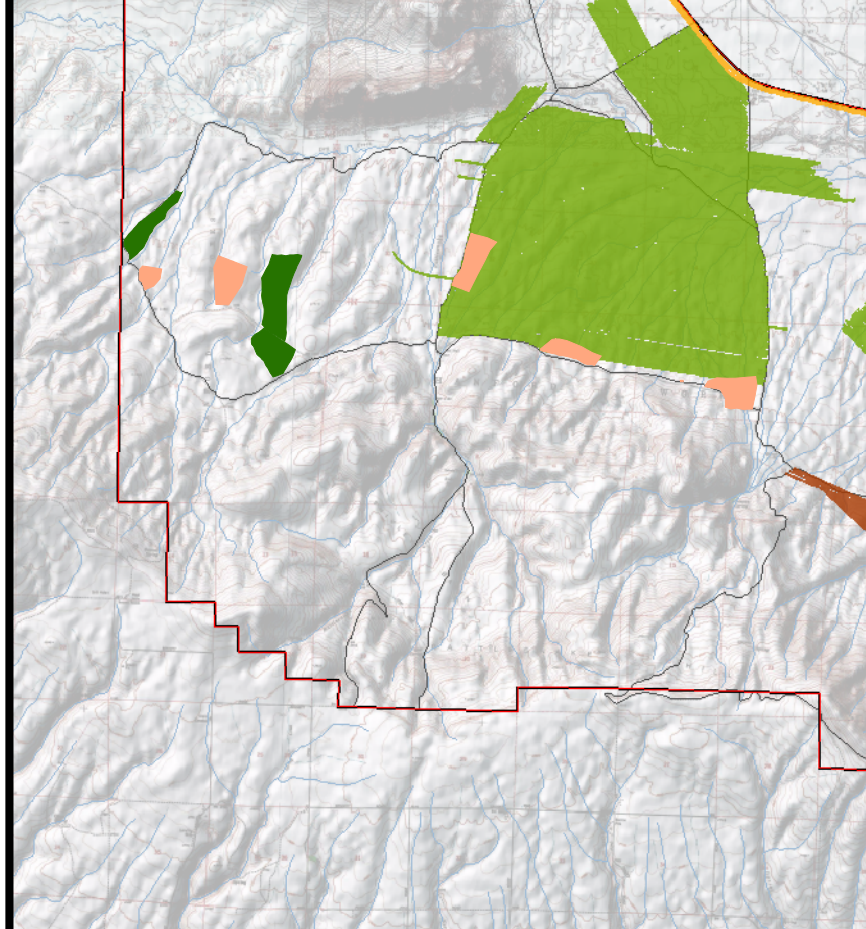

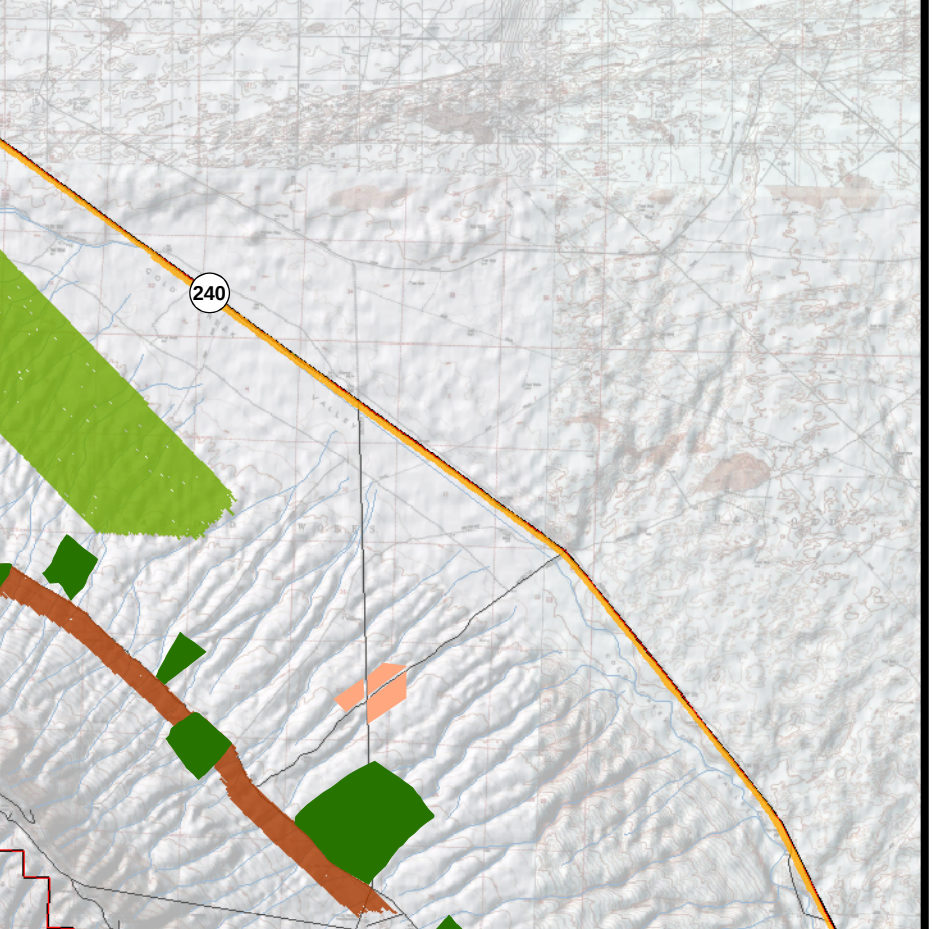

Infrastructure Repair
24 Command Fire

Hanford Reach National Monument
Arid Lands Ecology Reserve

Legend

- Gates
- Fence
- Highway
- Roads
- Monument Boundary

Miles: 0 1 2

Kilometers: 0 1 2 3

N

243

24

Gate 120

Gate 119

Gate 118

Gate 117

Gate 114

Gate 112

240

Gate 111

Gate 110

Gate 109

Gate 106

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Appendix B - Figure 3

24 Command - Emergency Stabilization
2002 Non-Native Species Control - Aerial Spray Treatments
Hanford Reach National Monument
Arid Lands Ecology Reserve

Legend

- Streams
- Roads
- Monument Boundary
- Waterbodies
- Roundup Spray Treatment

Miles: 0 1 2

Kilometers: 0 1 2 3

N

243

24

240

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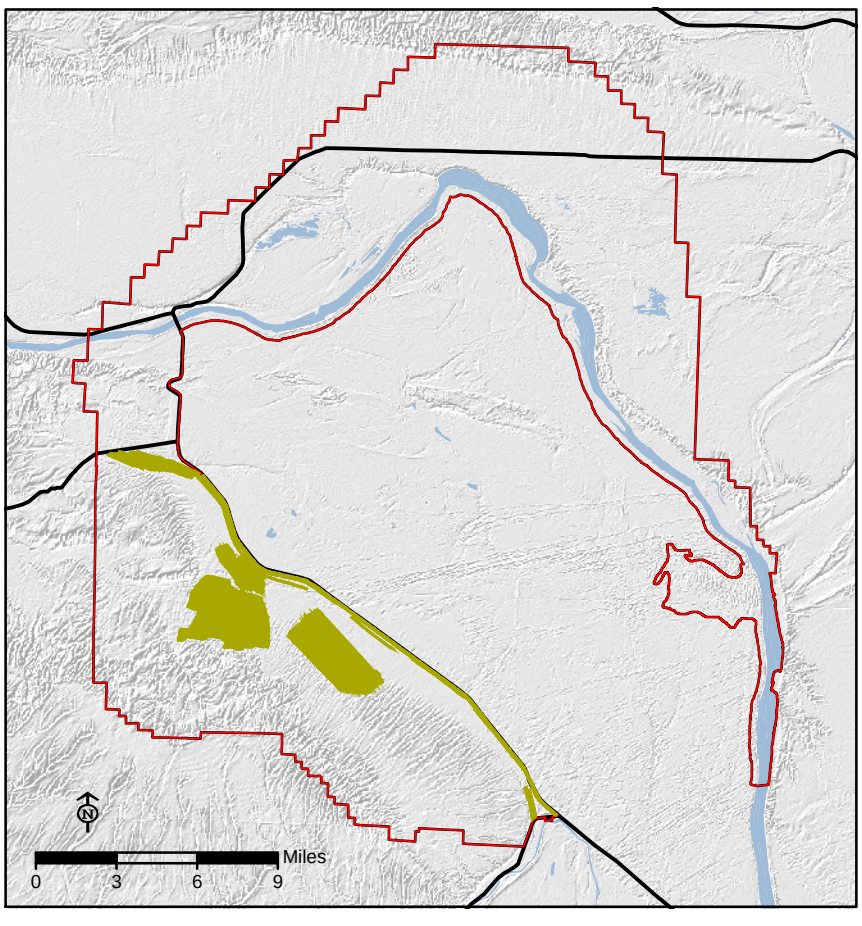

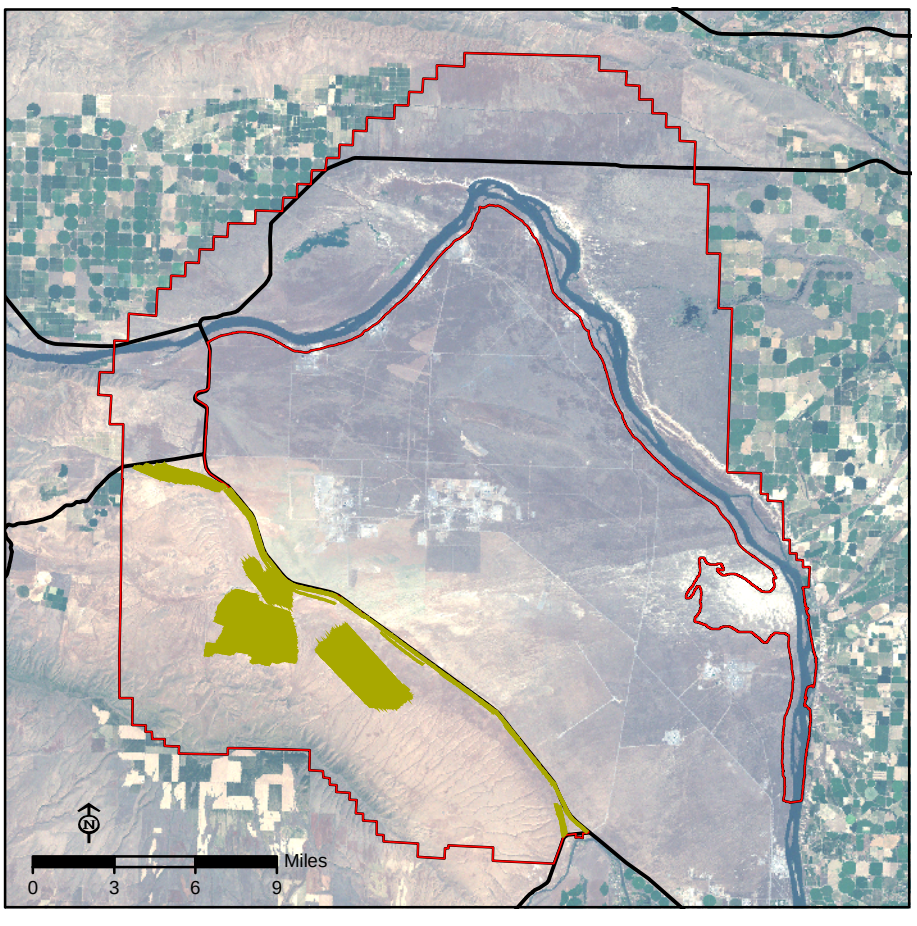

Appendix B- Figure 4

24 Command Fire - Emergency Stabilization
2003 Non-Native Species Control - Aerial Spray Treatments

Hanford Reach National Monument
Arid Lands Ecology Reserve

Legend

- Streams
- Roads
- Monument Boundary
- Waterbodies
- Roundup Spray Treatment

Miles: 0 1 2

Kilometers: 0 1 2 3

243 24 240

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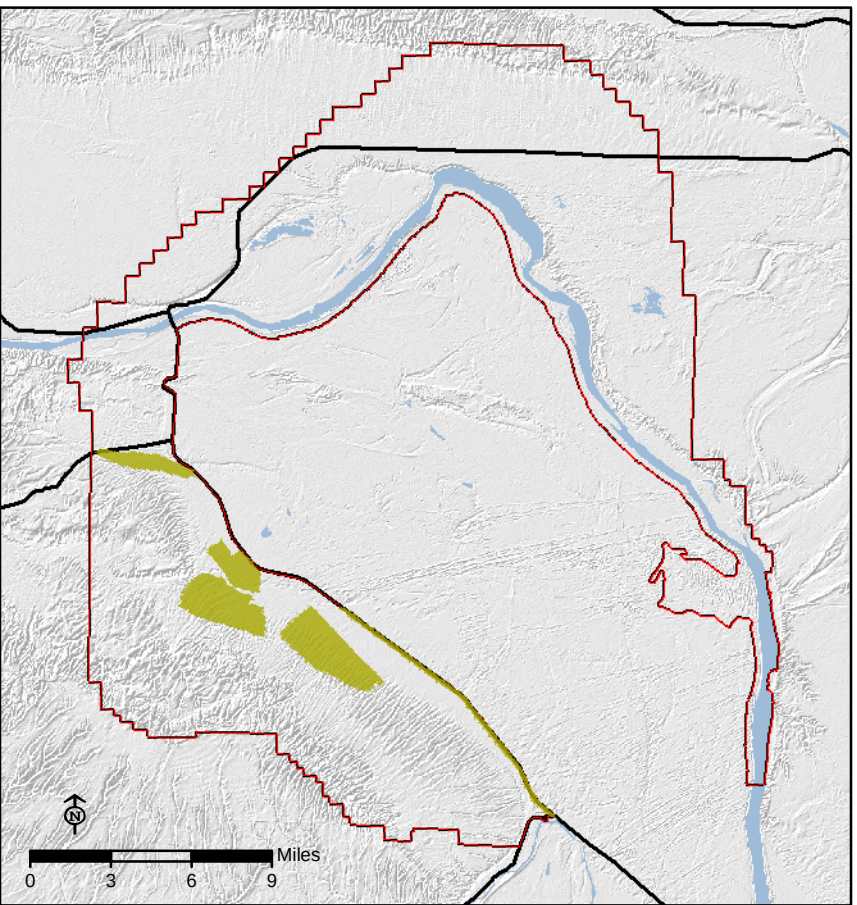

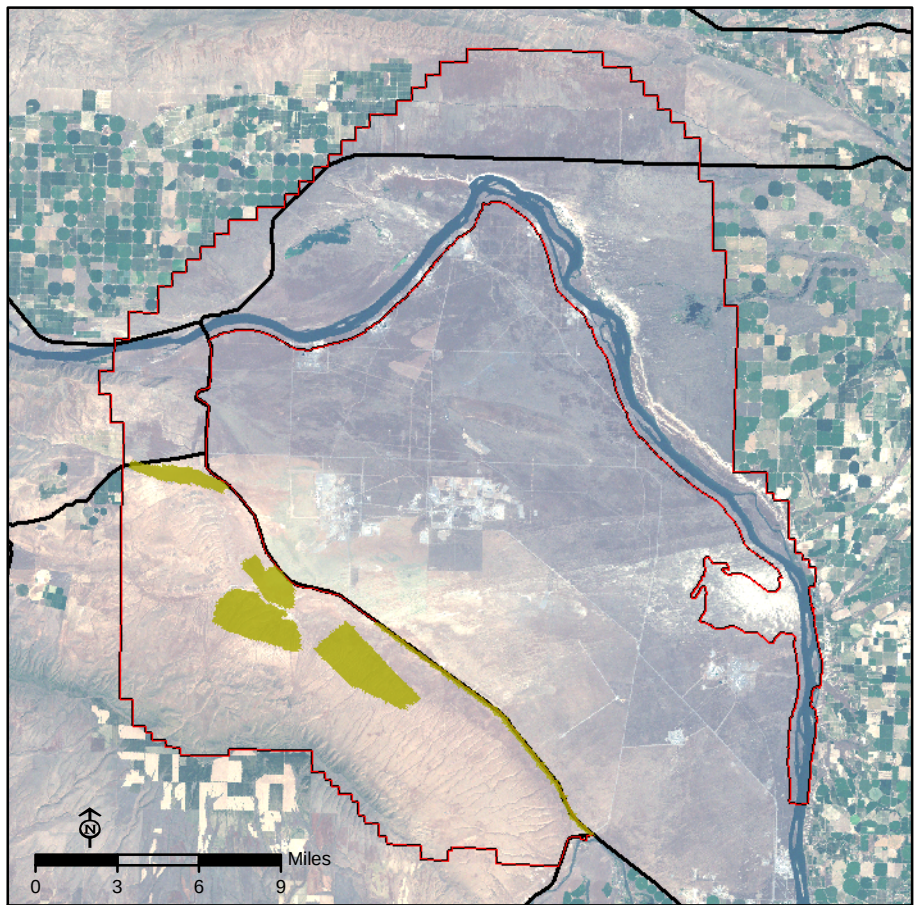

Appendix B- Figure 5

24 Command Fire - Emergency Stabilization
2002 Native Seeding Treatments
Non-Native Invasive Species Control

Hanford Reach National Monument
Arid Lands Ecology Reserve

Legend

- Streams
- Roads
- Monument Boundary
- Waterbodies

Treatment

- Drill Seeding
- Native Grass Seeding
- Shrub Seeding

Miles
0 1 2
Kilometers
0 1 2 3

243
24
240

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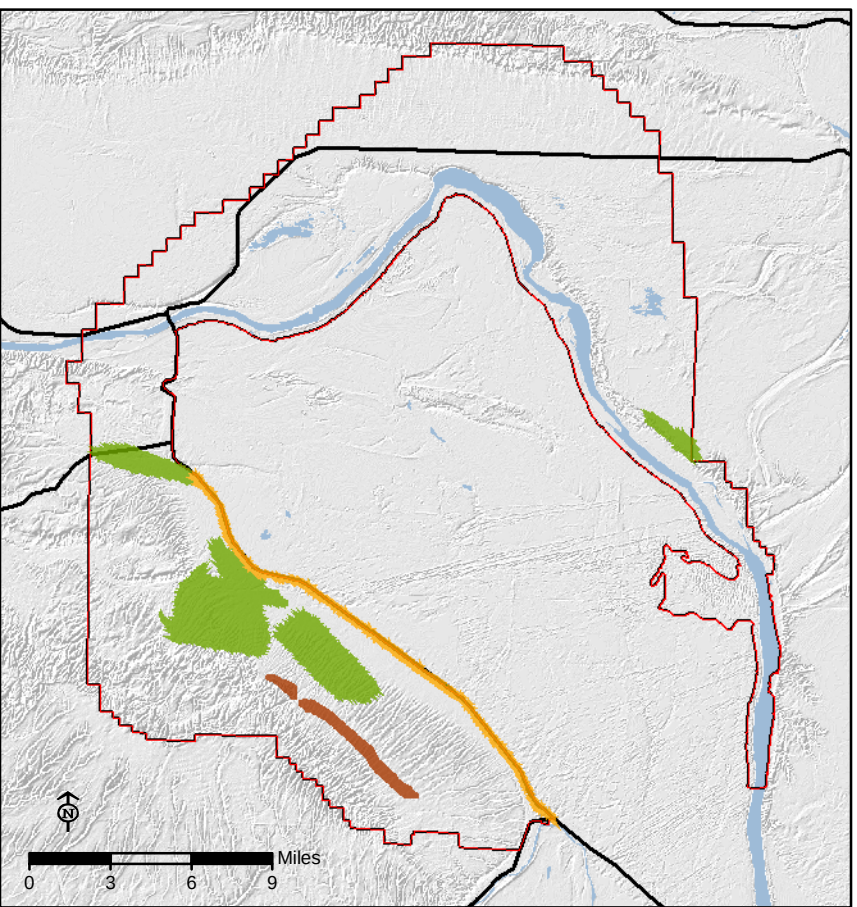

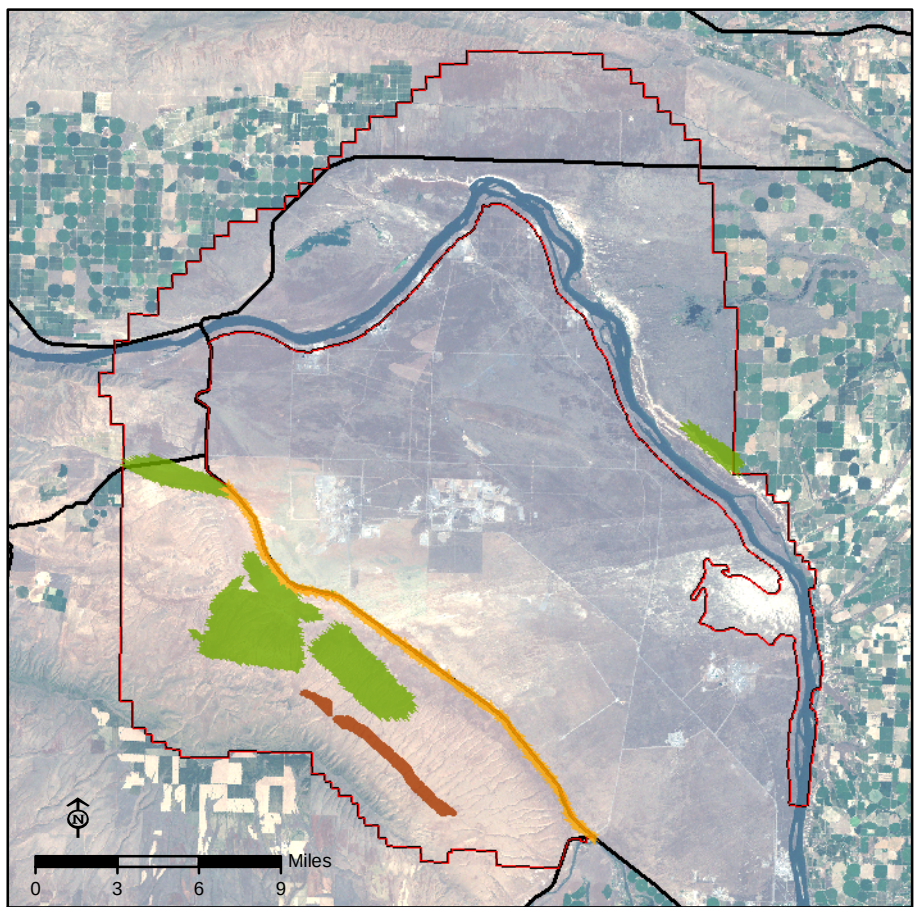

Appendix B- Figure 6

24 Command - Emergency Stabilization
Sagebrush Plantings Rehabilitation Treatments
2001 & 2002

Hanford Reach National Monument
Arid Lands Ecology Reserve

Legend

- Roads
- Streams
- Waterbodies
- Monument Boundary
- 2002 BAER Planted Plots
- 2001 BAER Planted Plots

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DEPARTMENT OF THE INTERIOR

Hanford Reach National Monument
Saddle Mountain National Wildlife Refuge

Miles: 0 1 2
Kilometers: 0 1 2 3

243
24
240

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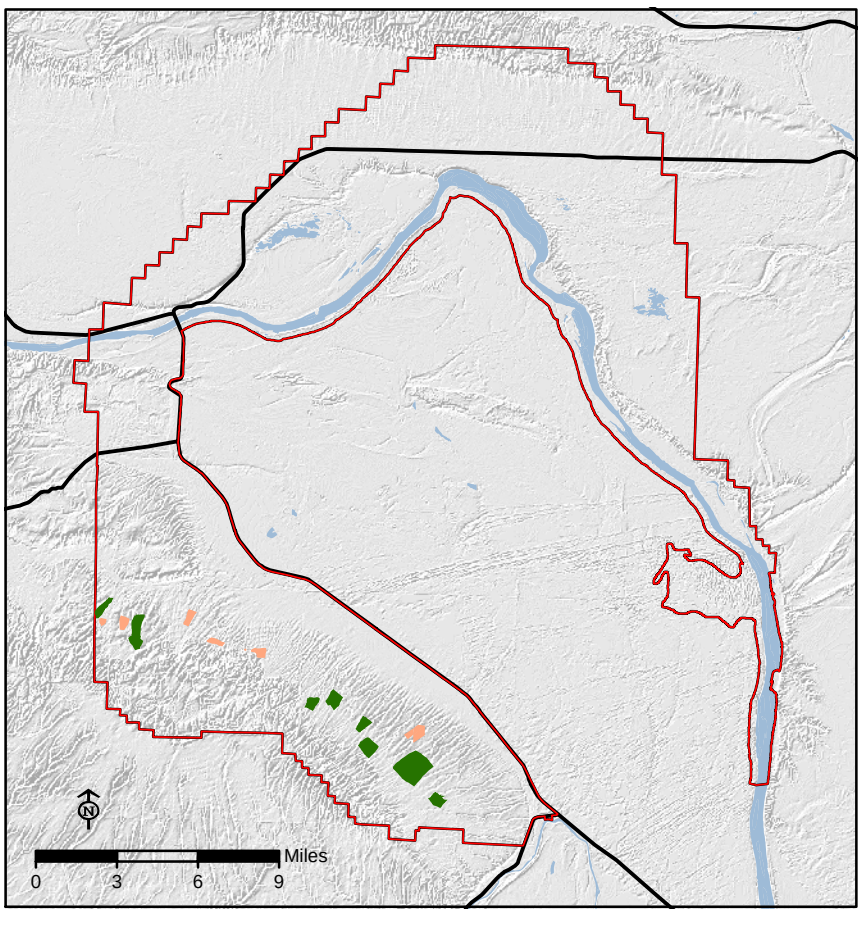
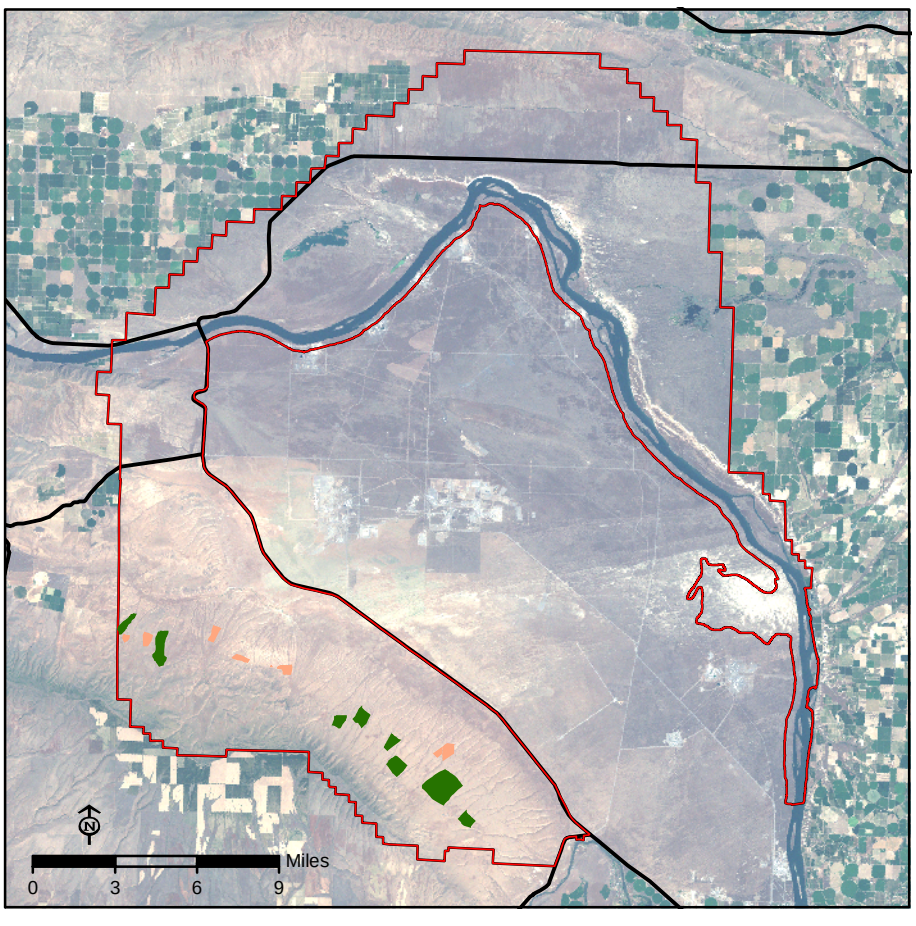




Appendix B - Figure 7

Non-Native Invasive Species Control
24 Command Fire, 2001 - 2003

Ground Application Treatments

Legend

- Spray Treatments
- Road Spray Treatments
- Monument Boundary
- Highway
- Monument Roads

Noxious Weeds

Point Locations

- Baby's Breath
- Bull Thistle
- Canada Thistle
- Common Reed
- Diffuse Knapweed
- Field Bindweed
- Kochia
- Rush Skeletonweed
- Russian Knapweed
- Scotch Thistle
- Swainson Pea
- White Top

Linear and Polygonal Locations

- Diffuse Knapweed
- Perrenial Pepperweed
- White Top
- Field Bindweed
- Russian Knapweed
- Canada Thistle
- Rush Skeletonweed

Miles
0 1 2 3

Kilometers
0 1 2 3

N

Data Source:
Invasive Weed Locations were collected by The Nature Conservancy, 2003

Road Spray Treatment locations were collected using GPS during the spray activity by the USFWS, 2003

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

Hanford Reach National Monument
Saddle Mountain National Wildlife Refuge

APPENDIX C

SUPPORTING DOCUMENTATION

- 24 Command Fire Amendment Funding Documentation
- News Release- Rehabilitation Effort Continues
- TNC- Short term impacts to vegetation- Synthesis of Findings- 24 Command Fire
- Contractual Sources Utilized for ESR Actions
- Tri-City Herald News articles- Rehabilitation Treatments on ALE
- Sagebrush Planting Fact Sheet- 2002
- 2001 Sagebrush plantings- Monitoring results- 2002 and 2003
- Mycorrhize Information
- Seed Tags- 2002 Emergency Stabilization treatments
- Seed Certification Testing Results (subsample of 2 species)
- Aero Tech Inc.- Reporting Information and GPS mapping example
- The Nature Conservancy articles on rehabilitation efforts
- Sagebrush Monitoring Field Techniques
- Restoration Reports- 2001, 2002

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

NWRS
cc: DRO/R

In Reply Refer To:
FWS/CNWR-NR-FM/007077

Memorandum

MAR 2 8 2002

To: Regional Director, Region 1

From: Chief, National Wildlife Refuge System

Subject: 24 Command Fire Rehabilitation Plan

I have reviewed the amended 24 Command Burned Area Emergency Rehabilitation Plan and found it to be very comprehensive. It identifies many useful post-fire activities that will both stabilize and prevent further resource degradation and begins post fire rehabilitation of the area.

Departmental policy establishes different standards for emergency stabilization and rehabilitation activities. It is important to identify the proper treatment category (i.e., emergency stabilization, rehabilitation, or both), and if the individual treatment specification accomplishes both, what portion of the treatment specification falls into emergency stabilization and what portion into rehabilitation. Departmental policy only allows shifting Base 8 salaries to Burned Area Rehabilitation sub-activity (9262) for emergency stabilization activities.

The authority to expend 9262 funds is also limited by different time lines. Since the 24 Command fire was controlled on July 2, 2000, under Departmental policy (620DM3) 9262 expenditures and funded contracts will end for:

- emergency stabilization activities within two full growing seasons (October 2002) and,
- rehabilitation activities within three years (July 2, 2003) following after control of the fire.

The following identified procedural and fund allocation changes are necessary prior to plan approval:

- N-2a- The individual specification needs to identify what portion is emergency stabilization and what portion is rehabilitation. If this is 100% rehabilitation, the Specification Type needs to be changed to "R", and if the midsummer 2003 Russian thistle herbicide application is before July 2. 2003, all $1,829,250 can be charged to 9262.
- N-4a - Because seeding success requires sufficient cold stratification to break seed dormancy, the second planting (if necessary) cannot occur until December-February 2003-04 and a funding source other than 9262 needs to be identified ($4,026,936). Also, because drilling is being considered, have National Historic Preservation Act clearance costs been incorporated in the specification?

- M-2b - Because seedling survival and health monitoring is planned through the 2004 summer drought, the Specification Cost Summary (III) needs to identify what part of the $35,228.23 is from 9262 and what part is from other funding sources. It appears from the Design/Construction Specifications that the May/June 2003 can be funded with 9262 funds ($8,807.06), but another funding source need to fund the October 2003 and May/June and October 2004 assessments ($26,421.17).
- C-1C - Stabilizing cultural resource sites is an emergency stabilization not a rehabilitation activity.
- F-3b - Repair and replacement of minor facilities is a rehabilitation not emergency stabilization activity.
- F-1a - Monitoring suppression activity damage rehabilitation is fire suppression not a rehabilitation activity and should be charged to fire suppression (9261) unless the fire suppression account is closed.

The 24 Command Burned Area Rehabilitation Plan amendment is approved with the above changes. As per your request for $10,719,216.12, the following is authorized under emergency fire account spending authority through July 2, 2003:

- 9261 - $4,680.00 (if suppression account is closed, charge to 9262)
- 9262 - $6,665,858.92 ($6,661,178.92 if $4,680 charged to 9262)
- To complete the project another funding source other than emergency fire funds will need to be found for $4,053,357.20 (N-4a)

If this allocation is not acceptable, please let me know. Please begin the plan implementation immediately, especially the time critical specifications (i.e., N-2a).

These rehabilitation activities are great learning experiences. Be sure to complete the initial and final accomplishment reports in order to share this information with others. (See Interagency Burned Area Emergency Stabilization and Rehabilitation Handbook section 8.15.)

If you need further information, please contact Roger Spaulding, Acting Chief, Fire Management Office, at 208-387-5595.

INTERNAL BRIEFING FOR THE REGIONAL DIRECTOR

PREPARED BY: Gregory Hughes, Hanford Reach National Monument, Project Leader

SUBJECT: 24 Command Wildfire BAER Supplemental/Amendment Request

PURPOSE OF BRIEFING DOCUMENT: Identify problems in the approval of our BAER Supplemental/Amendment for a requested time extension and/or approval to obligate beyond three years past fire out per BAER Policy.

ISSUES:

- **July 2000**, The Emergency Stabilization and Rehabilitation (ESR) for ALE was approved after a wildfire burned 167,000 acres including 77,000 acres of National Monument land and 11 houses in Benton City, WA.
- **December 4, 2000**, a Supplemental ESR for ALE for $6.4 M to restore damaged habitat was submitted to the Regional Office.
- **January 30, 2001**, ESR request for Vernita Flat Fire goes in to RO for review and approval.
- **June 1, 2001**, Regional Fire Coordinator reviews and signs and gets ready to prepare memo for RD signature.
- **June 4, 2001**, still no word on ALE ESR or Vernita Flat Fire ESR.
- **August 8, 2001**, supplemental ESR goes in to RO for BAER Short Team review but is denied by Regional Fire Coordinator. Still no word on ALE ESR supplemental.
- **October 22, 2001**, Regional Fire Coordinator conducts IG Audit on station ESR program and finds everything in order but still can not find ALE ESR and now Bill Leenhouts requires staff to prepare ESR Amendment since we are now under new ESR Policy that no longer allows them to be called Supplementals but Amendments
- **December 02, 2001**, ALE ESR Amendment goes to RO, while newly re-discovered ALE ESR Supplemental is forwarded from RO to WO.
- **February 11, 2002**, station requests status of ALE ESR Amendment from RO.
- **February 14, 2002**, RO requests status from WO, Tom Stewart.
- **February 27, 2002**, WO sends ALE ESR Supplemental (not sure if Supplemental or Amendment) to NIFC for review.
- **March 28, 2002**, WO Dan Ashe approves ALE ESR Amendment for $6.67M out of a $10.7 M. due to the fact that we do not have enough time to do the second seeding since it will now be outside the 3 year funding window of ESR Policy.

MAIN DECISION: Through no fault of the station they are reasonably requesting a one year policy waiver time extension for both emergency stabilization and rehabilitation to proceed with completion of all actions within the ALE ESR Amendment.($10.7M) and/or request the approval to obligate all funds ($10.7M) to The Nature Conservancy to accomplish the work in a fiscally responsible and accountable manner over the next two years.

BUREAU PERSPECTIVE: This would be the right thing to do for the resource.
CONTACT: Don Voros, Refuge Supervisor

United States Department of the Interior
U.S. Fish & Wildlife Service

Hanford Reach National Monument
Saddle Mountain National Wildlife Refuge
3250 Port of Benton Boulevard
Richland, Washington 99352
Phone: (509) 371-1801 Fax: (509) 375-0196

FWS-02-162

Memorandum

TO: Regional Director, Region 1

THROUGH: Regional Chief, NWRS

THROUGH: Refuge Supervisor

FROM: Greg Hughes, Project Leader

DATE: June 10, 2002

SUBJECT: Request for Extension of Burned Area Emergency Stabilization and Rehabilitation (BAER) Funds

On April 09, 2002 our office received approval through Memorandum FWS/CNWR-NR-FM/007077 for additional funds to conduct rehabilitation and stabilization actions under the 24 Command Fire Rehabilitation Plan. In reviewing the new policy guidelines contained within the Interagency Burned Area Emergency Stabilization and Rehabilitation Handbook we believe a waiver of current time frames for implementation is warranted for the 24 Command Fire.

On December 4, 2000 a supplemental plan for the 24 Command fire totaling $6.4 million dollars was forwarded to the Regional Office for review and approval. During this time frame, national policy for Emergency Stabilization and Rehabilitation (ESR) was changed through the approval of Part 620 Chapter 3 of the Department of Interior Manual (DM). The supplemental plan was not acted upon until October of 2001 when this office was advised to create and submit a "plan amendment" in accordance with new policy guidelines. As requested, a plan amendment for the Arid Lands Ecological Reserve (ALE) was submitted to the Regional Office on December 02, 2001. In February of 2002 this office determined that the ALE plan amendment had been forwarded to the Washington office for review and approval.

We would request your assistance, through this Memorandum, to seek a waiver of time lines outlined within 620 DM 3 and the ESR handbook for the rehabilitation specifications contained within the ALE fire plan amendment. Our request is for a one year policy waiver and time extension to adequately undertake necessary rehabilitation and stabilization actions.

This waiver is based upon our inability of effectively implement prescribed treatments due to the following:

- The initial supplemental funding request of December 2000 was not acted upon within a reasonable time frame.
- The ALE amendment of December 2001 was not acted upon within time frames prescribed by new policy guidelines of 620 DM 3. Current policy prescribes that all plan amendments be approved by the same individuals that approved the original ESR plan. Approval time frames for the U.S. Fish and Wildlife Service prescribe that the ESR Plan rehabilitation section will be developed within 6 months following control of the fire with approval or disapproval occurring within 2 months. The ALE amendment met these time- frames however the approval process was not completed until March of 2002.
- Three treatment seasons have been lost for rehabilitation efforts due to plan approval delays.
- The resources impacted by the 24 Command Fire are still at risk. Rehabilitation treatment is still required to meet national ESR guidelines and federal land management mandates.
- The rehabilitation actions prescribed within the ALE amendment, regardless of policy time-frames, need to be completed to fulfill the Agency's trust responsibility.

Please feel free to contact my office at 509-371-1801 should you have additional questions regarding this request or should additional information be required concerning the ESR efforts on ALE.

Department of the Interior
U.S. Fish & Wildlife Service
Hanford Reach National Monument/
Saddle Mountain NWR
3250 Port of Benton Blvd.
Richland, WA 99352
Phone: 509/371-1801
Fax: 509/375-0196

News Release

November 17, 2002

Contact: Mike Ritter, (509)-371-1801
Dave Smith, (509) 371-1801

24 Command Fire Rehabilitation Effort Continues

The U. S. Fish and Wildlife Service (FWS) is gearing up to restore about 10,000 acres of native grasses and shrubs on the Fitzner-Eberhardt Arid Lands Ecological (ALE) Reserve of the Hanford Reach National Monument within Benton County and 280 acres of a 2002 fire on the Wahluke Unit in Franklin County. On June 27, 2000, a major wildland fire quickly spread through the Hanford area, resulting from a fatal motor vehicle accident on State Route 24. The "24 Command" Fire significantly impacted the ALE's ecology and landscape by removing native grasses and shrubs.

Following the fire, in consultation with Tribes, the Department of Energy and local technical and academic experts, the FWS developed a comprehensive Burned Area Rehabilitation Plan (BAER) to address short and long-term rehabilitation needs. During the months of November and December this year, FWS will implement rehabilitation treatments identified in the 2000 BAER plan. The goals of the treatments are to stabilize erosive soils, prevent the spread of non-native invasive plant species (e.g. cheatgrass), and to restore native plant communities.

Four major rehabilitation projects will be implemented:

1) Replacing 30 miles of boundary fence along State Route 240
2) Planting 700,000 sagebrush plants on 1,600 acres within the ALE
3) Aerial spraying 10,000 acres for non-native species control
4) Aerial seeding native species on 10,000 acres within the ALE

Approximately four million dollars of this stabilization and rehabilitation effort will benefit the local economy through the award of contracts to local businesses. Tri-City Fence, L&H Seed, Wildlands Inc. and local support business will provide services, materials, and supplies.

Planting sagebrush seedlings is an effective way to restore shrubs within large burned areas. Sagebrush does not re-sprout following fire, and the heat of the fire destroyed all the seed that was in the ground. Planting will be conducted by professional reforestation crews, including Wildlands, Inc, of Richland. If conditions are favorable, the planting will create islands of shrubs within high quality native grasslands to provide a seed source over the larger burned area, and will provide habitat for wildlife dependent on sagebrush for their

survival, such as sage grouse.

The most visible operation to the general public will be the aerial spraying and seeding operations. The aerial spraying work will begin on or around November 21, depending on weather conditions. A light dose of Round-up® (3.5 ounces per acre) will be applied on 10,000 acres where most native vegetation and seed sources were removed from the soil due to the intense heat of the fire. Since the fire, these areas are either bare soil or contain a large percentage of undesirable annual species including cheatgrass, tumble mustard and tumbleweeds. The application of Round-up® will control cheatgrass and other annual species, allowing the reintroduction and establishment of native species. The spraying areas have been clearly defined and mapped for treatment using Global Positioning Systems (GPS) to avoid impacts to other native species. Round-up® is a contact herbicide that affects only actively growing plants and dissipates from the environment in less than 14 days. All herbicide applications will be weather dependent to avoid drift into non-target areas.

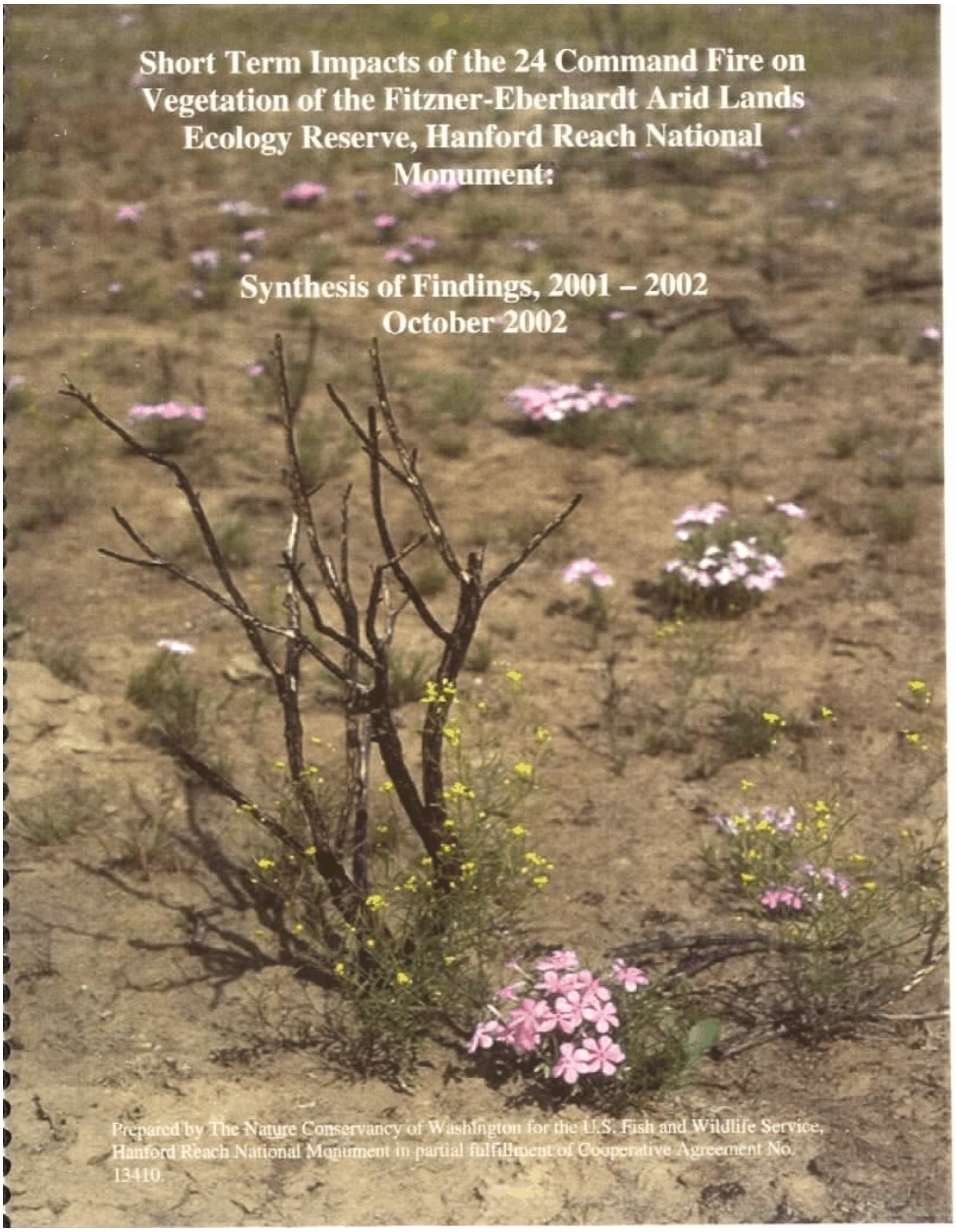
The seeding operation will follow in approximately 2 weeks beginning on or about December 10. The seeding operation will apply native seed mixes on 10,000 acres of high burn severity lands. Seed mixes have been chosen using local and eco-region derived species, and are being produced by a local seed grower.

The aerial operation will be conducted by successful bidder Aero Tech Inc., bringing state-of-the-art equipment and fire rehabilitation techniques to this effort. Aero Tech will use an 802A Air Tractor equipped with an onboard SATLOC GPS system. This system is capable of receiving GPS data input from FWS targeted treatment areas and providing a daily log of flight paths and treated acres. The FWS will receive a downloadable shapefile and digitally formatted maps of flight paths and spray path daily.

The U.S. Fish and Wildlife Service is the principal federal agency responsible for conserving, protecting, and enhancing fish, wildlife and plants and their habitats for the continuing benefit of the American people. The Service manages the 93-million acre National Wildlife Refuge System comprised of 531 refuges, thousands of small wetlands, and other special management areas. It also operates 66 national fish hatcheries, 64 fish and wildlife management assistance offices and 78 ecological services field stations. The agency enforces federal wildlife laws, administers the Endangered Species Act, manages migratory bird populations, restores nationally significant fisheries, conserves and restores wildlife habitat such as wetlands, and helps foreign governments with their conservation efforts. It also oversees the Federal Aid program that distributes hundreds of millions of dollars in excise taxes on fishing and hunting equipment to state wildlife agencies.

– FWS –

NOTE: This news release and others can be viewed on either the Service's Pacific Regional home page on the Internet at **http://www.r1.fws.gov** or the National home page at: **http://www.fws.gov/r9extaff/renews.html**



NOTE: This information is available in its entirety on the electronic (CD) version of this report. Due to the length of the TNC report, we are unable to reproduce it for the hard-copy version of this document.

24 Command Fire
-Burned Area Emergency Rehabilitation Treatments-
Final Implementation Report

Contractual Sources Utilized for Emergency Stabilization and Rehabilitation Actions:

Sagebrush Seedlings:
Lucky Peak Nursery
USDA- Forest Service- Boise National Forest
15169 East Highway 21
Boise, ID 83716
(208) 343-1977

Bitterroot Restoration
445 Quast Lane
Corvallis, MT 59828
(406)961-4626

Native Grass Seed:
L&H Seeds, Inc.
4756 W. Hwy 260
Connell, WA 99326
(509) 234-4433

Aerially Spraying and Seeding Operations
Aero Tech. Inc.
5333 E. 21st ST.
Clovis, NM. 88101
(505) 763-4300

Specialized Supplies/Services
Bareroot Sagebrush Treatment:
Mycorrhizal Applications Inc.
P.O. Box 1181
Grants Pass, OR 97528
(541) 476-3985

Monitoring Services

The Nature Conservancy
217 Pine Street, Suite 1100
Seattle, WA. 98101
(206) 343-4344

Fencing

Tri-City Fence Inc.
4330 Van Giesen
Richland, WA. 99353
(509) 967-2911

Sagebrush Planting
Reforestation Management
P.O. Box 206
Littlerock, WA 98556

Wildlands, Inc.
1941 Saint Street
Richland, WA. 99352
(509)375-4177

Bitterroot Restoration
445 Quast Lane
Corvallis, MT 59828
(406)961-4626

Native Seed Analysis

Washington State Department of Agriculture Seed Program
21 North 1st Avenue, Suite 203
Yakima, WA. 98902
(509) 225-2630

THURSDAY
JULY 6, 2000

Tri-City Herald

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Scorched reserve displaces elk, creates driving problems

Herald/Bob Brawdy

A herd of bull elk rests on a firebreak next to scorched earth Wednesday morning at the Arid Lands Ecology Reserve at Hanford. Biologists are warning motorists to use caution near the ALE because the elk herd, estimated at between 700 and 800 animals, is on the move since last week's fire.

Vegetation to return to land through care, time

By Annette Cary
Herald staff writer

From a distance, Rattlesnake Mountain is unrelieved black char.

But from the air above, the mountain and the rest of the Arid Lands Ecology Reserve are a mosaic of greens, grays and browns where the quickly moving fire spared vegetation in spots.

At the bottom of steep ravines down the sides of Rattlesnake, gray brush remains healthy where the fire skipped from ridge to ridge above it.

"There are areas the fire flew past so fast it didn't touch," said Greg Hughes, project leader for the Arid Lands National Wildlife Refuge Complex.

In other places, the 300-square-mile fire roared through grass so quickly last week that clumps of sage were left untouched as the fire licked through the grass in its path. Along springs and creeks, vegetation stands out in emerald green oases against the black.

"Where it was wettest, the fire cleared it in a single bound," Hughes said.

Other patches high on the hill remain light brown. Where soil was thin, little grew to add fuel to the fire. And close to Highway 240, the black of the fire has already been erased by winds that swept away dark ashes.

However, the vegetation that remains isn't enough to support the reserve's animals. Nearly all the ALE burned.

The estimated 700 to 800 elk on the reserve have started to roam in search of food, moving back and forth across roadways as they leave, then return to the burned reserve.

"They like the ash to roll in and remove insects and ticks," said Erv Gasser, a specialist with the Burnt Area Emergency Rehabilitation team, or BAER team, of the Department of Interior.

Two elk have already died, the losers in a confrontation with a semi-truck just before the sun rose Tuesday. A herd of bull elk ran into the roadway in the Horn Rapids area of Highway 240 in front of the semi, said Richland police reports.

Fish and Wildlife officials are warning drivers to slow down and watch for elk in unexpected areas, particularly when the animals are likely to be active in the early morning and evening hours. With a cow elk weighing about 500 pounds and bulls weighing more, a collision

See **Scorched,** Page A2

Scorched: Fish and Wildlife has sage plants in nursery

Continued from A1

could cause serious injuries to anyone in a car.

Drivers also are being warned about blowing dust and ash where there's no vegetation left to hold it to the ground along Highway 240 between Highway 225 at Horn Rapids and Highway 24 near the Yakima Barricade. Signs are being posted warning people to drive carefully.

When visibility is poor, Washington State Patrol troopers, Benton County Sheriff's deputies and the Washington Department of Transportation staff plan to either pilot vehicles through the problem areas or close roads.

BAER officials are advising drivers to slow down in the dust, turn their lights on and, when they can no longer see, pull well off the road and turn on their flashers until visibility improves.

Some of the vegetation could germinate this fall, if it's wet enough.

"There's a lot of black," Gasser said. "In some aspects, that's good. It's an indicator of low burn severity." The fire was intense, but it moved so quickly that just the surface vegetation was harmed.

"The seed within the soil did not die," he explained. "The seeds are intact."

"I suspect in bunch grass areas, we'll see a lot of nice bunch grass come back," Hughes said.

Gasser is predicting the variety of plants that grow back will be surprising. "Probably next year we'll see a flush of plants that have not been seen in the area," he said.

However, sage will be slower to regenerate.

"We will help nature — give it a jump-start," he said.

Fish and Wildlife already has 80,000 sage plants in a nursery — enough to plant a few hundred of the 77,000 acres of the reserve that burned. The plants were being grown from seed native to the Hanford area to replant already damaged areas, so the genetic makeup of the sage will remain pure.

Seed also will be collected from plants that were not burned. But because sage needs near-perfect conditions to regenerate in the wild, plants will be started in greenhouses, then replanted.

Biologists don't know how rare and endangered plant species will fare. About all they can do now is monitor the site to see if they reappear, said Dave Smith of BAER. The state lists five species of rare plants, including two types of milkvetch, Piper's daisy, gray cryptantha and coyote tobacco on the reserve.

The state also lists two types of birds found on the reserve as threatened — ferruginous hawks and sage grouse, which depend on sage for food. Several other birds are candidates for the state list, including the loggerhead shrike, two types of sparrows, the sage thrasher and the burrowing owl. They nest in the sage, or in the case of the owl, use it for shade in hot weather, as a hunting perch and as a hiding place.

Those birds will be stressed by the fire, said Heidi Brunkal, a wildlife biologist for Fish and Wildlife. Quality sage habitat will take years to redevelop, leaving them to look for more hospitable areas.

That will be difficult, however, because agriculture and development have destroyed so much of the good sage areas and at those that remain, the reserve wildlife will have to compete for habitat with wildlife already there, she said.

Biologists also are expecting weeds to invade areas torn up by firefighting equipment.

Initially, Fish and Wildlife asked firefighters to be careful of native vegetation and stay on roads. But as the fire quickly spread, firefighters brought in bulldozers and other heavy equipment with the blessing of Fish and Wildlife.

Tracks from light trucks crisscross the ground near the scene of the fatal accident on Highway 240 that sparked the fire June 27. Even within a mile of the accident scene, the fire burned quickly enough to leave a mosaic of unburned brush against the black ash.

Higher on the reserve, bulldozer lines scar the land, where vegetation was stripped in an effort to starve the fire.

However, the fire easily jumped or outpaced most fire lines on public and private lands. In other instances, equipment couldn't be ordered and delivered to the fire fast enough to help firefighters. At its worst, the fire ate through 20 miles of brush and grass in 90 minutes. "The fire was just too fast," Hughes said.

Hanford and Fish and Wildlife officials said they are working on a timeline to explain how the fire was fought and when decisions were made, but they don't have those answers yet.

No firefighters were seriously injured in the fire.

However, about a mile from the accident scene sits a blue one-ton pickup used by Hanford firefighters to carry water onto the reserve. The truck broke down on the first day. The two firefighters at the truck cleared the brush around it, but the firebreak failed to protect the truck.

The two firefighters walked about two miles to safety, and their lives were not in jeopardy, said Michael Turner, a Hanford spokesman.

Fire officials are continuing to hear reports of fires in the burned areas as dust devils rose high above the ground, swirling ash into the air as if it were smoke.

But "I'd rather have 40 false reports than nothing and miss a fire," Hughes said.

The fire last week burned 11 families out of their homes, and a fund has been started to help fire victims. It had collected $26,000 as of Wednesday. Donations can be made at any U.S. Bank branch, with checks made out to the Hanford Fire Relief Fund.

■ **Reporter Annette Cary can be reached at 582-1533 or via e-mail at acary@tri-cityherald.com.**

TCH

Thur. November 21, 2002

Reach repair to start

■ *$6 million plan to restore land destroyed by 2000 fire*

By Mike Lee
Herald staff writer

The Hanford Reach National Monument will get a $6 million makeover starting Friday, when the first restoration team plans to start chemically clearing weeds off 10,000 acres.

Next up is replacing 30 miles of fences, followed by hand-planting 700,000 sagebrush and the aerial seeding of 10,000 acres with native plants — all in one month.

The project marks substantial progress for the U.S. Fish and Wildlife Service, which had just adopted the monument when it was gutted by fire in June 2000.

"This kind of brings closure — like losing a loved one or something that has such impact," said Greg Hughes, project leader at the agency's Richland office. He has been planning rehab efforts for about two years while waiting for money and proper biologic conditions.

"We are excited about getting going and finally doing something to effect some change on the landscape," Hughes said. "Normally, what you are able to do is a postage stamp — an acre here and an acre there — and you don't get much bang for the buck."

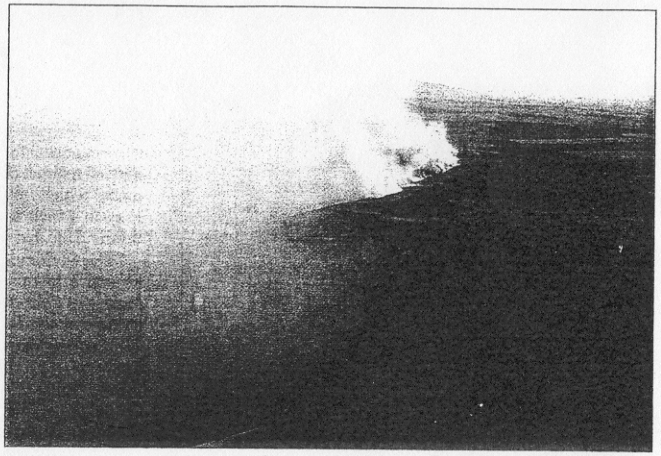
Because of the monument's prominence, the project cost and the size of the burned area — 163,000 acres — the rehabilitation effort is expected to draw interest from conservation scientists from across the arid West.

"Restoration work is still a very new science, and you can plant a whole bunch of new plants and have a couple of years with very low rainfall and lose them," said Leslie Brown, spokeswoman for The Nature Conservancy of Washington. "There are no guarantees. We do our part, Mother Nature does her part, and we see what happens."

The inherent risks of nature already have pulled $4 million away from the rehabilitation work. Officials in Washington, D.C., recently shifted that much money from the Hanford site to other fire sites.

"That's unfortunate because

See **Reach,** Page A2



Herald file

The Hanford Reach National Monument, 163,000 acres of which was scorched by fire in June 2000, is scheduled for a $6 million makeover starting Friday. The monthlong project will include replacing 30 miles of fence, hand-planting 700,000 sagebrush and the aerial seeding of 10,000 acres with native plants.

Reach: Workers to plant 700,000 seedlings over 2 weeks

Continued from A1

(monitoring and reseeding) is exactly what needs to be done," said Mike Lilga of Richland, who sits on the monument advisory committee. "These things are not one-shot deals. You really have to be persistent."

Slashed funding creates more pressure to get the job done right the first time, said Dave Smith, a natural resource supervisor with the Fish and Wildlife Service in Richland. However, it's likely that The Nature Conservancy of Washington will monitor recovery and the Fish and Wildlife Service is seeking more money for plantings next year.

"We will have to do it in little chunks and build on initial successes," Hughes said. "I guess it's too early to say 'success.' We will wait and see."

The project includes restoring 1,600 acres of what was high-quality sagebrush, the likes of which have been gobbled by development in the last 100 years, thereby limiting habitat for sage-dependent species.

Most high-quality stands of big sagebrush on the Arid Lands Ecology Reserve — an environmental centerpiece of the monument — were destroyed in the 2000 fire. Where the fire consumed sagebrush, it burned hotter than elsewhere and often destroyed native plants and the soil crust, leaving the land vulnerable to erosion and noxious weeds.

"The purists would say it will come back by itself, and part of me agrees with that," Lilga said. "But the other part of me says it really doesn't have a chance by itself because the frequency of fire is so much higher than it used to be before man was here in great numbers."

Approximately 45 workers are expected to help with what is expected to be less than two weeks of work to plant the 700,000 sagebrush seedlings. It is the largest such effort in the Northwest this year and by far the largest post-fire effort on the monument.

"We figure that one person can plant between 500 and 1,000 (seedlings) per day," said Bill Mast, owner of Richland-based WildLands, an environmental restoration company. "They hit it hard and they are good."

Mid-Columbia businesses such as WildLands, Tri-City Fence and L&H Seed won approximately $4 million in contracts.

Plans also call for replacing 30 miles of wire fencing with one-strand fence that collects fewer tumbleweeds, thereby reducing the danger that a fire will spread rapidly in quick-burning brush caught in the fence line.

This week's weather conditions are about as good as possible, given the region's prolonged drought, making project managers optimistic about their chances.

"It's looking good for the planting effort that we will have moisture to plant in," Smith said after a series of small rain showers this week. "It was hard to believe, but (moisture) was there."

Just as important, cheat grass is starting to flourish in the recent warm and wet weather, creating a relatively easy target for aerial applications of the herbicide Roundup scheduled to start Friday.

"If we don't move in quickly, cheat grass will take over, and cheat grass is what has ... made this a more fire-prone landscape," Brown said.

The project is expected to be done by the end of the year, but fire management and restoration will remain central topics for agency managers and the advisory committee. "The big fire is behind us, but there are always new fires ahead," Lilga said.

■ **Reporter Mike Lee can be reached at 582-1542 or via e-mail at mlee@tri-cityherald.com.**

Scouts, others help heal wildfire's wounds

Volunteers plant thousands of sagebrush sprouts on Hanford fire land

By Janine Jobe
Herald staff writer

Herald/Evan E. Parker

Phil Birks of Kennewick helps his son Scott, 11, a Boy Scout with Troop 148, retrieve his hat on a windy Saturday morning on Rattlesnake Mountain. The two helped plant more than 5,000 sagebrush seedlings in areas burned in the Hanford wildfire.

Herds of tumbleweeds scampered across the steppes, driven by a wind sharp enough to steal your breath.

But that didn't stop a couple of dozen volunteers from lugging shovels and boxes across the base of Rattlesnake Mountain on Saturday to help heal the wounds from the Hanford wildfire in June 2000 that scorched 75,000 acres.

With tall sagebrush sprouts in hand, Boy Scouts with Troop 148 followed assistant troop leader John Westleigh across the rolling hills, carefully stuffing the root plugs in small holes and stamping the soil back around the plant.

"I guess I would rather be watching Saturday cartoons, but we're here doing something good," said Boy Scout Jeremy May, 12. "Once you get going, it's kind of fun."

While farmers and homeowners might be more likely to pull sagebrush than plant it, the native plant provides important food and shelter for birds, deer, elk and other smaller creatures, said Heidi Brunkal, wildlife biologist with the Fish and Wildlife Service.

"It's a major structural component for the area and it doesn't resprout," she said. "The burn area here is so vast it wouldn't naturally regenerate."

The sagebrush starts were grown from seeds taken from nearby and grown in tall tubes. Once they reached about 8 inches high, the starts were packed into boxes of 98 and carted up the mountain.

"Using seeds from the area increases the survival rate of the plants, which is about 70 percent," Brunkal said.

When the sagebrush is mature, it will be a bushy, chest-high plant.

Saturday's goal was to plant 5,000 to 7,000 seedlings in the Fitzner-Eberhart Arid Lands Ecology Reserve of the Hanford National Monument. About 140,000 sagebrush sprouts have been planted since the fire.

Charred skeletons of sagebrush still can be seen in the area, and blackened clumps of scrub grass dot the hillside, mingling with the new growth.

Repeated fires have eliminated nearly all the scrub plants from that part of the preserve, and active restoration is required to get it re-established, Brunkal said.

Volunteers from Duratek also joined the Scouts on Saturday to brave the wind and chill to help with the revegetation.

"I wanted to do something to help the community and the environment," said Juan Rodriguez, a manager with Duratek.

Reporter Janine Jobe can be reached at 582-1543 or via e-mail at jjobe@tri-cityherald.com.

ARID LANDS ECOLOGY RESERVE STABILIZATION 2002

SAGEBRUSH PLANTING
24 COMMAND FIRE

Plot	size in acres	planted by	Modified	actual plants planted	
Plot A	600 acres	Bitterroot	265,750		
Plot B	71 acres	Wildlands	101 acres	53,530	
Plot C	132 acres	Frank Maduzia	54,800		
Plot D	76 acres	Frank Maduzia	35,700		
Plot E	115 acres	Frank Maduzia	partial plant	22,500	18,000(Frank) + 4500 Wildlands
Plot G	65 acres	Frank Maduzia	30,000		
Plot J	68 acres	Frank Maduzia	31,252		
Plot K	152 acres	Wildlands	102 acres	46,470	(-4500)
Plot L & M	40 acres and 45 acres		Bitterroot		38,250
	1364 acres		578,252		

Proposed plots and number of plants:
Bitterroot Restoration **300,000 plants @ 450 plants per acres is approximately 670 acres**

plots A, L and M (685 acres) have been assigned

Wildlands 84,000 plants @450 plants per acres is approximately 190 acres

plots B and K (223 acres) have been assigned
16,350 added because of surplus from Lucky Peak
total: 100,350 plants @ 450 plants per acre is 223 acres

Frank Maduzia 89,300 and surplus 72,200 from Lucky Peak

total: 161,500 plants @ 450 per acre is 360 acres
Plots C,D,G, J (341 acres) have been assigned

Sage monitoring numbers: Summer 2002 & 2003

2002 data in black, 2003 data in red

	2002	2002	2003	2003
Plot 1 Transect 1		**Percentages**		
Healthy	27	25%	11	10.30%
Sick	43	39.80%	9	8.40%
Dead	27	25%	87	81.30%
Missing	10	9.30%		
Total	107		107	

	2002	2002	2003	2003
Plot 1 Transect 2		**Percentages**		
Healthy	64	44.40%	16	11.40%
Sick	48	33.30%	14	10.00%
Dead	23	16.00%	114	81.40%
Missing	9	6.30%		
Total	144		144	

	2002	2002	2003	2003
Plot 3 Transect 1		**Percentages**		
Healthy	28	28.90%	7	7.20%
Sick	49	50.50%	13	13.40%
Dead	20	20.60%	77	79.40%
Missing				
Total	97		97	

	2002	2002	2003	2003
Plot 3 Transect 2		**Percentages**		
Healthy	37	39.30%	3	
Sick	34	36.20%	3	3.20%
Dead	22	23.40%	88	3.20%
Missing	1	1%		93.60%
Total	94		94	

	2002	2002	2003	2003
Plot 5 Transect 1 10"		**Percentages**		
Healthy	58	54.70%	37	34.90%
Sick	29	27.60%	6	5.70%
Dead	10	9.50%	63	59.40%
Missing	9	8.60%		
Total	106		106	

	2002	2002	2003	2003
Plot 5 Transect 2 10"		**Percentages**		
Healthy	49	50.50%	41	
Sick	25	25.80%	5	42.30%
Dead	15	15.50%	51	5.20%
Missing	8	8.20%		52.30%
Total	97		97	

	2002	2002	2003	2003
Plot 6 Transect 1		**Percentages**		
Healthy	19	18.30%	9	8.70%
Sick	36	34.60%	0	0.00%
Dead	27	26.00%	95	91.30%
Missing	22	21.20%		
Total	104		104	

	2002	2002	2003	2003
Plot 6 Transect 2		**Percentages**		
Healthy	53	47.30%	31	
Sick	35	31.30%	7	27.70%
Dead	22	19.60%	74	6.25%
Missing	2	1.80%		66.10%
Total	112		112	

	2002	2002	2003	2003
Plot 9 Transect 1		**Percentages**		
Healthy	61	48.40%	33	26.20%
Sick	36	28.80%	2	1.60%
Dead	26	20.80%	91	72.20%
Missing	3	2.40%		
Total	126		126	

	2002	2002	2003	2003
Plot 9 Transect 2		**Percentages**		
Healthy	40	29.60%	19	
Sick	56	41.20%	0	14.10%
Dead	30	22.10%	116	0.00%
Missing	9	6.60%		85.90%
Total	135		135	

	2002	2002	2003	2003
Plot 2 Transect 1		**Percentages**		
Healthy	65	60.20%	9	8.30%
Sick	26	24.10%	20	18.50%
Dead	17	15.70%	79	73.10%
Missing				
Total	108		108	

	2002	2002	2003	2003
Plot 2 Transect 2		**Percentages**		
Healthy	56	55%	13	12.70%
Sick	35	34.30%	22	21.60%
Dead	11	10.80%	67	65.70%
Missing				
Total	102		102	

	2002	2002	2003	2003
Plot 5 Transect 1 4"		**Percentages**		
Healthy	58	52.30%	45	41.30%
Sick	48	44%	26	23.80%
Dead	2	1.80%	38	34.70%
Missing	1	0.90%		
Total	109		109	

	2002	2002	2003	2003
Plot 5 Transect 2 4"		**Percentages**		
Healthy	50	38.50%	31	23.80%
Sick	60	45.80%	23	17.70%
Dead	15	11.50%	76	58.50%
Missing	5	3.80%		
Total	130		130	

	2002	2002	2003	2003
Plot 5 Transect 3 10"		**Percentages**		
Healthy	51	48.10%	35	33.00%
Sick	43	40.20%	8	7.50%
Dead	8	7.50%	63	59.40%
Missing	4	3.70%		
Total	106		106	

	2002	2002	2003	2003
Plot 5 Transect 4 10"		**Percentages**		
Healthy	55	52.40%	30	28.60%
Sick	27	25.70%	15	14.30%
Dead	8	7.60%	60	57.10%
Missing	15	14%		
Total	105		105	

	2002	2002	2003	2003
Plot 7 Transect 1		**Percentages**		
Healthy	47	39.80%	26	22.00%
Sick	40	33.90%	0	0.00%
Dead	25	21.20%	92	78.00%
Missing	6	5.10%		
Total	118		118	

	2002	2002	2003	2003
Plot 8 Transect 1		**Percentages**		
Healthy	4	4.40%	4	4.40%
Sick	24	26.40%	2	2.20%
Dead	62	68.10%	85	93.40%
Missing	1	1.10%		
Total	91		91	

2002 Results:			**2003 Results:**		
Total healthy	822	41.30%	Total healthy	400	20.10%
Total dead	370	18.60%	Total dead	1416	71.10%
Total sick	694	34.90%	Total sick	175	8.80%
Total missing	105	5.20%			
Total seedlings sampled	1991		Total seedlings sampled	1991	
Total seedlings planted	173,348				

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Packaging:	Bag	Pail	3 Pails

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Amount:	1 lb.	25 lbs.	125 lbs.
Price:	$29.95/lb.	$24.95/lb.	$19.95/lb.
Packaging:	1 lb. bags	25 - 1 lb. bags/case	Small barrels

Plant Success Soluble - 13 species Mycorrhizae/Biostimulant/Vitamins

Amount:	1 lb.	25 lbs.	125 lbs.
Price:	$39.95/lb.	$29.95/lb.	$25.95/lb.
Packaging:	1 lb. bags	25 - 1 lb. bags/case	Small barrels

BioGROW Endo Plus: 3 Species Mycorrhizae / 2 Species Tricoderma / Biostimulant

Amount:	25 lbs.	375 lbs.	1000 lbs.
Price:	$6.95/lb.	$4.50/lb.	$3.95/lb.
Packaging:	Bags	3 - Small barrels	3 - Large barrels

BioGROW Endo/Ecto Plus: 8 Species Mycorrhizae/ 2 Species Tricoderma / Biostimulant

Amount:	25 lbs.	375 lbs.	1000 lbs.
Price:	$7.95/lb.	$4.95/lb.	$4.40/lb.
Packaging:	Bags	3 - Small barrels	3 - Large barrels

BioGROW Endo:

3 Species Mycorrhizae Granular / Endomycorrhizal Spore Count / 60,000 Spores Per/lb.

Amount:	25 lbs.	375 lbs.	900 lbs.
Price:	$6.95/lb.	$4.60/lb.	$4.05/lb.
Packaging:	Bags	3 - Small barrels	3 - Large. barrels

Arbuscular Mycorrhizae and Water Stress Tolerance of Wyoming Big Sagebrush Seedlings

Peter D. Stahl,* Gerald E. Schuman, Sandra M. Frost, and Stephen E. Williams

ABSTRACT

Although Wyoming big sagebrush (*Artemisia tridentata* Nutt. ssp. *wyomingensis* Beetle and Young) is widespread in the western USA, reestablishment of this native shrub on disturbed lands by direct seeding is problematic. A number of theories have been proposed to explain this difficulty. Included are the hypotheses that seedlings are unable to obtain adequate moisture and are handicapped by reduced levels of mycorrhizae in perturbed soils. We conducted a greenhouse study to examine the influence of vesicular arbuscular mycorrhizae (VAM) and seedling age on soil moisture stress tolerance of Wyoming big sagebrush seedlings. Results demonstrated greater survival of mycorrhizal seedlings than nonmycorrhizal seedlings as soil dried down past soil water potential values of −2.5 MPa to as dry as −3.8 MPa. For all different aged seedlings tested (30, 45, 60, 90, 120, 150 d), the degree of soil dryness resulting in death of mycorrhizal seedlings was significantly greater ($P < 0.01$) than that causing death of nonmycorrhizal seedlings. Analysis of variance indicated a significant interaction of seedling age and mycorrhizae on moisture stress tolerance. Experimental data suggest that as sagebrush seedlings age, the beneficial influence of arbuscular mycorrhizae on soil water stress tolerance increases.

THE IMPORTANCE OF SHRUBS, including Wyoming big sagebrush, in arid and semiarid environments is well documented (McKell, 1975). On millions of hectares of western North America, shrubs are essential to ecosystem function and soil stability (McArthur and Welch, 1985). Shrubs are also important as wildlife habitat and serve as preferred feed for many types of domestic and wild animals (Roundy et al., 1995). It seems obvious that to restore productivity and stability to disturbed shrublands, shrub reestablishment is critical.

Although big sagebrush is one of the most common and widespread shrubs in the western USA, reestablishment of this species on disturbed lands by direct seeding has proven difficult for a number of reasons (Cockrell et al., 1995). This poses important concerns in Wyoming, where restoration of sagebrush is required by law.

A number of hypotheses have been proposed to explain the difficulty in successfully establishing sagebrush from seed on disturbed sites. These include the idea that reduced levels of arbuscular mycorrhizae on roots of sagebrush seedlings in perturbed soils decrease their ability to survive stressful environmental conditions (Call and McKell, 1982; Stahl et al., 1988). This hypothesis is based on the fact that arbuscular mycorrhizae can improve a host plant's ability to extract nutrients and water from the soil and observations that sagebrush appears to be particularly dependent on mycorrhizal symbiosis to reach full growth potential (Allen, 1984).

Indirect evidence indicates that soil water availability is one of the most critical factors involved in big sagebrush seedling establishment (Jones, 1991). On both local and regional levels, sagebrush distribution has been shown to be related to soil water availability (Burke et al., 1989; West, 1979). Because water availability is a key factor in sagebrush establishment, mortality of sagebrush seedlings is high; however, once established, mortality among adult plants is low (Daubenmire, 1974; Cawker, 1980). In addition to mycorrhizae, adult sagebrush plants employ various physiological and morphological mechanisms to deal with moisture stress (DePuit and Caldwell, 1973; Romo, 1984; Campbell and Harris, 1977) that are not developed in seedlings. Formation of arbuscular mycorrhizal symbiosis may enable sagebrush seedlings to obtain more moisture from soil than nonmycorrhizal seedlings and may play an important role in seedling establishment.

The objectives of this study were to: (i) determine if mycorrhizal sagebrush seedlings are more tolerant of soil moisture stress than nonmycorrhizal sagebrush seedlings and (ii) determine if there is an interaction between seedling age and mycorrhizae on soil moisture stress tolerance.

METHODS

A greenhouse experiment was conducted to test two null hypotheses: (i) mycorrhizal sagebrush seedlings are equally tolerant of soil moisture stress as are nonmycorrhizal sagebrush seedlings, and (ii) there is no interaction between seedling age and mycorrhizae on soil moisture stress tolerance in big sagebrush.

The soil used in this study, classified as a Ustic Torriorthent, was collected from an undisturbed sagebrush–grassland site on the North Antelope Coal Mine in the Powder River Basin of northeastern Wyoming. Selected physiochemical characteristics of this soil are given in Table 1.

All soil was passed through a 1.0-cm sieve before use. Arbuscular mycorrhizal fungi were eliminated from soil for the nonmycorrhizal treatment by pasteurizing at 115°C for 4 h. The pasteurized soil was subsequently treated with a finely sieved-(24 μm) water extract of unautoclaved soil to restore indigenous soil microorganisms other than arbuscular mycorrhizal fungi. The mycorrhizal treatment utilized fresh untreated soil. Each soil treatment (−VAM and +VAM) was used to fill 108 15-cm pots with about 1.4 L of soil. Approximately 10 sagebrush seeds were placed on the surface of each pot. After germination and emergence, sagebrush seedlings were thinned to two per pot. All seedlings were planted on the same date.

To test these hypotheses, different aged mycorrhizal and

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Abbreviations: ANOVA, analysis of variance; VAM, vesicular arbuscular mycorrhizae.

Table 1. Physical and chemical characteristics of soil used in the experiment.

pH	Electrical conductivity	Cation-exchange capacity	Texture	Soluble cations				Kjeldahl N	Inorganic P
				Mg	Ca	Na	K		
	dS m^{-1}	cmol, kg^{-1}		mg kg^{-1}				mg kg^{-1}	
7.2	2.3	15.7	sandy clay loam	47	449	10	20	362	2.6

nonmycorrhizal sagebrush seedlings were subjected to increasing levels of soil moisture stress by discontinuing water application to the pots. Moisture stress evaluations were conducted on 30, 45, 60, 90, 120, and 150-d-old seedlings. At each sampling interval, 18 pots (each with two sagebrush seedlings) of both soil treatments were subjected to the moisture stress evaluation. Pots were allowed to dry until the seedlings died (seedlings were subjected to water stress one time only) and were then harvested immediately to quantify the amount of mycorrhizae on root systems.

Soil moisture status of all 36 pots subjected to moisture stress at each sampling interval was monitored daily. Soil water potential was estimated gravimetrically based on a soil moisture retention curve established for the soil used in this study (Fig. 1). Pots and soil were weighed and soil moisture was determined using the initial weight of the pot and dry soil. The soil moisture retention curve was generated by the method of Klute (1986). Soil water potential was then estimated by relating the soil moisture percentage to the moisture retention curve using the following regression formula:

$$\text{soil water potential} = 24.2 - 1.7(\text{soil moisture content, \%}) \quad [1]$$

Dead sagebrush seedlings were harvested by first soaking pots and soil in water until they were completely saturated. Pots were then removed from the water so the excess moisture could drain. Dead sagebrush seedlings were then carefully excavated from the soil using a gentle stream of water. After harvest, roots were prepared for examination of mycorrhizal status by washing with distilled water and clearing in warm (≈60°C) 10% KOH for 30 min. Root samples were then stained with 0.166% trypan blue in lactoglycerol (equal parts glycerin, lactic acid, and distilled water) for 1 h and then destained in clear lactoglycerol. Levels of arbuscular mycorrhizal infection were quantified using the method of Allen and Allen (1980).

This study was designed as a completely randomized 2 × 6 factorial experiment with experimental factors being mycorrhizal status (−VAM or +VAM) and seedling age (30, 45, 60, 90, 120, or 150 d old). Two hundred sixteen experimental subjects (pots containing sagebrush seedlings) were included in this test with 18 replicates per treatment. Paired *t*-tests were used to compare the responses of mycorrhizal and nonmycorrhizal sagebrush seedlings in each age group to soil moisture stress (i.e., the level of soil dryness resulting in death). Analysis of variance (ANOVA) was used to test the hypotheses of main effects (the influence of arbuscular mycorrhizae and seedling age on sagebrush drought stress tolerance) and the interaction of these two factors.

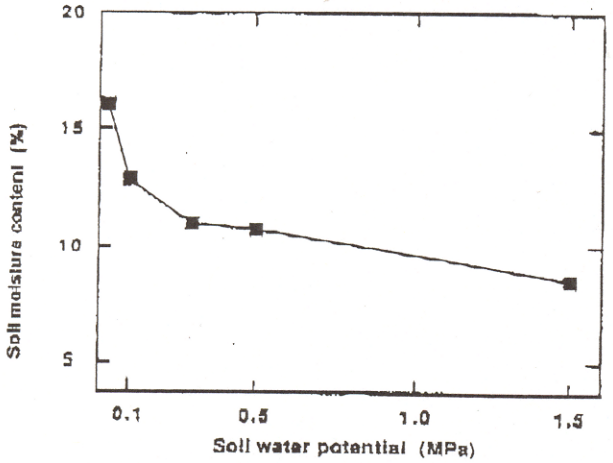

Fig. 1. Soil moisture retention curve.

RESULTS AND DISCUSSION

Sagebrush seedlings from the mycorrhizal treatment developed arbuscular mycorrhiza on 65 to 86% of root segments examined while seedlings from the nonmycorrhizal treatment formed mycorrhizae on only 1 to 2% of the root segments examined (Table 2). The observed differences in levels of mycorrhizae on sagebrush roots in the two treatments were statistically significant at $P < 0.001$ for all age groups.

Sagebrush seedlings in the mycorrhizal treatment were able to tolerate significantly drier soil conditions than nonmycorrhizal seedlings (Fig. 2, Table 3). For all of the different aged seedlings tested (30, 45, 60, 90, 120, and 150 d), the degree of soil dryness causing death of mycorrhizal seedlings was significantly greater ($P < 0.01$, based on paired *t*-tests) than that causing death of nonmycorrhizal seedlings. For example, after 45 d of growth, the average soil water potential resulting in death of mycorrhizal seedlings was −3.22 MPa, compared with an average of −2.77 MPa causing death of nonmycorrhizal seedlings, a difference of 0.45 MPa. As soils dried, the soil water potential that caused first deaths of nonmycorrhizal seedlings was about −2.5 MPa, compared with a dryness value of −2.8 MPa causing the first deaths of mycorrhizal seedlings (Fig. 3). Further, no nonmycorrhizal seedlings survived in soils

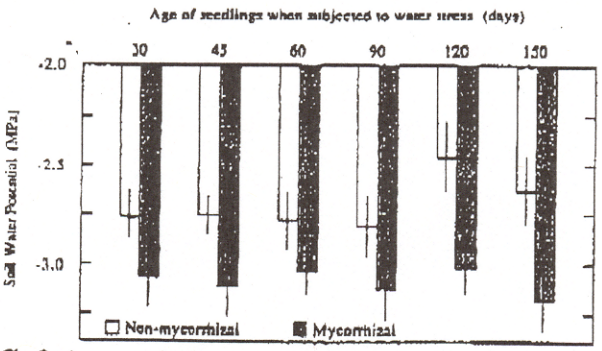

Fig. 2. Average soil water potentials resulting in death of mycorrhizal and nonmycorrhizal sagebrush seedlings.

Table 2. Amount of mycorrhizae on different aged seedlings.

Treatment	30 d	45 d	60 d	90 d	120 d	150 d
Nonmycorrhizal	2 ± 3†	1 ± 1	1 ± 2	1 ± 2	1 ± 1	1 ± 1
Mycorrhizal	86 ± 8	69 ± 17	77 ± 14	74 ± 12	70 ± 11	68 ± 20

† Values indicate percentage of observed 1-mm root segments inhabited by arbuscular mycorrhizal fungi ± standard deviation. Differences in mycorrhizae formation in the two treatments were statistically significant at the $P < 0.001$ for each age group.

with water potential values less than −3.3 MPa , whereas some mycorrhizal seedlings survived in soil as dry as −3.7 MPa (Fig. 3).

Analysis of variance indicated that seedling age, regardless of mycorrhizal treatment, also significantly affected water stress tolerance in sagebrush (Table 3). Additionally, ANOVA showed that the influence of mycorrhizae on soil moisture stress tolerance in sagebrush was disparate for different aged seedlings; that is, there was a significant interaction of plant age and mycorrhizal status on moisture stress tolerance ($P < 0.024$, Table 3).

Experimental data suggested that as sagebrush seedlings age, the beneficial influence of arbuscular mycorrhizae on soil moisture stress tolerance by sagebrush increases (Fig. 2). The data showed clearly that 120- and 150-d-old nonmycorrhizal seedlings are much less tolerant of soil moisture stress than younger nonmycorrhizal seedlings and that the disparity between mycorrhizal and nonmycorrhizal seedlings is greater for 120- and 150-d-old seedlings than for younger plants. On average, for seedlings 90 d old or younger, soil moisture levels resulting in death of mycorrhizal plants were about 12% drier than those causing death of nonmycorrhizal plants. For 120- and 150-d-old seedlings, soil moisture levels at the time of death of mycorrhizal plants were about 24% drier than those causing death of nonmycorrhizal plants This indicates that sagebrush seedlings become more dependent on the benefits of mycorrhizae as they age.

Research on the effects of arbuscular mycorrhizae on the water relations of a number of different plant species show generally improved water relations and greater drought resistance of mycorrhizal compared with nonmycorrhizal plants (Safir et al., 1971; Allen et al., 1981; Hetrick et al., 1987; Kothari et al., 1990; Bethlenfalvay, 1992). Researchers have observed a number of beneficial changes in the water relations of arbuscular mycorrhizal plants including altered rates of water uptake, hydraulic conductivity, leaf and stem water potentials, stomatal resistances, and transpiration rates. Several mechanisms have been proposed to explain the observed effects of mycorrhizae on host plant water relations. One explanation is that changes in host plant water relations are simply a secondary response due to improved nutrition, especially P uptake, provided by the arbuscular mycorrhizal fungus. Improved P nutrition due to mycorrhizal infection may have a direct effect on membrane resistance to water flow, probably the greatest limiting factor to water movement in plants (Nobel, 1974; Nelsen, 1987). Other explanations include: (i) external fungal hyphae may increase the total surface area of the host root system and increase the volume of soil exploited for water, in effect making more water available to the host plant; (ii) hyphae penetrating the root cortex to the endodermis may provide a low resistance pathway for water movement throught the root; and (iii) fungae may alter of root and shoot hormone levels that affect host plant water relations (Allen, 1982; Gogala, 1991; Murakami-Mizukami et al., 1991). For a number of reasons, George et al. (1992) concluded that water transport throught the hyphae is probably not the major cause of the greater rate of water uptake per unit root length of arbuscular mycorrhizal plants.

Improved ability to obtain water from soil and increased drought tolerance in Wyoming big sagebrush seedlings may have critical consequences in reestablishment of this important shrub on disturbed lands such as surface mine reclamation sites. This is especially important considering the arid and semiarid habitat in which this species occurs and is being planted. A number of studies have demonstrated that increasing the amount of soil moisture available to big sagebrush seedlings increases their survival and establishment (Young et al., 1990; Jones, 1991; Cockrell et al., 1995). One reason for this response is that sagebrush seedlings, compared with herbaceous species, appear to be poor competitors for water (Blaisdell, 1949; Sturges, 1977). Cockrell et al. (1995) showed that big sagebrush establishment was significantly reduced by the inclusion of herbaceous species in the seed mixture on surface mine reclamation sites.

Our data also showed that sagebrush seedling survival across a wide range of soil water potentials is greater for mycorrhizal than for nonmycorrhizal plants (Fig. 3). This may be critically important during early stages of seedling establishment when sagebrush root development is quite limited. Cockrell et al. (1995) reported finding significantly fewer sagebrush seedlings on plots treated with >5-yr-old stockpiled topsoil compared with plots treated with stripped and directly placed topsoil. The stockpiled topsoil used in their study had significantly lower numbers of arbuscular mycorrhizal fungal spores than did the fresh topsoil. Examination of root

Table 3. Summary of analysis of variance results.

Source	Sum of squares	df	Mean square	F-ratio	P
Mycorrhizal treatment	978.580	1	978.580	132.130	0.000
Seedling age	265.959	5	53.192	7.182	0.000
Mycorrhizae × age	98.092	5	19.618	2.649	0.024
Error	1421.988	192	7.406		

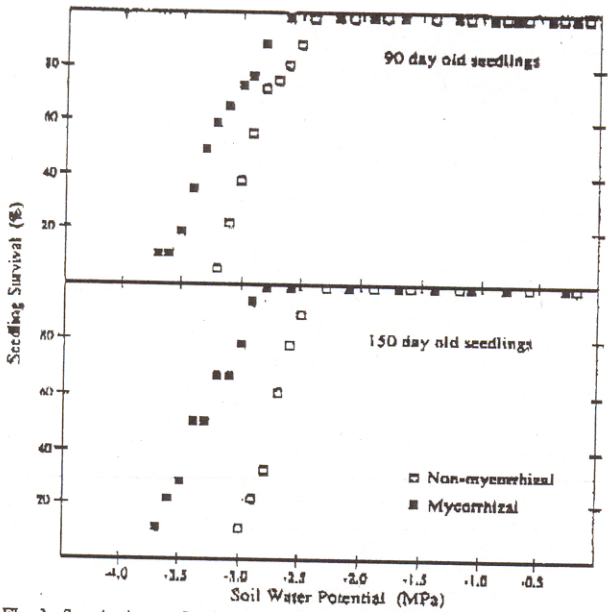

Fig. 3. Survival rates for 150- and 90-d-old mycorrhizal and nonmycorrhizal seedlings at different levels of soil dryness.

systems at the end of the first growing season, however, showed that surviving seedlings in both treatments had similar levels of mycorrhizal roots. The researchers hypothesized that the majority of seedlings germinating in stockpiled topsoil failed to develop mycorrhizae and did not survive; only those seedlings that did establish a mycorrhizal root system lived through the first growing season. The observation of similar levels of mycorrhizae on all surviving sagebrush seedlings led to this investigation to further assess the role of mycorrhizae in drought stress tolerance of big sagebrush.

Another environmental factor that makes moisture stress tolerance critical to sagebrush reestablishment is the degraded edaphic conditions often encountered on reclamation sites. Reconstructed soils on these sites usually have reduced infiltration rates and less water-holding capacity than undisturbed soils (Pederson et al., 1978; Smith and Sobek, 1979). This implies that sagebrush seedlings establishing on revegetation sites may have to survive greater moisture stress than those on undisturbed sites.

Results of this and other studies lead us to conclude that mycorrhizal big sagebrush seedlings are generally more vigorous, stress tolerant, and competitive than nonmycorrhizal seedlings. This may be a critical advantage in reestablishment of this species on disturbed lands. We recommend that sagebrush revegetation efforts include a strategy to ensure an opportunity for formation of the mutually beneficial mycorrhizal symbiosis. This can be accomplished by planting sagebrush seed in freshly placed (as opposed to stockpiled) topsoil containing sufficient levels of viable propagules of effective mycorrhizal fungi.

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4756 W. HWY 260, CONNELL, WA 99326 (509) 234-4433

AMS 3288

LOT#: 17939

4374 AC. HIGH ELEVATION MIX

	PURE SD	GERM	TST DTE	ORIG
BLUEBUNCH WHEATGRASS	56.43%	91.00%TZ	9/02	WA
NATIVE SANDBERG BLUEGRASS	33.13%	87.63%TZ	9/02	WA
BOTTLEBRUSH SQUIRRELTAIL	6.29%	84.33%TZ	8/02	WA
WHITE YARROW	.57%	89.50%TZ	10/02	WA

CROP 0.02%
INERT 3.46%
WEED 0.10%
NOXIOUS: NONE

NET WT: 50 LBS

16.7# PLS = 19.39# BULK

L&H SEEDS, INC.

4756 W. HWY 260, CONNELL, WA 99326 (509) 234-4433

AMS 3288

LOT#: 17930

LOW ELEVATION MIX

	PURE SD	GERM	TST DTE	ORIG
SCHWENDIMAR THICKSPIKE WTGR.	31.18%	92.31%	8/02TZ	WA
NEZPAR INDIAN RICEGRASS	30.40%	93.61%	9/02TZ	WA
SANDBERG BLUEGRASS	27.67%	86%	10/02TZ	WA
BOTTLEBRUSH SQUIRRELTAIL	5.77%	84.58%	7/02TZ	WA
NEEDLE & THREAD GRASS	1.42%	84.77%	9/02TZ	WA
YARROW	.57%	84%	10/02TZ	WA

CROP 0.06%
INERT 2.76%
WEED 0.17%
NO NOXIOUS

NET WT: 50 LBS

18.35# PLS = 21.01# BULK

EBCO Printing & Graphics (925) 743-8976

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4756 W. HWY 260, CONNELL, WA 99326 (509) 234-4433

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LOT#: 17949

SAGEBRUSH / RABBITBRUSH MIX	PURE SD	GERM	TST DTE	ORIG
WYOMING BIG SAGEBRUSH	4.51%	78.5%	9/02TZ	WA
GREEN RABBITBRUSH	.75%	69%	10/02TZ	WA
GREY RABBITBRUSH	.39%	84%	11/02TZ	WA
CORN GRIT	57.03%			

CROP 0.00%

INERT 37.32%

WEED 0.00%

NOXIOUS: NONE

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AMS 3288

LOT#: 17937

MIX #7 HELLS CANYON DRILL MIX	PURE SD	GERM	TST DTE	ORIG
NATIVE HELLS CANYON BLUEBUNCH	70.57%	87.39%TZ	9/02	WA
NATIVE SANDBERG BLUEGRASS	14.34%	86.00%TZ	10/02	WA
SANDHOLLOW BOTTLEBRUSH SQUIREL	7.17%	86.00%TZ	8/02	WA
YARROW, VNS	.73%	84.00%TZ	10/02	WA

CROP 0.81%
INERT 6.24%
WEED 0.14%
NOXIOUS: NONE

NET WT: 50 LBS
13.1# PLS = 16.2# BULK

L&H SEEDS, INC. 4756 W. HWY 260, CONNELL, WA 99326 (509) 234-4433

AMS 3288

LOT#: 17934

MIX #5 P7 DRILL MIX	PURE SD	GERM	TST DTE	ORIG
P7 BLUEBUNCH WHEATGRASS	72.96%	84%TZ	08/02	WA
NATIVE SANDBERG BLUEGRASS	14.26%	86%TZ	10/02	WA
SANDHOLLOW BOTTLEBRUSH SQUIREL	7.12%	86%TZ	08/02	WA
YARROW, VNS	.73%	84%TZ	10/02	WA

CROP 0.00%
INERT 4.89%
WEED 0.04%
NOXIOUS: NONE

NET WT: 50 LBS
13.1# PLS = 15.3# BULK

EBCO Printing & Graphics (925) 743-8976

ANATONE BLUEBUNCH WHEATGRASS	73.31%	87%TZ	07/02	WA
SANDHOLLOW BOTTLEBRUSH SQUIREL	7.42%	86%TZ	08/02	WA
YARROW, VNS	.76%	84%TZ	10/02	WA

CROP 0.00%
INERT 3.63%
WEED 0.05%
NO NOXIOUS

NET WT: 50 LBS
13.1# PLS = 15.67# BULK

L&H SEEDS, INC.

4756 W. HWY 260, CONNELL, WA 99326 (509) 234-4433

AMS 3288

LOT#: 17933
MIX #4 SECAR DRILL MIX

	PURE SD	GERM	TST DTE	ORIG
SECAR BLUEBUNCH WHEATGRASS	72.72%	92%	10/02	WA
NATIVE SANDBERG BLUEGRASS	15.56%	86%TZ	10/02	WA
SANDHOLLOW BOTTLEBRUSH SQUIREL	7.78%	86%TZ	08/02	WA
YARROW, VNS	.80%	84%TZ	10/02	WA

CROP: 0.04%
INERT: 3.02%
WEED: 0.08%

NET WT: 50 LBS
NO NOXIOUS
13.1# PLS = 14.94# BULK

EBCO Printing & Graphics (925) 743-8976

L&H SEEDS, INC. 4756 W. HWY 260, CONNELL, WA 99326 (509) 234-4433

AMS 3288

LOT#: 17936

MIX #6 ANATONE DRILL MIX	PURE SD	GERM	TST DTE	ORIG
ANATONE BLUEBUNCH WHEATGRASS	73.31%	87%TZ	07/02	WA
NATIVE SANDBERG BLUEGRASS	14.83%	86%TZ	10/02	WA
SANDHOLLOW BOTTLEBRUSH SQUIREL	7.42%	86%TZ	08/02	WA
YARROW, VNS	.76%	84%TZ	10/02	WA

CROP 0.00%
INERT 3.63%
WEED 0.05%
NO NOXIOUS

NET WT: 50 LBS
13.1# PLS = 15.67# BULK

L&H SEEDS, INC. 4756 W. HWY 260, CONNELL, WA 99326 (509) 234-4433

AMS 3288

LOT#: 17933

MIX #4 SECAR DRILL MIX	PURE SD	GERM	TST DTE	ORIG
SECAR BLUEBUNCH WHEATGRASS	72.72%	92%	10/02	WA
NATIVE SANDBERG BLUEGRASS	15.56%	86%TZ	10/02	WA
SANDHOLLOW BOTTLEBRUSH SQUIREL	7.78%	86%TZ	08/02	WA
YARROW, VNS	.80%	84%TZ	10/02	WA

CROP: 0.04%
INERT: 3.02%
WEED: 0.08%

NET WT: 50 LBS
NO NOXIOUS 13.1# PLS = 14.94# BULK

EBCO Printing & Graphics (925) 743-8976

Fall 2[illegible]echtel Seed Mix
List of Components, Test Information and Weights

Revised [illegible]

Variety	Lot #	Bulk #	Purity	Germ	PLS #	Current Test	Noxious Test
SECAR	099-100-212A	30644.00	0.9562	0.9000	26371.61	09/03/2002	11/07/2002
ANATONE	LHS1-D2-44-3-B	584.10	0.9514	0.9200	511.26	07/24/2002	10/31/2002
ANATONE	LHS1-D2-44-3-1	2630.00	0.9758	0.8700	2232.73	07/24/2002	10/31/2002
P-7	LHS1-G2-43-3-B	507.00	0.9587	0.8400	408.29	08/23/2002	10/31/2002
P-7	LHS1-G2-43-3	6998.40	0.9536	0.9300	6206.52	08/14/2002	10/31/2002
P-7	N2C0-P71-1	10999.60	0.9766	0.9300	9990.25	10/15/2002	10/31/2002
HELLS CANYON	LHS1-A12-31-3	937.00	0.9434	0.8800	777.89	08/14/2002	10/31/2002
HELLS CANYON	LHS1-F31-31-3-B	391.00	0.9281	0.8200	297.57	08/14/2002	10/31/2002
HELLS CANYON	LHS1-F31-31-3	1194.00	0.9101	0.8600	934.53	08/14/2002	11/01/2002
HELLS CANYON	H711HC0	477.00	0.9540	0.8900	405.00	10/29/2002	11/01/2002
HELLS CANYON	LHS1-A12-31-2	348.00	0.8912	0.9200	285.33	10/25/2002	11/05/2002
SECAR	N2LH-SEC2-2	4776.10	0.9839	0.9200	4323.27	09/20/2002	10/31/2002
					0.00		
					0.00		
					0.00		
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TOTAL NEEDED FOR MIXES 52,740 PLS LBS.					0.00		
					0.00		
					0.00		
TOTAL LBS.		**60486.20**			**52744.24**		

Washington State Department of Agriculture
Seed Program
21 North 1st Avenue, Suite 203
Yakima, WA 98902

Telephone: (509) 225-2630
Facsimile: (509) 454-4395
E-mail: seed@agr.wa.gov

Laboratory Report of Analysis

Account No.	Date Received	Date Completed	Lab Number
1799	08/08/02	09/03/02	2-931

Sender's Information*

Product/Variety	Secar
Kind	Wheatgrass, bluebunch
Genus/Species	Pseudoroegneria spicata
Lot Number	099-100-212A
Class	Certified

*The information provided here is that of the sender and not of the laboratory.

Purity Analysis

Pure Seed Components

In 8.06 grams.

		Purity
Wheatgrass, bluebunch	*Pseudoroegneria spicata*	95.62%

Purity Grams Required	8	Weed Seed	0.12%
Noxious Grams Required	80	Crop Seed	0.00%
Grams Submitted	339	Inert Matter	4.26%

Viability Analysis

Germ Date	Germination %	Dormant %	Hard %
09/03/02	88	-N-	-N-

r Crop Seeds None Found

Noxious Weed Seeds: None Found
States: WA
In 80.36 Grams.
(P)Prohibited Noxious in WA (R)Restricted Noxious in WA

Weed Seeds:
Downy brome *Bromus tectorum* 225 Per lb

Other Determinations
Wheatgrass, bluebunch TZ test 90 %
Inert matter: Empty florets, leaves, stems, chaff

Status: Passed. - Meets viability standards for the certified class. Meets purity standards for the certified class.

Additional Sender's Information*
65-WG-12
Bill To: (414)Rainier Seed Company

Remarks
Analyzed using AOSA rules as a guideline.
TZ completed on August 15 2002.

Tests Requested Germination, Purity, TZ test. No other tests requested.
Services Requested Rush. Fax results.

Signature: Nancy Hartshorn

Washington State Department of Agriculture
Seed Program
21 North 1st Avenue, Suite 203
Yakima, WA 98902

Telephone: (509) 225-2630
Facsimile: (509) 454-4395
E-mail: seed@agr.wa.gov

Laboratory Report of Analysis

Account No.	Date Received	Date Completed	Lab Number
1311	10/29/02	11/07/02	2-3587

L & H Seeds, Inc.
4756 West Highway 260
Connell WA 99326

Sender's Information*

Product/Variety	Secar
Kind	Wheatgrass, Snake River
Genus/Species	Elymus wawawaiensis
Lot Number	099-100-212A
Class	Official 30644 lbs Bulk

*The information provided here is that of the sender and not of the laboratory.

		Viability Analysis			
		Germ Date	Germination %	Dormant %	Hard %
Wheatgrass, bluebunch	*Pseudoroegneria spicata*	-N-	-N-	-N-	-N-

Noxious Weed Seeds:
States: WA
In 50.90 Grams.
None found
(P)Prohibited Noxious in WA (R)Restricted Noxious in WA

Status: None.

Remarks
Analyzed using AOSA rules as a guideline.
Officially sampled by T. Meacham

Tests Requested Noxious exam. No other tests requested.
Services Requested Rush.

Signature: Nancy Hartshorn

11/6/02

Variety	Lot #	Bulk #	Purity	Germ	PLS #	Current Test	Noxious Test
NEEDLE & THREAD GRASS	STC0-1	740.50	0.9953	0.8400	619.10	09/12/2002	11/04/2002
NEEDLE & THREAD GRASS	STC0-3	61.30	0.9851	0.8500	51.33	05/23/2002	11/05/2002
NEEDLE & THREAD GRASS	001-1601-R	1029.20	0.9275	0.8600	820.94	11/14/2002	11/07/2002
NEEDLE & THREAD GRASS	H1054NT0	27.10	0.9286	0.8400	21.14	10/19/2002	11/08/2002
NEEDLE & THREAD GRASS	LHS1-F42-32-3-1	21.20	0.9218	0.8200	16.02	10/07/2002	11/08/2002
NEEDLE & THREAD GRASS	LHS1-F42-32-2	32.90	0.8394	0.8100	22.37	10/04/2002	11/06/2002
NEEDLE & THREAD GRASS	LHS1-F42-32-2-1	19.20	0.7852	0.8500	12.81	10/08/2002	11/06/2002
NEEDLE & THREAD GRASS	LHS1-F42-32-3	135.80	0.9655	0.8300	108.83	10/08/2002	11/07/2002
					0.00		
					0.00		
					0.00		
					0.00		
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					0.00		
TOTAL NEEDED FOR MIXES 1672.5 PLS LBS.					0.00		
1512.5 PLS LBS. AND 160 PLS LBS.(HANFORD)					0.00		
					0.00		
					0.00		
TOTAL LBS.		**2067.20**			**1672.54**		

Evergreen Seed Lab

Phone (503) 647-5151 P.O. Box 1960 North Plains OR. 97133 Fax (503) 647-5111

Report of Seed Analysis FINAL

DATE RECEIVED	DATE COMPLETED	TEST NO.
09/09/02	09/12/02	21665

L & H SEEDS
4756 W. HIGHWAY 260
CONNELL, WA 99326

Attn:
cc:

SENDERS INFORMATION*

KIND: Needle & Threadgrass
VARIETY: Not stated
GENUS/SPECIES: Not stated
LOT NUMBER: STCO-1
SIZE OF LOT: Not stated
SAMPLE TYPE: Submitted sample
GROWER: Not stated
OTHER INFORMATION:

* The information provided here is that of the sender and not of the laboratory

PURITY ANALYSIS (15.00 GRAMS ANALYZED)

PURE SEED COMPONENT(S)

Needle & Threadgrass (Hesperostipa comata)	99.53%
OTHER CROP SEED	0.20%
INERT MATTER	0.27%
WEED SEED	0.00%

OTHER CROP SEED

	# Per lb.
Slender Wheatgrass	272
Crested Wheatgrass	60

INERT MATTER:
Broken seed, awns, ergot, sterile florets

WEED SEED: # Per lb.
None found

VIABILITY ANALYSIS

GERM-INATION %	HARD SEED %	TOTAL VIABLE %	NO SEEDS (GERM)	DAYS TESTED	TZ %	FLUOR-ESCENT %	DORMANT %
xx	xx	xx	200	xx	84	xx	xx

COMMENTS:

ALL STATES NOX WEED SEEDS 150.00 GMS ANALYZED: # Per lb.
(EXCEPT HAWAII AND UNDESIREABLE GRASS SEEDS)
None found

OTHER DETERMINATIONS:
Not conducted

DATE ISSUED 9/12/2002

TEST CODES AND FEES:

RULES FOLLOWED OTHER THAN AOSA: _____

SIGNATURE _____
REGISTERED SEED TECHNOLOGIST- SEAL NO. 112

The purity and germination test results reported on this form have been carried out in accordance with AOSA rules unless otherwise specified. Test results reflect condition of the submitted sample and may not reflect the condition of the seed lot from which the sample was taken.

9/16/02

Washington State Department of Agriculture
Seed Program
21 North 1st Avenue, Suite 203
Yakima, WA 98902

Telephone: (509) 225-2630
Facsimile: (509) 454-4395
E-mail: seed@agr.wa.gov

Laboratory Report of Analysis

Account No.	Date Received	Date Completed	Lab Number
1311	10/29/02	11/04/02	2-3579

L & H Seeds, Inc.
4756 West Highway 260
Connell WA 99326

Sender's Information*

Product/Variety	VNS
Kind	Needle & Thread
Genus/Species	Hesperositipa comata
Lot Number	STCO-1
Class	Official 742.75 lbs Bulk

*The information provided here is that of the sender and not of the laboratory.

		Viability Analysis			
		Germ Date	Germination %	Dormant %	Hard %
Needle & Thread	*Hesperositipa comata*	-N-	-N-	-N-	-N-

Noxious Weed Seeds:
States: WA
In 150.2 Grams.
None found
(P)Prohibited Noxious in WA (R)Restricted Noxious in WA

Status: None.

Remarks
Analyzed using AOSA rules as a guideline.
Officially sampled by T. Meacham

Tests Requested: Noxious exam. No other tests requested.

Signature: Nancy Harkhorn

 Printed: 11-04-02 13:56:36

11/6/02

AERO TECH, INC.

AERIAL APPLICATION REPORT

5333 East 21st Street
Clovis, New Mexico 88101
(505) 763-4300

Customer US FISH & WILDLIFE SERVICE Unit

Forester DAVE SMITH Airport RICHLAND

County/Parish State WASHINGTON

Pilot RON SMITH Aircraft N 9197F

DATE	TRACT	LOAD #	TIME OUT	TIME IN	PRODUCT	PPA	POUNDS	ACRES
12/17	MID ELEVATION	1	10:54	11:07	SEED	20	2000	100
12/17	"	2	11:10	11:24	"	20	2000	100
12/17	"	3	11:27	11:41	"	20	2000	100
12/17	"	4	11:44	12:00	"	20	2000	100
12/17	"	5	12:03	12:41	"	20	2000	100
12/17	"	6	12:45	1:00	"	20	2000	100
12/17	"	7	1:03	1:17	"	20	2000	100
12/17	"	8	1:20	1:36	"	20	2000	100
12/17	"	9	1:38	1:53	"	20	2000	100
12/17	"	10	1:56	2:09	"	20	2000	100
12/17	"	11	2:13	2:29	"	21	2100	100
12/17	"	12	2:31	3:08	"	21	2100	100
12/17	"	13	3:14	3:28	"	21	2100	100
12/17	"	14	3:37	3:51	"	21	2100	100
12/17	"	15	3:54	4:07	"	21	2100	100
12/19	"	16	8:42	8:57	"	21	2100	100
12/19	"	17	9:08	9:23	"	21	2100	100
12/19	"	18	9:27	9:43	"	21	2100	100
12/19	"	19	9:49	10:05	"	21	2100	100
12/19	"	20	10:08	11:00	"	21	2100	100
12/19	"	21	11:04	11:18	"	21	2100	100
12/19	"	22	11:21	11:36	"	21	2100	100
12/19	"	23	11:39	11:55	"	21	2100	100

	TOTAL POUNDS	TOTAL ACRES
~~UREA~~	NEXT PAGE	NEXT PAGE
~~DAP~~		
~~BLEND~~		

Aero Tech _____ Forestry Company _____

GROUND SUPERVISOR FIELD REPRESENTATIVE

AERO TECH, INC.
AERIAL APPLICATION REPORT

5333 East 21st Street
Clovis, New Mexico 88101
(505) 763-4300

Customer US FISH + WILDLIFE SERVICE Unit

Forester DAVE SMITH Airport RICHLAND

County/Parish State WASHINGTON

Pilot RON SMITH Aircraft N 9197F

DATE	TRACT	LOAD #	TIME OUT	TIME IN	PRODUCT	PPA	POUNDS	ACRES
12/19	MID ELEVATION	24	11:59	12:12	SEED	21	2100	100
12/19	"	25	12:15	12:30	"	21	2100	100
01/03	"	26	2:06	2:20	"	21	2100	100
01/03	"	27	2:22	2:35	"	21	2100	100
01/03	"	28	2:37	2:48	"	21	700	33

	TOTAL POUNDS	TOTAL ACRES
~~UREA~~	56,400	2733
~~DAP~~		
~~BLEND~~		

Aero Tech Steven D May Forestry Company

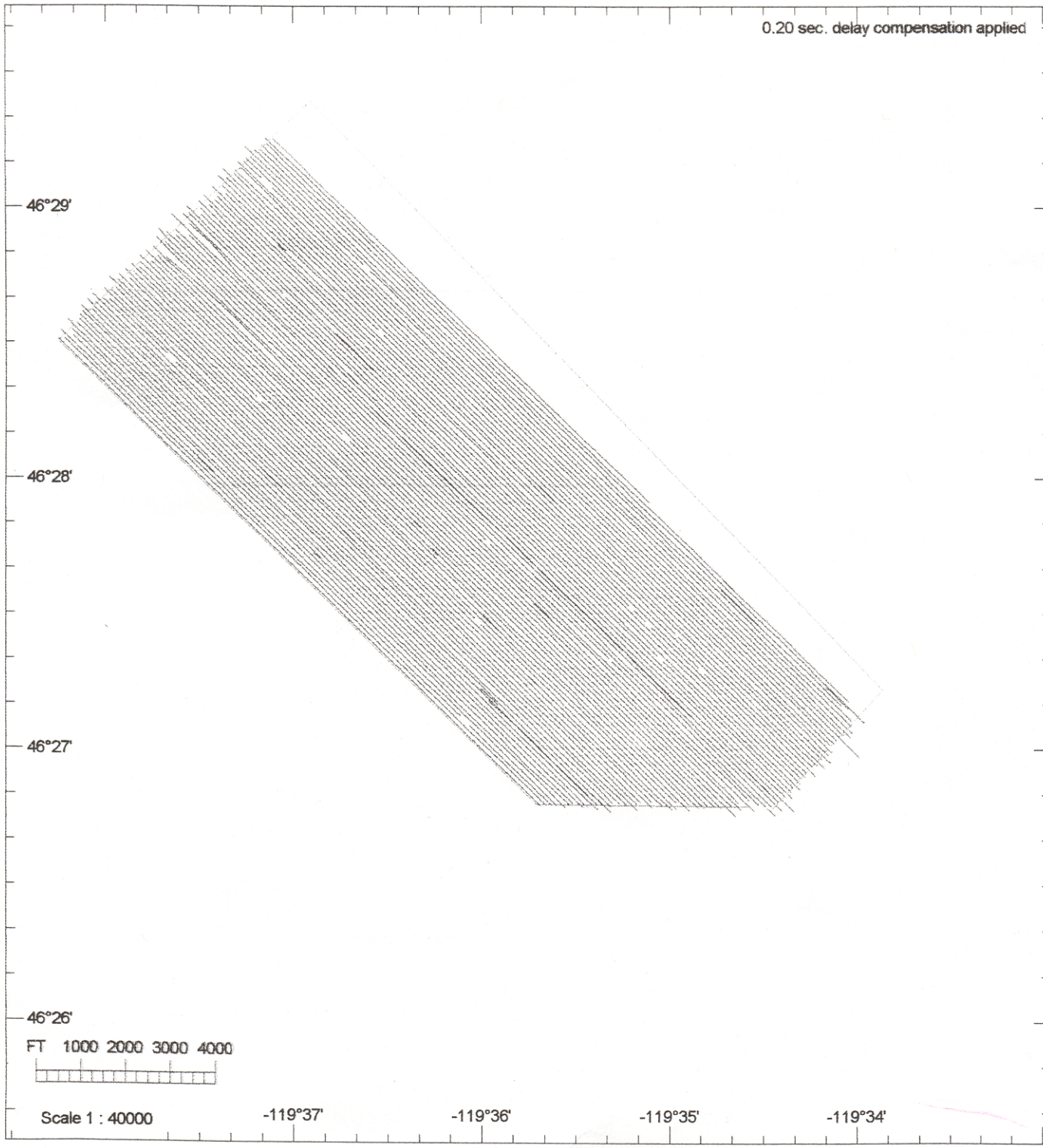
GROUND SUPERVISOR FIELD REPRESENTATIVE

SATLOC
MapStar 1.7

U S Fish and Wildlife Service

Mid Elevation Block 2733 Acres

12-17-2002 10:55:02 Field: ----------
PMap: <NONE> Chan 1:
Logs: 12171052, 01031408, 12190844



Hanford's Arid Lands Ecology Reserve begins to recover from last year's fires

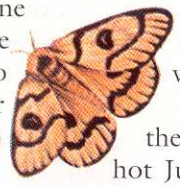
The vast open spaces of the Columbia River drainage have long resonated with both the lure of great adventure and seemingly insignificant sidelights. In the late winter of 1834, attracted by both the large and the small elements of this equation, 48-year-old English naturalist Thomas Nuttall resigned from his Harvard teaching post to fulfill a lifelong dream of collecting flora and fauna west of the Continental Divide.

Nuttall accompanied a load of fur trade goods whose drovers crossed the Rockies via the South Pass route, then pushed northwest into some pristine shrub-steppe habitat along the Snake River. There, the furmen spent late July and early August building the trading post that came to be known as Fort Hall, Idaho.

All along the route, and with single-minded purpose during those stationary days beside the Snake, Nuttall pursued his dream—collecting rocks, petrified wood, mollusks, plants, mammals, and birds at a furious pace. As part of his effort, the naturalist plucked two species of unknown moths from the steppe, then somehow managed to preserve them during a rugged canoe trip down the Columbia River and a stormy sailing voyage around Cape Horn.

Upon landing in Boston, Nuttall was approached by John James Audubon, recently returned from a successful sales trip to England and desperate for information about western birds so he could complete his massive *Birds of America*. "Mr. Nuttall generously gave me of his ornithological treasures all that was new," Audubon later wrote, but it was more than that: the collector provided the painter with bird's nests, specimens of western plants, and western butterflies and moths for use in his backgrounds.

Audubon used this infusion of material to paint more than seventy new figures for his opus. Among them is a plate that depicts a Say's phoebe and a Western kingbird, two classic birds of the Great Basin. Two phoebes are perched on one branch of a bedraggled, almost leafless plant specimen, with their bills pointed straight up; one has snaked its neck back to worry an airborne fly. On a forked branch below this group, two kingbirds and a scissor-tailed flycatcher ponder a pair of flattened moths that seem pinned to the paper between them.



The patterns of these two moths are almost identical—each forewing is framed with a pair of horizontal Ss, and the rear fringe of both fore and hind wings is marked with a succession of neat vertical lines. The heads of the moths sprout orange hairs, while their abdomens are graced with dark and light bands. Audubon painted the wings of one of the moths a creamy white, and dabbed the other with the pink and yellow that he had used on his birds. They are Thomas Nuttall's two Fort Hall moths, appearing in public and the scientific eye for the very first time.

In that plate, Audubon represented two moths of the Hemileuca genus that we now call sagebrush sheepmoth and Nuttall's sheepmoth. They belong to the family of Giant Silkmoths, cousins to such night-flying, damp forest-dwelling species as the Luna and Polyphemus moths. Unlike their kin, however, these Hemileuca fly during the day and inhabit the arid country of the American West—the sagebrush sheepmoth feeds on big sagebrush, the Nuttall's on antelope bitterbrush. In the hundred and seventy years since Nuttall picked his two specimens off their food plants, each has assumed a role as a sensitive monitor of healthy shrub-steppe habitat.

In the hundred and seventy years since Nuttall picked his two specimens off their food plants, each has assumed a role as a sensitive monitor of healthy shrub-steppe habitat.

Larvae of the more common sagebrush sheepmoth, *Hemileuca hera*, emerge from their eggs in early spring as velvety black caterpillars decorated with yellow lines and rows of spiny tubercles. They ascend their sagebrush to a conspicuous sunny perch, gather in communal clumps, and proceed to gnaw voraciously through several stages of metamorphosis. Around the end of May, the fattened caterpillars descend the shrubs to pupate underground. They remain dormant through an entire annual cycle, or even two, before emerging again in late summer for a final brief fling as non-feeding, fast-flying adults.

In Eastern Washington, August is the time to look for flying sheepmoths, and large stretches of carefully preserved shrub-steppe such as the Arid Lands Ecology (ALE) Reserve are usually the place. But sometimes a small occurrence like the flight of a few moths can be overwhelmed by a more dramatic event.

Last summer, there was a big wildfire on the ALE Reserve. The conflagration began on a hot June day with an explosive auto-truck crash that soon engulfed lush native shrub-steppe across the west side of the Pasco Basin and up into the Rattlesnake Hills. Recently cured cheatgrass helped the fire burn unusually hot, and swirling winds drove the flames at such a furious pace that for a while it threatened some of the core facilities

THE FLAMES MUST HAVE ROASTED MANY OF THE SHEEPMOTHS' BLACK PUPAE SHELLS IN AN INSTANT . . . IT SEEMED LIKE A LONG CHANCE THAT ANY OF THEM WOULD BE ABLE TO CONTINUE A VIABLE LIFE CYCLE.

on Central Hanford itself. When it was finally over, the local press ran so many stark photos and apocalyptic quotes that it was left to Bill Rickard, one of the driving forces behind the creation of the reserve, to offer some kind of bracing perspective. "I've been here for 40 years," Rickard offered. "And that's the fourth time I've seen those hills black."

For an observer with a somewhat narrower perspective, it is hard to come up with an equally soothing line. In June, sheepmoths that lived on the reserve were supposed to be tucked close to the trunks of aged sagebrush plants, pupating just beneath the surface of the earth. When I visited the place in late August, I walked through acres of fine dust without seeing even the skeleton of single sagebrush. The flames must have roasted many of the sheepmoths' black pupae shells in an instant. Any that managed to survive would have emerged to a moonscape that contained little cover of any description, and it seemed like a long chance that any of them would be able to rise up and locate enough of their essential shrub to continue a viable life cycle.

A female sheepmoth, Hemileuca hera, *had emerged from her pupa and ascended to the very top sprig of this bush to find her proper spot.*

For half a mile or more in from the highway, the only cover I saw came in clumps of man-dropped landscape features. Sagebrush lizards skittered into a pile of steel fenceposts. The upright pickets of a ruined study plot provided perches for a Say's phoebe. Thumb-sized scorpions poised brazenly beneath a stray refrigerator, looking as though they had passed through the fires of hell not once but many times.

I DON'T THINK I'D BET AGAINST THE ABILITY OF SAGEBRUSH SHEEPMOTHS TO CONTINUE UNREELING THEIR SINGLE GOLDEN THREAD, PULSE BY PULSE, AND WEAVE IT INTO THE WHOLE.

Then the valley floor warped upward to approach a low ridge that supported an ancient jeep track and a line of wireless fenceposts. These together had provided enough of a fire break to protect small patches of greenery. From a few lonely examples of sagebrush, scattered oases coalesced into an untouched island that covered several acres, complete with the familiar oily tang of the late hot season. The green belt rode the high ground and curled down toward a long-established spring whose natural outflow was lined with peachtree willows. From their branches came the scolds of some raspy Western kingbirds.

A white shape the size of a child's hand appeared near the top of a shoulder-high sage. The bush grew at the edge of the jeep track, and its branches hung out over the completely charred landscape of the fire. I thought at first the shape might represent the pinned meal of some opportunistic shrike, but soon realized that it was instead a living insect. A female sagebrush sheepmoth, *Hemileuca hera,* had emerged from her pupa and ascended to the very top sprig of this bush to find her proper spot. No matter how close a human face approached her, she was not about to move.

The body of the moth resembled a fecund bumblebee, and the female slowly pulsed and curled her abdomen—seven golden segments separated by seven jet black bands—like a bee intent on stinging. Her shoulders were wrapped in a luxurious stole of foxy sorrel that was really separate furry scales. All the rich tones climaxed in a reddish gold that topped her pate and swept to the tip ends of her antennae. Short combs grew quite visibly off each antennae segment, and a few on the outside of the left one looked bent or damaged. The moth seemed fragile and, on such an exposed perch, extremely vulnerable.

The sheepmoths in John Audubon's watercolor painting showed the same swollen abdomen and short-combed antennae as this female by the fence. Her appearance here allowed me to understand how Thomas Nuttall could easily have picked up a perfect moth or two in the sagebrush country of the upper Snake River. Perhaps in his time he saw clouds of white and melon-colored males roving across the steppe in search of mates; perhaps female Hemileuca of both the hera and nuttallii species littered their respective bush tops, and he could have picked up as many as he wanted. But none of them could have been any more resilient than this female in the midst of the scorched Arid Lands Ecology Reserve.

As I walked the ridge, dodging a few male sheepmoths flying their zig-zag patterns in search of waiting females, it became obvious that the Hemileuca weren't the only living things to survive the fire. Magpies dogged my tracks, and each swale hid bunches of meadowlarks and mourning doves. Late-summer asters bloomed all around. Nuttall's cottontails stood quietly in open spaces, not stirring until I was well past. I kept stepping in other footprints, especially the wide-cloved hooves of elk.

The tapestry of flora and fauna that spread over the reserve had been torn and crumpled by the summer fire, then tossed by chance onto this small rise. As over time the fabric stretched itself back out, its makeup would certainly be altered; some elements would play a greater role, while others might disappear entirely. It would take many years for this unfurling to take place, and the results were impossible to predict. But I don't think I'd bet against the ability of sagebrush sheepmoths to continue unreeling their single golden thread, pulse by pulse, and weave it into the whole.

Fire damage assessed at the Arid Lands Ecology Reserve

The dramatic wildfire that swept through the new Hanford Reach National Monument in June 2000 left much of the 76,800-acre Arid Lands Ecology (ALE) Reserve charred and blackened. Now, after four months of intensive field work, Conservancy botanists have begun to determine the extent of the damage, its impact on the shrub-steppe vegetation, and some of the steps that will be necessary to begin restoration.

The U.S. Fish and Wildlife Service, which manages the Hanford Reach National Monument, contracted with the Conservancy to monitor the vegetation in the aftermath of the fire. (ALE is wholly contained within the new national monument.) Jim Evans, the Conservancy's shrub-steppe ecologist, his field crew, and several volunteers have revisited more than 60 historic plots and established dozens of new ones to try to assess the fire's impact.

Their work confirmed what many already knew: The fire devastated ALE's sagebrush community, particularly big sage, a critical plant for shrub-steppe-dependent wildlife. "The plant does not resprout after fire. It reproduces only from seed, which means you have to have seed sources. So its disappearance from large portions of this landscape is very serious," Evans said.

But the crew also found that many of the plants associated with sagebrush—bluebunch wheatgrass, for instance—suffered major losses as well. Big sage, because it is large and woody, burned very hot; the intensity of that fire consumed a lot of other plant life, leaving huge voids where invasive plants can now encroach. In other areas, surviving native plants lost tissue and vigor, weakening their ability to reproduce and again creating openings for aggressive invasives, such as the fast-growing cheatgrass.

"There's an overall loss of vigor to the entire ecosystem at low and middle elevations that could facilitate the spread of invasives into areas that were high-quality shrub-steppe and grassland just a few years ago," Evans said.

Greg Hughes, project leader for the Hanford Reach National Monument, said he believes the findings will help him secure funding for a major restoration effort at ALE in the wake of the fire. He plans to have 300,000 seedlings of big sagebrush planted this fall. He hopes to follow up with a 20,000-acre cheatgrass removal next year.

"This monitoring work is going to help us figure out what we need to do and how to do it," Hughes said. "It's hard to see so much of ALE burned. But I'm confident it will have a good recovery."

—Leslie Brown

Jim Evans/The Nature Conservancy /U.S. Fish and Wildlife Service

Planning under way for future of national monument at Hanford

Keith Lazelle

In June 2000, the Hanford Reach made national headlines when the Clinton administration established it as one of the country's newest national monuments. Now, more than a year later, the slow and assiduous work of figuring out how to manage this 195,000-acre expanse of shrub-steppe habitat and free-flowing Columbia River is under way.

The U.S. Fish and Wildlife Service is managing the monument. Though its numbers are small and resources limited, the monument staff has begun the work of creating a comprehensive conservation plan for the Hanford Reach National Monument, a plan that will determine everything from public use to habitat and wildlife management.

The Service's work is being guided by a 13-member advisory committee, comprised of local residents representing economic interests, education, science, conservation groups, irrigators, tribal government, and local and state government. The advisory panel, which will make recommendations, met for the first time in June. Greg Hughes, project leader for the new national monument, said the meeting went well.

"Everyone has a common ideal of how important the reach is. We all know it's a special place. My sense is that everyone there felt that it's time to get on with it and plan a vision for the future," Hughes said, adding that he was speaking for himself and not the committee.

Hughes said he expects the Service will complete its plan in two to three years. The advisory committee will meet again in September and continue to meet as the plan is crafted. Conservationists, tribal groups, local citizens, and others have pushed for protection of the Hanford Reach and its surrounding grasslands for more than 20 years. Hughes urged those who care about the Hanford area to remain involved.

"It's a public process," he said. "Advocacy remains important if we're to get the resources necessary to craft a thorough plan."

—Leslie Brown

◂ ***Some plants, such as longleaf phlox and tansy mustard, are returning. Still, the fire is likely to have long-term effects. Big sagebrush, which dominated this landscape and provided key habitat, was devastated by the fire.***

▲ ***The 195,000-acre Hanford Reach National Monument permanently protects 50 miles of the Columbia River.***

Restoration effort recovers charred Arid Lands Ecology Reserve

When a fire swept through south central Washington's Hanford site three years ago, thousands of acres of some of the state's best remaining shrub-steppe habitat were devastated. Most affected was the Fitzner/ Eberhardt Arid Lands Ecology Reserve, or ALE, a 76,000-acre section of Hanford and, to ecologists, the gem of the newly created Hanford Reach National Monument.

Today, thanks in part to the Conservancy's scientific work and years of data collection by dozens of ecologists, restoration is under way on portions of this scarred landscape. Last November and December, in one of the biggest restoration efforts this state has ever seen, crews working for the U.S. Fish and Wildlife Service planted 700,000 sagebrush seedlings and spread native bunchgrass seeds across 10,000 acres. The Service manages the monument.

"This is a remarkable effort to restore what was one of our state's most vibrant shrub-steppe landscapes," said Jim Evans, the Conservancy's shrub-steppe ecologist. "With so little of Washington's shrub-steppe ecosystem still intact, it is critical to maintain this as a landscape that supports all the plant and animal species that depend on it."

It is an ironic twist of history that Hanford contains some of the most extensive shrub-steppe habitat left in the state. In the 1940s, when plutonium production was under way at what is now known as Central Hanford, the federal government established a reservation with a security buffer of more than 200,000 acres. And in the decades that followed, that land remained largely untouched. ALE was established as an ecological reserve in the 1960s. Until it was charred by the June 2000 fire, it contained the area's largest continuous blocks of native plant communities, including stands dominated by Wyoming big sagebrush.

KEITH LAZELLE

The Conservancy has been working for nearly two decades to safeguard the biological values of the lands surrounding the Hanford Reach.

Fire is nothing new to Eastern Washington. Historically, however, those fires were patchy and not very intense. The incursion of weeds—particularly the highly invasive cheatgrass—has dramatically altered the system's ecology. And today, throughout much of the West, cheatgrass crowds out native plants, promoting frequent, severe, and often extensive wildfires. By the 1990s, cheatgrass incursions and a series of extensive fires had taken a toll on ALE. In the 2000 fire, cheatgrass, high winds, and soaring temperatures combined to burn much of ALE's remaining big sagebrush.

ALE has been extensively studied over the years. So when the Service hired Evans and his crew to monitor the fire's impact, they stepped into the charred landscape armed with reams of data. That data—collected over the years by the Conservancy, the Pacific Northwest National Laboratory, and the volunteer-based Steppe-in-Time project—enabled the Conservancy team to begin comparing the pre- and post-fire landscape at specific sites and with a high degree of detail. In many places, the team found, native grasslands appeared to be recovering. In big sagebrush communities, however, much of the associated bunchgrasses and microbiotic crusts had been destroyed along with the shrubs. Bare ground was exposed to erosion and colonization by invasive weeds, and cheatgrass was increasingly prevalent.

That information laid the groundwork for last winter's restoration project, which targeted the 10,000 acres most seriously affected by the 2000 fire. The Service and the Conservancy are now monitoring the project to determine the results of the restoration. The partners fully realize, however, that good science and restoration technology alone will not dictate the project's success.

"In landscapes as arid as the Columbia Basin, you can do everything right but if you don't get the moisture, the project can fail," Evans said. "We're going to need a year or two of adequate rainfall for those new plants to get established."

—L.B.

JIM EVANS/U.S. FISH AND WILDLIFE SERVICE

These photos document the effects of the 2000 fire. Top: A healthy Wyoming big sagebrush community before the fire. Recreating that plant community is the goal of the restoration effort now underway. Bottom: The same location one year after the fire.

Fish and Wildlife seizes 1,500 pounds of sagebrush taken from Hanford Reach

Seeds from sagebrush a new hot commodity

By Annette Cary
Herald staff writer

The U.S. Fish and Wildlife Service has seized 1,500 pounds of seed-laden sagebrush poached on national monument land to cash in on the booming seed market.

"I see this as a potentially huge problem in the West," said Greg Hughes, project manager for Fish and Wildlife in Richland.

Fish and Wildlife officers recently discovered a crew of people on the Wahluke Slope of the Hanford Reach National Monument clipping off sage branches with seeds that were nearing ripeness, Hughes said. The officers seized the 40 bags of clippings.

They traced the harvest to a Mid-Columbia contractor and seed company, Hughes said. Because the investigation is continuing and no arrests have been made, he declined to name those involved.

He put the value of the unprocessed seed at about $1,000.

Removing sage seeds from public land is illegal, just as taking game or archaeological artifacts would be, said Fish and Wildlife officials. It's punishable by fines of up to $5,000 and six months in jail, Hughes said.

Fish and Wildlife agents are following leads about illegal harvests on public and private land in the Mid-Columbia, Hughes said.

Sage seeds also may have been harvested at the Mid-Columbia Wildlife Refuge, and Fish and Wildlife has heard from a landowner concerned that his land might be targeted by sage sced hunters, Hughes said.

"Native seed is a hot commodity in the marketplace right now," said Heidi Brunkal, a biologist for Fish and Wildlife.

The large fires that raged across the West over the summer — and land still not restored from previous fires

See **Reach,** Page A2

Herald/Bob Brawdy

Dave Gonzales, refuge operations specialist for the U.S. Fish and Wildlife Service, holds up a branch of recently confiscated sage-brush. About 40 bags of clippings, totaling about 1,500 pounds, were found poached from the Wahluke Slope of the Hanford Reach National Monument.

Tri
THURSDAY
DEC. 7, 2000

Reach: Seeds perishable

Continued from A1

— has increased demand for the seed as federal agencies replant.

"(Sage-covered land) is an imperiled habitat, not just here, but through the West," Hughes said. In May, the Clinton administration named 200,000 acres as the Hanford Reach National Monument, in part to preserve increasingly rare undisturbed shrub-steppe habitats.

Harvesting the seed can be tricky, and biologists are not sure the seeds seized in the sage bust are viable.

Fish and Wildlife officials harvest small amounts of seeds from small areas of public land this time of year but are careful to get seeds at the peak of maturity.

"That determines how well they germinate when we try to grow it," Hughes said.

The seized seed will be dried, cleaned and separated for replanting on the national monument.

Brunkal also is concerned about the natural seed bank in the area where the seeds were harvested.

"They depleted the whole area of this year's seed rain," she said. "Sage seed is very small and does not germinate easily."

About 2 million seeds weigh 1 pound, she said, and they're fairly perishable. Very few seeds will germinate three years after they've been harvested.

■ **Reporter Annette Cary can be reached at 582-1533 or via e-mail at acary@tri-cityherald.com.**

Sagebrush Monitoring Field Techniques

Monitoring transects were set up in the winter/spring of 2002 to determine the percent survival of sagebrush bareroot plants and tublings planted in December 2001. The strategy was to set up monitoring transects at time zero just after the plants were planted when all the plants were still alive. The transects will then be evaluated again in late summer to determine the number of live, sick, or dead plants. From these numbers, the percent survival of the plants over a nine month time period will be determined. Additional monitoring will take place in summer of 2003 and then every 5 summers after that, in 2008, 2013, etc.

Materials:

- 2 people
- 30 m measuring tape
- Compass
- Tent stakes (to stake down tape in wind)
- Flagging
- 100 m measuring tape
- Fiberglass poles (2 per transect)
- Data sheets and clipboard
- GPS unit

Methods:

First we determined that we were going to sample approximately one percent of the total tublings (165,000) planted. We decided to set up 20 transects to include each of the different planting types and different sampling patterns (4"tublings, 10" tublings, bareroots, triad planting, and strip planting).

Each transect was to include 100 plants, and to accomplish this each transect was 100 m long and 5 meters wide on both sides of the tape. Before going in to the field, a number of factors were determined in the office, such as which plots to sample, how many transects in each plot, and random numbers for sampling. To obtain a random sample from each plot, we chose random numbers (1-100) from a random number table. We then set up a 100 m tape in the plot, (making sure there was enough space for the transects anywhere off that tape), and based our transects off of the 100 m tape according to the random numbers generated for that particular plot. The transects were laid out in opposite directions off the tape if the random numbers happened to be close to each other. However, this proved to be a problem when setting up transects in the plots that were planted in strips. There was not an area large enough to set up a meter tape to base the random numbers off of, so a transect was randomly set up in an area that included enough plants.

When the origin of the transect was determined, a fiberglass rod was pounded into the ground and the tape was laid out 100 m. A GPS waypoint was also recorded here (be sure to note which datum is being used). At the 100 m point, another fiberglass rod was placed in the ground, and the 100 m tape was pulled taught and wrapped around the pole, and another GPS way point was taken. The compass was used to set out a straight line and to get a bearing. If it was extremely windy, tent stakes were used to hold the tape in place. The stakes were placed at 10 m intervals and the compass was used to keep a constant bearing. However for the 4" tublings that were planted in strips, the plants were closer together, and the transects were shortened (25 m to 30 m) to include only 100 plants.

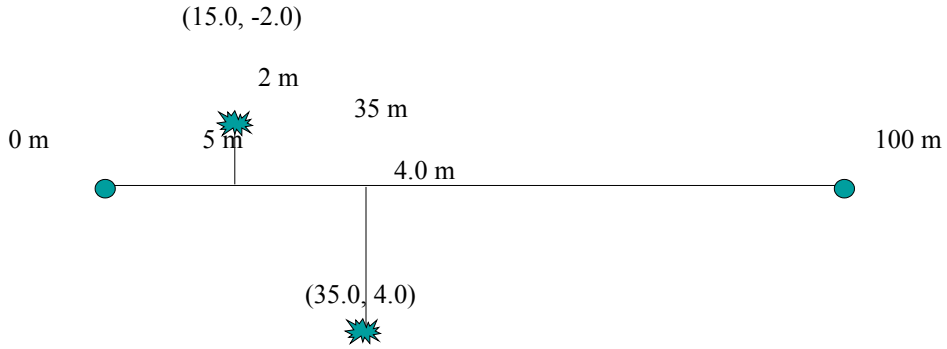
In future plot set up, a bearing of 360 degrees should be used for all transects.

When standing at the origin of the transect and facing the end of the transect, to the right of the line is considered positive, and to the left is negative. (See diagram on next page)

We began with the positive side, one person (the recorder) stands along the 100 m tape and the other uses the 30 m tape to measure out 5 m. The pair move down the line, with one person at the zero point (recorder) and the other staying 5 m from the 100 m tape. They record the coordinates of every plant within the 5 meters in 0.1 m increments (See figure 1 below)

Occasionally an exception was made, and a plant at a distance of greater than 5 meters was recorded to ensure that 100 plants were recorded. (These can always be discarded at a later date). At the end of the transect, the pair turned around and recorded the coordinates on the negative side. The number (0-5) should be the negative number and the 0-100 measurement is positive. At time zero, all plants will receive a rating of alive, however, some plants already appeared sick, so that was noted. When the plants are resampled, a rating system of 0=dead, 1=unhealthy (sick) or 2=alive, should be used.

Figure 1



Sagebrush Restoration Report for BAER Specification N-3b
December 2001
(by J. Meisel and H. Brunkal 1/29/02)

A vehicle accident on the afternoon of June 27, 2000 was the cause of the 24 Command Fire that burned 163,844 acres of Federal, state and private lands between June 27 and July 2, 2000. Of this total, approximately 69,244 acres of mature shrub-steppe plant communities were burned, and approximately 26,500 acres of this burned shrub-steppe habitat was located on the ALE. Through funds from the BAER (Burned Area Emergency Rehabilitation) assessment, we were able to have sagebrush plants grown at native plant nurseries around the area, and also to contract two professional reforestation crews to plant the seedlings.

Prior to the planting, H. Brunkal and J. Meisel set up 9 plots totaling about 500 acres for the sage planting. This was done by placing fiberglass fence posts approximately 100-200 m apart around the perimeter of each plot. The range finder was used for the spacing of the posts and a GPS waypoint was taken at each post. Each post was marked with colored flagging, and the corner posts were double high. The GPS way points were then entered into the Terrain Navigator program to produce maps and acreage of each plot. Brunkal and Meisel spent a considerable amount of time choosing sites. Sites were chosen using the criteria developed for previous planting efforts. These criteria are as follows:

- Sites should have pre-existing under story characteristics that contain significant proportions of native vegetation so that they will develop into high quality habitat capable of supporting wildlife populations
- Sites should be relatively large (>20 acres) so that larger blocks of habitat will develop over time
- Sites should attempt to bridge gaps between existing blocks of shrub-steppe habitat OR should attempt to replace sagebrush into areas that had mature sage stands prior to the "24 Command Fire"
- Sites should be near established roads on ALE to minimize disturbance to this Research Natural Area.
- All sites will be cleared for planting through the cultural resource program, such that planting will not disturb any culturally significant sites.

Each plot was examined by J. Gaston for cultural resources before the planting began. Any areas of significance located during the cultural resource survey were marked and avoided. Please see attached maps for locations and acres of planting sites.

Plants were provided by Buffaloberry Nursery, Lucky Peak Nursery and Bitterroot Restoration. Buffaloberry Nursery provided 19,200 - 10" tublings and 20,111 - 4" tublings. Lucky Peak Nursery provided 51,980 bare root plants and 7,056 - 4" tublings. Bitterroot Restoration provided 75,000 plants, all 4" tublings. This resulted in a total of 173,348 sagebrush plants. However, this total number of plants that we received was significantly less than the 250,000 that we had originally ordered to complete the restoration project as specified in the BAER plan. The 7,056 - 4" tublings were purchased by Duratek Inc., and provided as part of a volunteer effort by their company to help re-vegetate the burned area. Due to the short fall of plants during

production at Lucky Peak Nursery, (LPN) the project still requires approximately 85,000 bare root plants. (Production short fall was caused by low germination of seed provided to LPN by USFWS. During 2000, a large amount of see was collected from the Wahluke slope illegally. USFWS confiscated the seed, and used it for production of plants. However the seed was collected early {mid-November} and had probably not matured enough to be viable). USFWS will collect seed during late December 2001, and will contract with LPN to produce the 85,000 additional plants for planting in fall/winter of 2002. This will complete the project as described in the BAER specification.

Plant spacing to produce the desired density of plants in each plot was determined to be approximately 10 feet. The resulting density would be approximately 400 plants per acre. Three methods of planting were used in the 500 acres. (1) A standard planting with the 10 foot spacing in rows 10' apart, (2) plants were planted in groups of three (triads), followed by a single plant, still using a 10 foot spacing between each triad and single plant. This created a triad, single, triad, pattern. Because of the small size of the 4" tublings from Bitterroot Restoration, the (3) plants were placed only 4 feet apart and were planted in strips within each plot. (See attached map showing planted areas)

The planting began with a volunteer effort organized by Duratek on December 1, 2001 in which approximately 40 volunteers planted 3,681 - 4" tublings in plot 5. Brunkal, Meisel, and D. Gonzales gave a demonstration on planting and supervised the volunteers. There were several young boy scouts and others who had no previous planting experience. Although the volunteers worked hard, and did a great job, there is some concern as to how well these plants will survive. Following the planting, during spot check of planting effort, it was noted that some of the plants were not properly placed in the ground (shallow plantings, etc.). Professional planting crews were used to plant the remainder of the plants provided by Duratek, and for all of the plants grown to complete the restoration project.

Frank Maduzia, Forestry contractor, was hired to complete the 90,000 plants ordered from Lucky Peak Nursery and from Buffaloberry farm. Maduzia's crew began planting on Monday, December 3, and continued through Saturday, December 8, planting a total of 94,917 plants. The crew from Bitterroot Restoration planted all of the plants provided by their company. They began on Wednesday, December 5, and finished on Wednesday, December 12, planting a total of 75,000 plants,. The final totals for each plot are included on a separate sheet.

Since Bitterroot Restoration provided their own plants they were very self-sufficient and required little supervision and extra help from us. We provided the plants for Maduzia's crew and were therefore responsible for transporting the plants, via a U-Haul truck, to each of the plots for hydrogel mixture and the transport of plants out into the field. Brunkal, Meisel and Maduzia worked on gathering water for the hydrogel mixture and dipping the plants, while D. McDonald shuttled the plants to the workers using the ATV.

Maduzia's crew consisted of 9 individuals plus Maduzia who headed up the logistics. They planted in a grid pattern using planting shovels.

Daily activities for Maduzia's crew were as follows:

12-03-01: Plot 5. Maduzia's crew planted 3,626 10" tublings, 7,200 - 4" tublings and an additional 7,290 - 10" tublings. Brunkal and Meisel supervised the activity. Daily total- 18,116.

12-04-01: Plot 2. 17,100 bare roots were planted. Bare root stock was root dipped into a hydrogel (Terra Sorb) mixture prior to planting. This substance helps retain moisture to the roots during plant establishment. Five gallon buckets were pre-mixed with hydrogel and brought into the field. Additional hydrogel powder was also brought into the field. The initial amount of hydrogel was used up quickly. The 5 gallon buckets were then filled with water and mixed with the powder substance. Buckets had to be filled several times, and eventually the hydrogel powder was used up. Due to the shortage pf hydrogel mixture, buckets, and water, the process of dipping the roots seemed to slow the planting effort. In the end, some of the plants were dipped in water without any hydrogel, because all of the mixture had been used. Additional buckets, and additional hydrogel mixture was needed to make the operation efficient, and this was noted for later in the week. Throughout the process, Brunkal and Meisel helped Maduzia dip the plants while McDonald shuttled plants out to the workers using the ATV for transport.

12-05-01: Plot 2. Planted 8,930 bare root seedlings. An additional 10- 5 gallon buckets were prepared with hydrogel mixtures, prior to planting in the field. With proper supply, the root dipping was more efficient. Meisel and Maduzia dipped plants while McDonald continued to shuttle plants to the workers using the ATV.

12-05-01: Plot 1. Planted 8,111 - 4" tublings and 4,050 - 10" tublings. The sagebrush was planted using the triad pattern in this plot. Daily total plots 1 and 2 -21,091.

12-06-01: Plot 1. Maduzia's crew split up–3 of the planters finished plot 1 by planting approximately 4,000 additional 10" tublings.

12-06-01: Plot 3. Maduzia, Meisel and the remainder of the crew started on plot 3. Buckets of hydrogel and water were prepared the night before. 13,200 bare root plants were planted. Meisel and Maduzia dipped the plants while McDonald shuttled the plants to the workers.
Daily total plots 1 and 3 17,200 plants.

12-07-01: Plot 3. In the morning, 7,650 bare roots were planted. Meisel and Maduzia dipped the plants while McDonald shuttled the plants.

12-07-01: Plot 5. In the afternoon 3,510 - 10" tublings and 4,800 - 4" tublings were planted to finish this plot. Daily total, plots 3 and 5 15960.

12-08-01: Plot 8. The remaining plants were placed in this plot. 5,450 bare root and 300 - 10" tublings. Meisel and Maduzia dipped the remaining bare root plants while McDonald

shuttled plants to the workers. Daily total 5,750.

Bitterroot's crew consisted of 5 individuals the first 3 days, plus 8 more for a total of 13 individuals for the remaining 4 days of work. The planters used hoedads to plant the sagebrush in strips.

Daily activities for the Bitterroot crew were as follows:

12-05-01: Plot 6. Approximately 6,000 - 4" tublings were planted in strips by 5 crew members. Brunkal supervised.

12-06-01: Plot 6. Approximately 8,000 - 4" tublings were planted in strips by the 5 person crew while Brunkal supervised.

12-07-01: The additional crew members arrived. The crew did not work on this date so that the entire crew could start together the next morning.

12-08-01: Plot 6. The 13 member crew finished this plot with 16,000 - 4" tublings. Following the completion of this plot, Brunkal and Meisel escorted the crew leader to the remaining plots. After orienting him to the area and the plot boundaries, the Bitterroot crew was provided an access key to complete the project.

12-09-01: Plot 8. The crew planted 4,000 - 4" tublings to finish where Maduzia's crew had left off.

12-09-01: Plot 7. Approximately 7,000 - 4" tublings were planted in strips. Meisel went out in the afternoon to provide some oversight to the crew and to check on progress.

12-10-01: Plot 7. Approximately 4,000 - 4" tublings were planted to finish this plot.

12-10-01: Plot 9. Approximately 8,000 - 4" tublings were planted in contoured strips to begin this plot. Meisel went out again in the afternoon to check up on the crew and to determine the progress on the project.

12-11-01: Plot 9. Approximately 12,000 - 4" tublings were planted in contoured strips. Meisel again went out in the afternoon to provide oversight on the contract.

12-12-01: Plot 9. Approximately 10,000 - 4" tublings were planted in contoured strips to finish this plot. Meisel met the crew at the end of the day to get the key and maps of the plantings from the Bitterroot Restoration field crew leader (Nate).

See attached sheets for information on the number of plants in each plot, the location and the acreage of each plot, a summary from Maduzia of the planting effort by his crew and a map of the strip plantings installed by the Bitterroot crew.

Overall this project went very well. A few problems were noted in the beginning with the hydrogel, but after the proper equipment and supplies were obtained, things ran smoothly

Because Frank Maduzia and his crew were so flexible and helpful, we were able to work out any minor problems that occurred daily.

Monitoring plots to assess survival of the planted stocks will be installed to track the progress of the planting effort.

BAER Restoration Report
November/December 2002

Intro:
On June 27, 2000, a major wildland fire quickly spread through the Hanford area, resulting from a fatal motor vehicle accident on State Route 24. The "24 Command" Fire significantly impacted the ALE's ecology and landscape by removing native grasses and shrubs.

Following the fire, in consultation with Tribes, the Department of Energy and local technical and academic experts, the US Fish and Wildlife Service (FWS) developed a comprehensive Burned Area Rehabilitation Plan (BAER) to address short and long-term rehabilitation needs. Monitoring conducted under the original BAER plan indicated an on-going emergency and an Amendment to that plan was written in 2001, with approval of the Amendment in March 2002. During 2002, FWS implemented rehabilitation treatments identified in the 2000 BAER plan and Amendment. The goals of the treatments are to stabilize erosive soils, prevent the spread of non-native invasive plant species (e.g. cheatgrass), and to restore native plant communities, protect cultural resources and replace infrastructure lost to the fire. Vegetation and invasive species monitoring is on-going with reports on first two monitoring seasons available. Monitoring of initial treatments installed in 2001 has been conducted one season and will be conducted again this year (2003). A large portion of the on-the-ground work for Amendment specifications was conducted during the months of November and December 2002, and little information on the results of these treatments will be available until late 2003, into 2004.

Preliminary set up
The staff at Hanford Reach National Monument (HRNM) has been anticipating and preparing for this rehabilitation effort since late 2001. Tasks that were completed included collecting sage and rabbit brush seed (winter 2001/02), and purchasing compatible sage seed that could be sent to the nurseries to be grown for planting in fall of 2002, and getting contracts in place for planting and aerial operations.

Non-native invasive plant control/site preparation
Areas that were identified as being at risk of invasion by non-native invasive species were identified. Treatment with a light dose of Roundup® was identified as the treatment to affect the cheatgrass while minimizing injury to desirable native plants. An area of approximately 10,000 acres was identified for this treatment. A contract was developed to have an aerial applicator conduct this treatment because it was such a large area and because the areas

Native grass seed
The fire areas that were burned most intensively were identified as areas that would need native seeding treatment (see Amendment, and TNC monitoring report). Native seeding was intended to prevent the spread of non-native invasive plant species. Contract specifications for the native seed were developed to obtain native grass seed for the rehabilitation. Specifications indicated that all seed would have to be source identified with Hanford derived seed would being

preferred, followed by Columbia Basin sources. Additionally, seed would have to grown in Washington, be certified as weed free, tested for germination and delivered on a pure live seed (PLS) basis. Two seed mixes were developed, a low elevation seed mix for sandy soils and a higher elevation seed mix for areas of loamy soils (see Amendment specification # N-4a) The native seed contract was competitively bid and the contract was awarded to L & H seed, a local native seed producer out of Connell, Washington. Seed reports are available for each species of seed used in the seed mixes. Plans indicated that aerial treatment of native

Native shrub production

supplies, rental equipment, suppliers–L&H,bitterroot, lucky peak, buffalo berry, aerotech

Prior to the planting, H. Newsome, J. Meisel and D. Smith set up 13 plots totaling about 1600 acres for the sage planting. This was done by creating planting plots. They placed fiberglass fence posts approximately 100-200 m apart around the perimeter of each plot. The range finder was used for the spacing of the posts and the Trimble Pro-XR GPS unit was used to map the boundary of each plot. Each post was marked with colored flagging, and the corner posts were double high. The GPS data was downloaded into Pathfinder software where acreage was determined and shapefiles were created. These shapefiles were sent to the regional office in Portland where a GIS technician created maps of the planting areas. Meisel and Smith went to Portland to coordinate with the technician so the maps depicted what was needed for the whole operation. Separate maps were made of the sage planting areas, seeding areas, and spraying areas, as well as an overview map of the whole project.

Plot sites were chosen using the following criteria developed for previous planting efforts.

- Sites should have pre-existing under story characteristics that contain significant proportions of native vegetation so that they will develop into high quality habitat capable of supporting wildlife populations
- Sites should be relatively large (>20 acres) so that larger blocks of habitat will develop over time
- Sites should attempt to bridge gaps between existing blocks of shrub-steppe habitat OR should attempt to replace sagebrush into areas that had mature sage stands prior to the "24 Command Fire"
- Sites should be near established roads on ALE to minimize disturbance to this Research Natural Area.
- All sites will be cleared for planting through the cultural resource program, such that planting will not disturb any culturally significant sites.

Each plot was examined by J. Gaston, members of the Wanapum people and Umatilla tribe for cultural resources before the planting began. Any areas of significance located during the cultural resource surveys were marked and avoided. Please see attached maps for locations and acres of planting sites.

Areas where the aerial applications and drill seeding were to take place were created using GIS

capabilities. Smith, Meisel and Newsome collaborated on where the sites should be located, the area was then digitized using ArcMap software so the total acreage could be determined, and a shapefile was created for the plane.

Aerial spraying:
chemical, dates, weather

Aerial seeding:
technique-on the ground coordination, seed mixes, equipment, weather, daily totals??? from GPS?

Sage planting
Coordination was the key to this year's successful BAER restoration. We learned a lot from last year's planting and were much more prepared and organized for this year's event. The availability of staff members was the one asset that really made the project possible. The whole process was well thought out, and we were prepared with all the necessary equipment and personnel.

Stations were set up to dip the bare root plants in mycorrhizal and hydrogel solutions. There were 3 different mixtures that were used on the plants. One consisted of a hydrogel only solution (Terra-sorb) that was applied to the plants planted by Wildlands Inc. The second was a micorrhizal root dip (Mycor-Tree) that was applied to a portion of plantings by Frank Maduzia's crew. **Third root dip?**
Materials present at each dipping station included: Rental moving truck to hold boxes of plants, 2 tables, 4 tubs, water, Mule 4 wheeler for transport, and buckets of root gel mixture prepared the night before so that it could set prior to being used, and at least 4 staff members to dip and transport plants.

Plant spacing to produce the desired density of plants in each plot was determined to be approximately 9 feet. The resulting density would yield approximately 450 plants per acre.

Plants were provided by Lucky Peak Nursery(LPN), Buffalo Berry Nursery, and Bitterroot Restoration Inc. (BRI). LPN provided **357,252** bare root plants planted by Frank Maduzia's crew and Wildlands Inc. Buffalobery Nursery provided 28,076 4" tublings, 10,287 10" tublings, 5,891 green rabbit brush tublings, and 1,897 gray rabbit brush tublings–for a total of 46,151 tublings, which were planted by Frank Maduzia's crew. Bitterroot Restoration Inc. Provided 304,000 4" tublings planted by their own crews. **Coordiante with heidi for final numbers**

LPN surplus-- make up for shortfall from last year

Bitterroot Restoration Inc. (BRI)
Bitterroot started planting using hoedads on Dec. 3 with a total of 300,000 plants and 15 planters. They were assigned to plant plots A, L, and M–for a total of 685 acres. It was noted that the plants did not meet our standards once again. The plants were very small in size, did not have sufficient leaf structure, had yellowing leaves, and a number of them could have been classified as dead before they were even planted. This was brought to the attention of the crew

leader, Brevy, and also to **Len Baleck** at BRI. It was agreed that Bitterroot would provide 4,000 more plants to be planted within the time frame to make up for the inadequate plants. The Bitterroot crews worked well–the first day they had problems planting in straight lines–so it was suggested that they mark their progress. There were no more problems after this.
Crew members seemed to take care placing each plant in the ground and making sure it was securely in place. The crew was supervised daily by Meisel, Newsome, Smith or S. Immele.
Daily totals for BRI can be found on the attached Excel document.

Frank Maduzia and crew

Frank's crew began planting using 10" planting shovels on December 3, 2002. Plots C, D, F, G, H, I , and J were assigned for a total of 662 acres. Plots F, H and I were designated as ERDF plots.
The bare root plants were first dipped in the root gel mixture, re-boxed and shuttled out to the planters. Plot I was the only plot containing tublings. There were 4 and 10 inch sage brush tublings along with gray and green rabbit brush tublings.
The process of dipping the plants went smoother than last year because we were prepared with more staff members, and had better equipment.
There was one isolated incident by a crew member which involved burying a handful of plants. This was discovered and corrected immediately. The crew did a great job of planting, working efficiently and accurately.
The crew was supervised mostly by Newsome, but also by Smith and Meisel.
Daily totals can be seen on the attached Excel spreadsheet.

Wildlands Inc.

Wildland's Inc. began planting on December 4, 2002. Plots B and K were assigned for a total of 203 acres. These plants were dipped in hydro gel solution prior to planting, and then transported out to the crews. Wildlands decided after the first day that their 12" hoedads were not creating a deep enough hole for the roots, so the second day the blades were replaced with 14" blades. This seemed to solve the problem until the next day when they approached us and asked if they could trim the roots on some of the plants. It was decided that only plants with multiple long taproots could be trimmed. It was observed during the planting that many plants were not in placed in the ground properly, there were a large number of dropped plants, and the crew members were shaking the hydro gel off the plants before planting. The crews had to be constantly reminded of this.
On the last day of planting, J. Vineyard and Meisel found handfuls of cut off roots laying on the ground. After further investigation–it was determined that approximately 4500 plants had cut off roots and were poorly planted. (See attached documentation) this resulted in Wildlands Inc. providing and planting an additional 4500 plants acquired from Plants of the Wild Nursery. The crew was supervised by Meisel.
See Excel document for daily totals.

Drill seeding

cultivars

ERDF

plants–seeding–upcoming projects

Sagebrush Monitoring 6-27-2003

During winter 2002-2003, a total of 26 plots were established to monitor the survival of outplanted big sagebrush nursery stock. Plot locations within polygons were determined randomly using GIS. Three plots were installed in each of seven polygons; an eighth polygon, 3-4 times the size of the next largest polygon, received 5 plots. All polygons were stratified into three segments of roughly equal size in order to assure a minimum dispersion of plots across the polygons.

Monitoring methodology follows protocols established by Monument personnel for monitoring shrub seedling survival for plantings in previous years (primarily 2001). Sample plots consist of a 100 m x 12 m belt transect bisected lengthwise by a 100 m baseline. Baseline transects run due magnetic north from the randomly selected origins. The position of individual sagebrush plants was recorded in terms of distance along the baseline from the origin, and perpendicular distance from the baseline at that point. Position right or left of the baseline was recorded as plus (+) or minus (-) respectively. The aim was to capture approximately 100 seedlings within the belt transect. Actual plots contained a total of 2814 seedlings or 108.2 (_ 13.8 SD) seedlings / plot.

Seedling survival and health will be recorded again for each seedling during October-November, 2003 and compared to time-zero records to determine percent survival. Fall sampling will be repeated during 2004. Sagebrush plantations installed in 2001 and currently monitored by USFWS according to the same protocols will also be available for comparison. Differences between plots, treatments, and years will be explored using ANOVA. Significant differences indicated by ANOVA will be investigated using t-tests or similar comparison tests.

ARID LANDS ECOLOGY RESERVE STABILIZATION 2002
SAGEBRUSH PLANTING
24 COMMAND FIRE

Plot	size in acres	planted by	Modified	actual plants planted	
Plot A	600 acres	Bitterroot		265,750	
Plot B	71 acres	Wildlands	101 acres	53,530	
Plot C	132 acres	Frank Maduzia		54,800	
Plot D	76 acres	Frank Maduzia		35,700	
Plot E	115 acres	Frank Maduzia	partial plant	22,500	18,000(Frank) + 4500 Wildlands
Plot G	65 acres	Frank Maduzia		30,000	
Plot J	68 acres	Frank Maduzia		31,252	
Plot K	152 acres	Wildlands	102 acres	46,470	(-4500)
Plot L & M	40 acres and 45 acres	Bitterroot		38,250	
	1364 acres			578,252	

Proposed plots and number of plants:

Bitterroot Restoration **300,000 plants @ 450 plants per acres is approximately 670 acres**
plots A, L and M (685 acres) have been assigned

Wildlands 84,000 plants @450 plants per acres is approximately 190 acres
plots B and K (223 acres) have been assigned
16,350 added because of surplus from Lucky Peak
total: 100,350 plants @ 450 plants per acre is 223 acres

Frank Maduzia 89,300 and surplus 72,200 from Lucky Peak
total: 161,500 plants @ 450 per acre is 360 acres
Plots C,D,G, J (341 acres) have been assigned