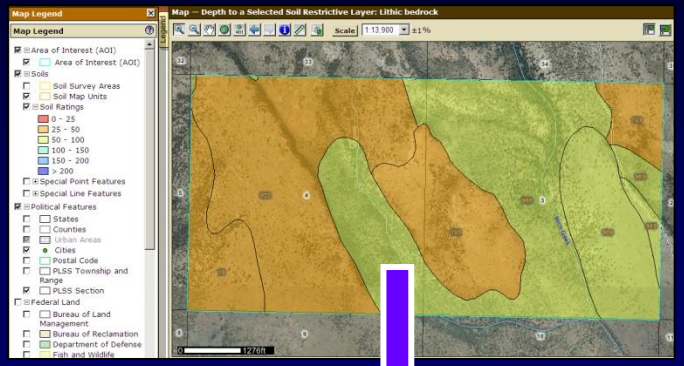
Applications of ESDs in Restoration



Mike Pellant
Great Basin Restoration Initiative Coordinator
BLM, Boise, ID

GREAT BASIN Restoration Initiative

Date Proposed: 3/69
Author(s): RK/GKB
MLRA: 25

South Slope 8-12" P.Z.
025XY015NV
ARTRW/AGSP

Ecological Site Description

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

NEVADA
Range Site Description

A. PHYSICAL CHARACTERISTICS

1. PHYSIOGRAPHIC FEATURES

This site occurs on southerly facing sideslopes of hills, erosional fan remnants and rock-pediment remnants. Slopes range from 15 to 75 percent, but slope gradients of 30 to 50 percent are most typical. Elevations are 5500 to 6500 feet.

2. CLIMATIC FACTORS

Average annual precipitation is 8 to 12 inches. Mean annual temperatures is 45 to 50 degrees F. The average growing season is about 100 to 120 days.

3. SOIL FACTORS

The soils in this site are typically moderately deep and well drained. Surface soils are medium to moderately fine textured and are normally less than 10 inches thick. Subsoils are moderately fine to fine textured. Most of these soils are modified with 35 to 50 percent rock fragments through the soil profile. Available water capacity is low to moderate. On the southerly exposures of this site, more sunlight is received and the soils tend to warm and promote plant growth earlier in the spring than on adjacent sites. High evapotranspiration potentials on this site result in depletion of the available soil moisture supply early in the growing season. Runoff is medium to rapid. Potential for sheet and rill erosion is moderate to high depending on slope. A surface cover of gravels and/or cobbles on these soils provides a stabilizing affect on surface erosion conditions.

For a listing of soils correlated to this range site and representative pedon, see Appendix II.

4. VEGETATION FACTORS

a. Potential Native Vegetation

The plant community is dominated by bluebunch wheatgrass. Other plants of importance are Thurber needlegrass and Wyoming big sagebrush.

Potential vegetative composition is about 80% grasses, 5% forbs and 15% shrubs.

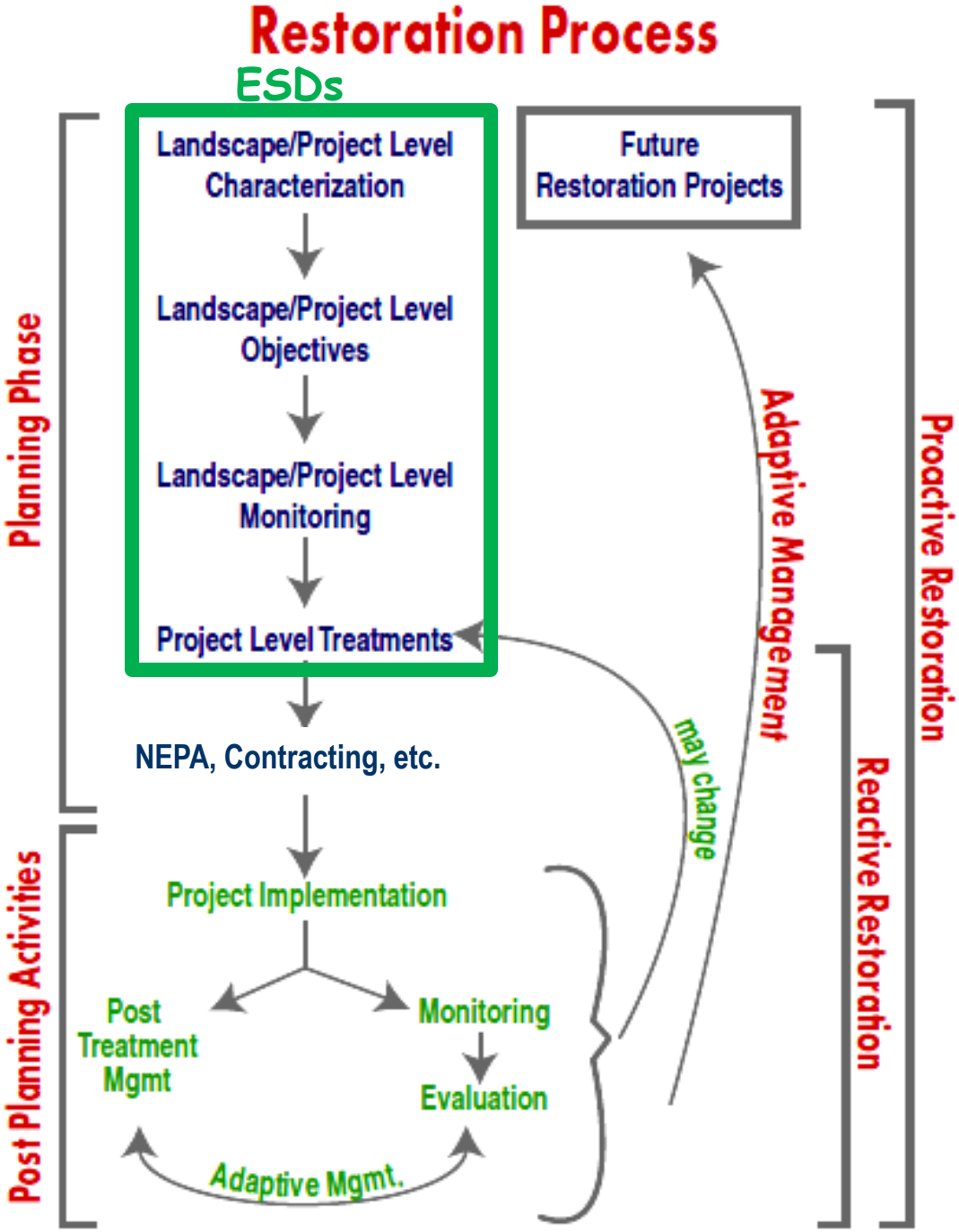
Restoration Definition--Society for Ecological Restoration (2004)

Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.



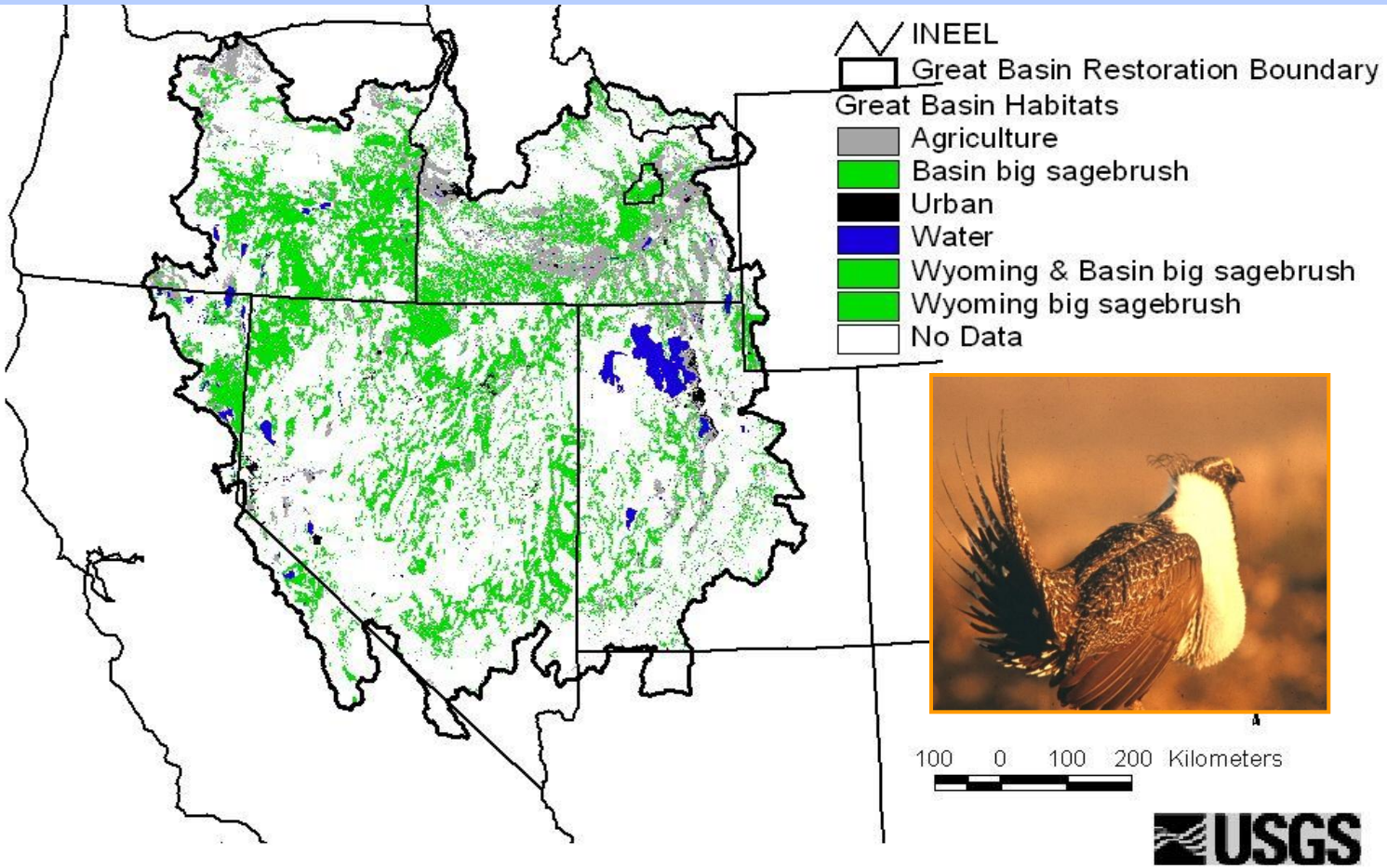

BLM National Training Center "Restoration of Sagebrush Ecosystems" Course

Class offered in October 2012 in Boise ID

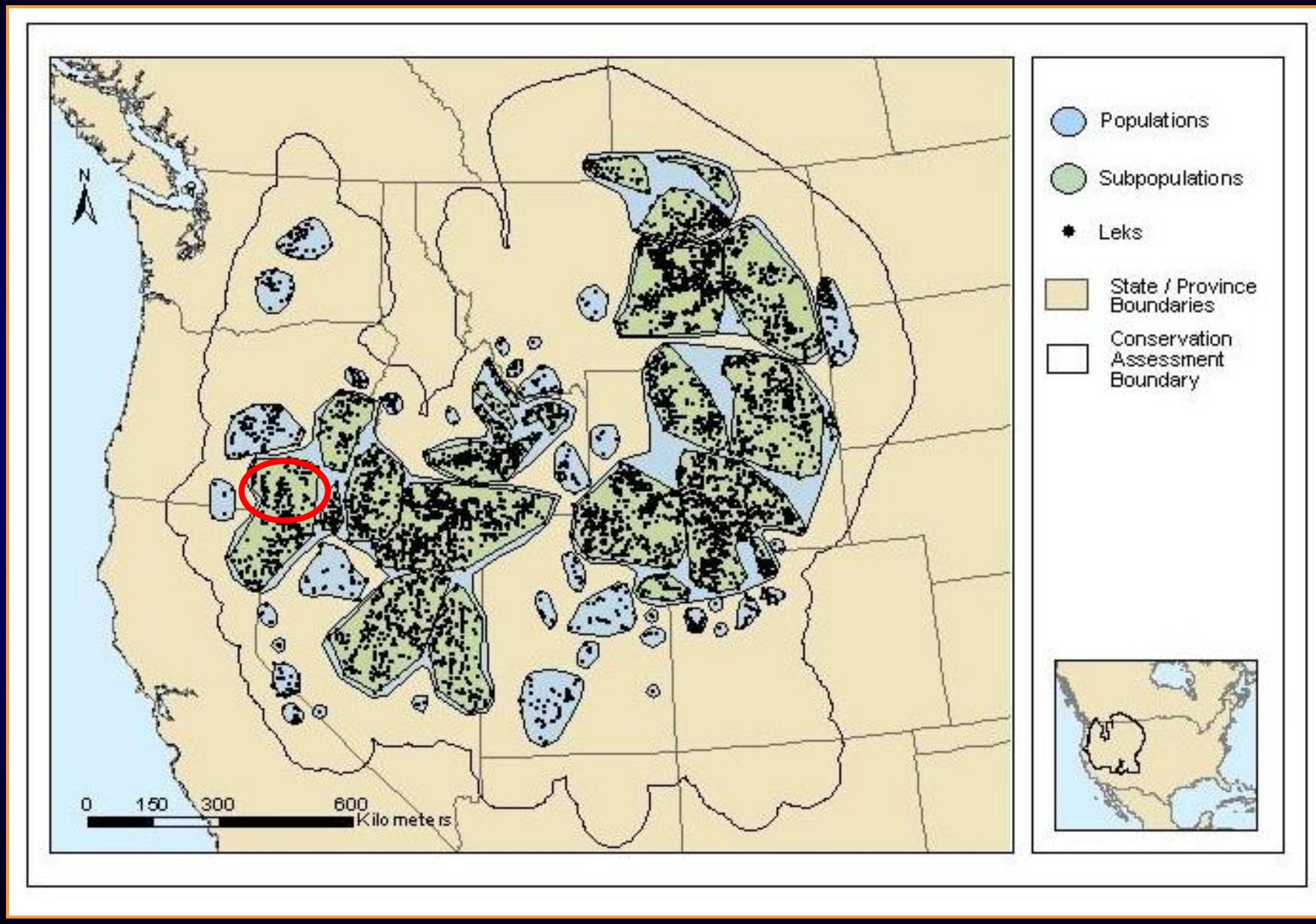


Landscape Scale and ESDs

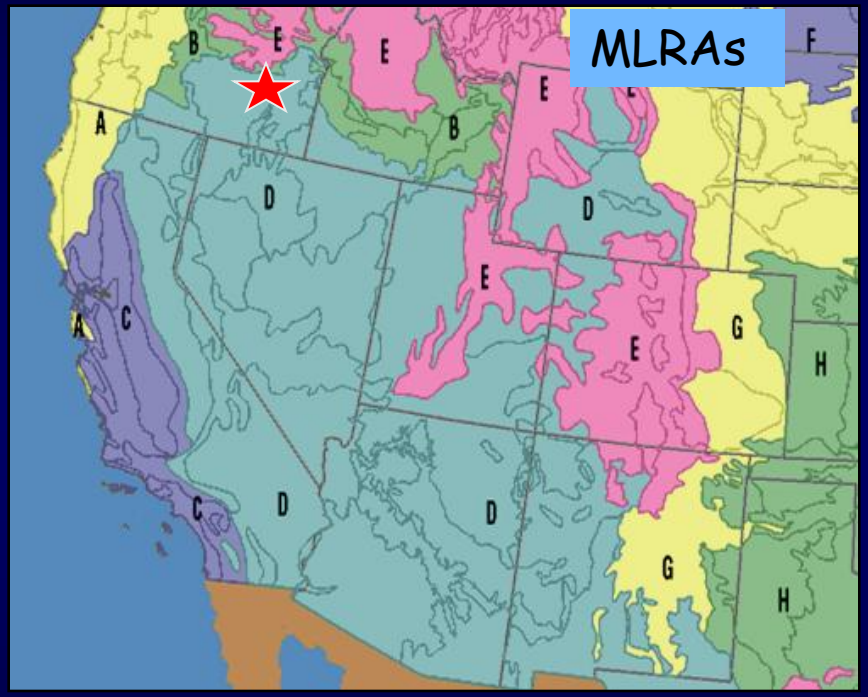
Goal—Reduce Fragmentation of Sagebrush Steppe Where **Potential** for Success is High

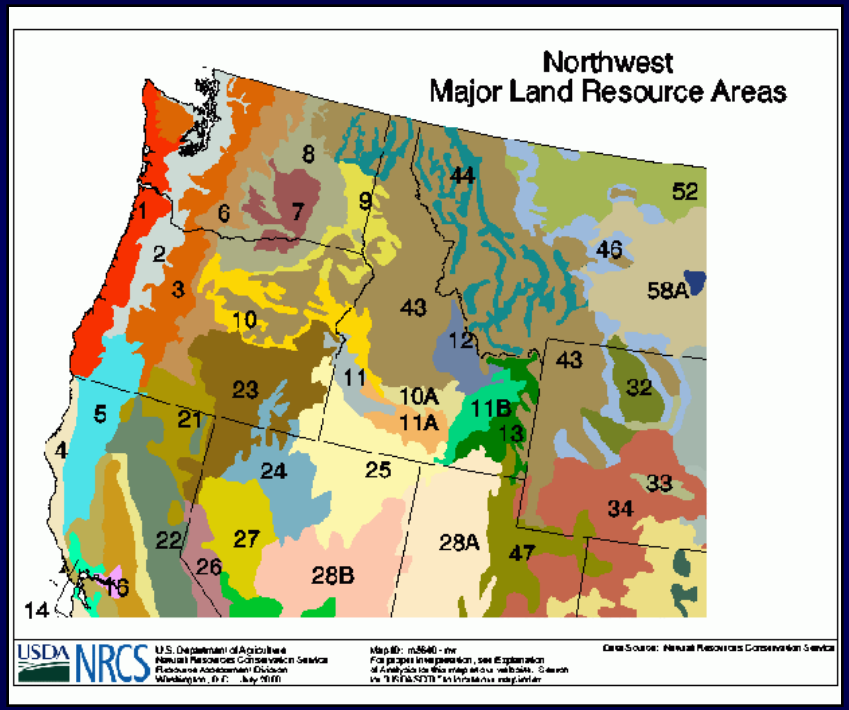


Greater Sage-grouse Populations



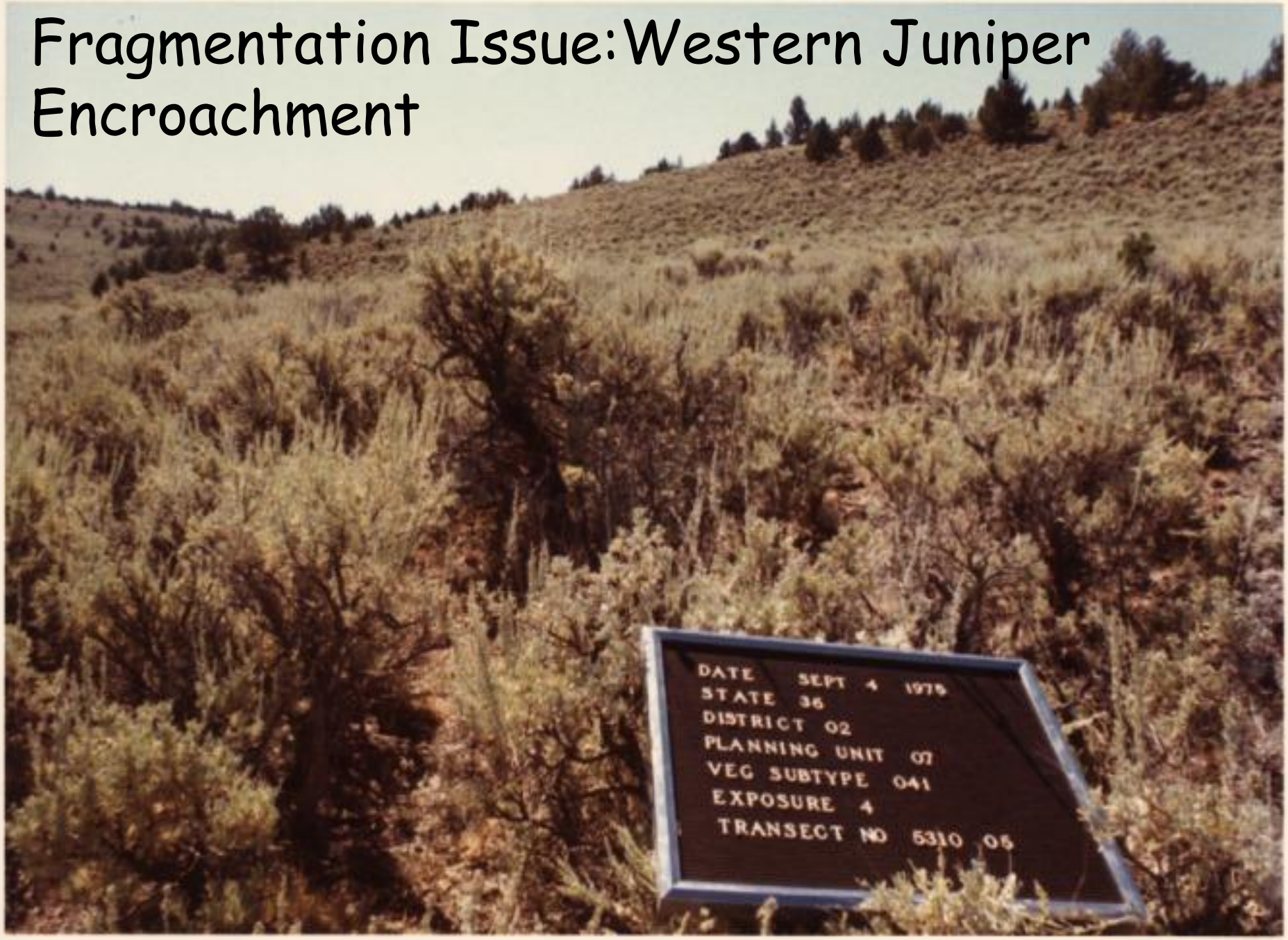
Land Resource Regions and Major Land Resource Areas





http://www.nrcs.usda.gov/survey/geography/mrla/

Fragmentation Issue:Western Juniper Encroachment

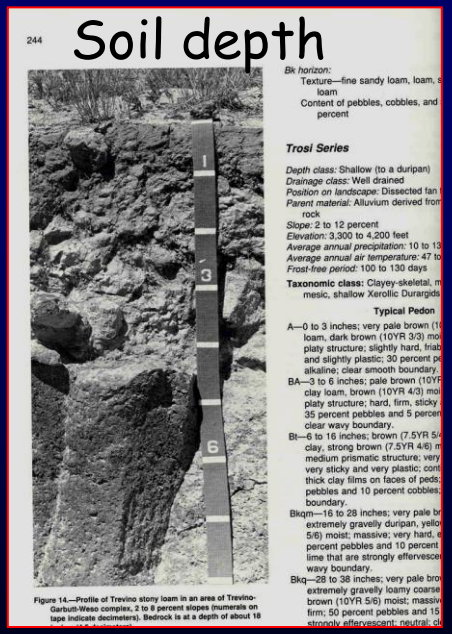


Fragmentation Issue: Cheatgrass/Medusahead Wildrye Invasion

Selection of High Potential Treatment Sites to Benefit Sage-Grouse

Soil Survey + ESDs Critical for Restoration Planning

ESDs focus on the plant community and provide the general soils information but not the specific edaphic information required to plan most restoration treatments



Steve Campbell, Soil Scientist
USDA – Natural Resources Conservation Service
West National Technical Support Center
Portland, Oregon

websoilsurvey.nrcs.usda.gov

You are here: WSS Home

Search

Enter Keywords | Go

All NRCS Sites

Browse by Subject

- Soils Home
- National Cooperative Soil Survey (NCSS)
- Archived Soil Surveys
- Status Maps
- Official Soil Series Descriptions (OSD)
- Soil Series Extent Mapping Tool
- Soil Data Mart

The simple yet powerful way to access and use soil data.

START WSS

Welcome to Web Soil Survey (WSS)

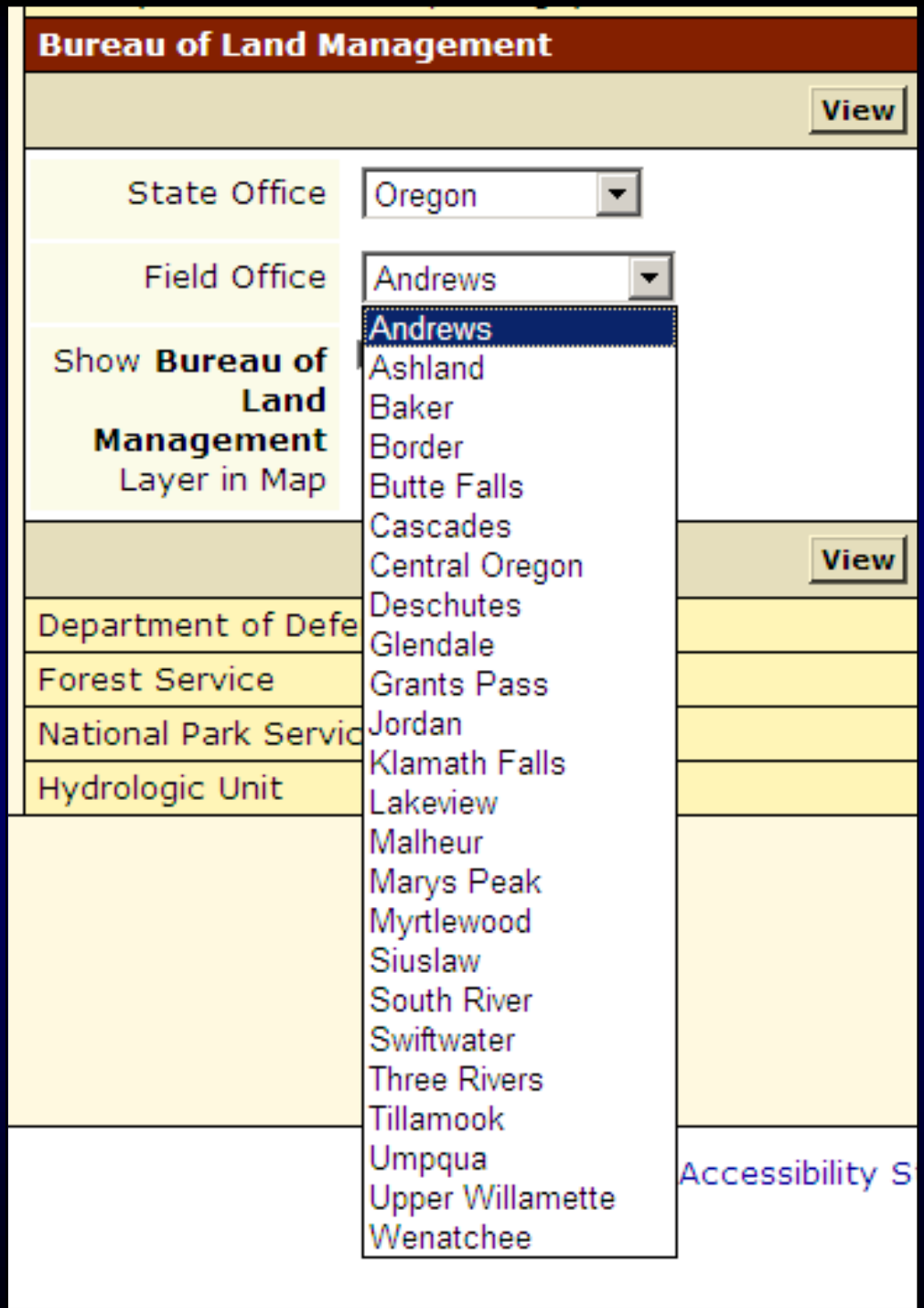
Web Soil Survey (WSS) provides soil data and information produced by the National Cooperative Soil Survey. It is operated by the USDA Natural Resources Conservation Service (NRCS) and provides access to the largest natural resource information system in the world. NRCS has soil maps and data available online for more than 95 percent of the nation's counties and anticipates having 100 percent in the near future. The site is updated and maintained online as the single authoritative source of soil survey information.

I Want To...

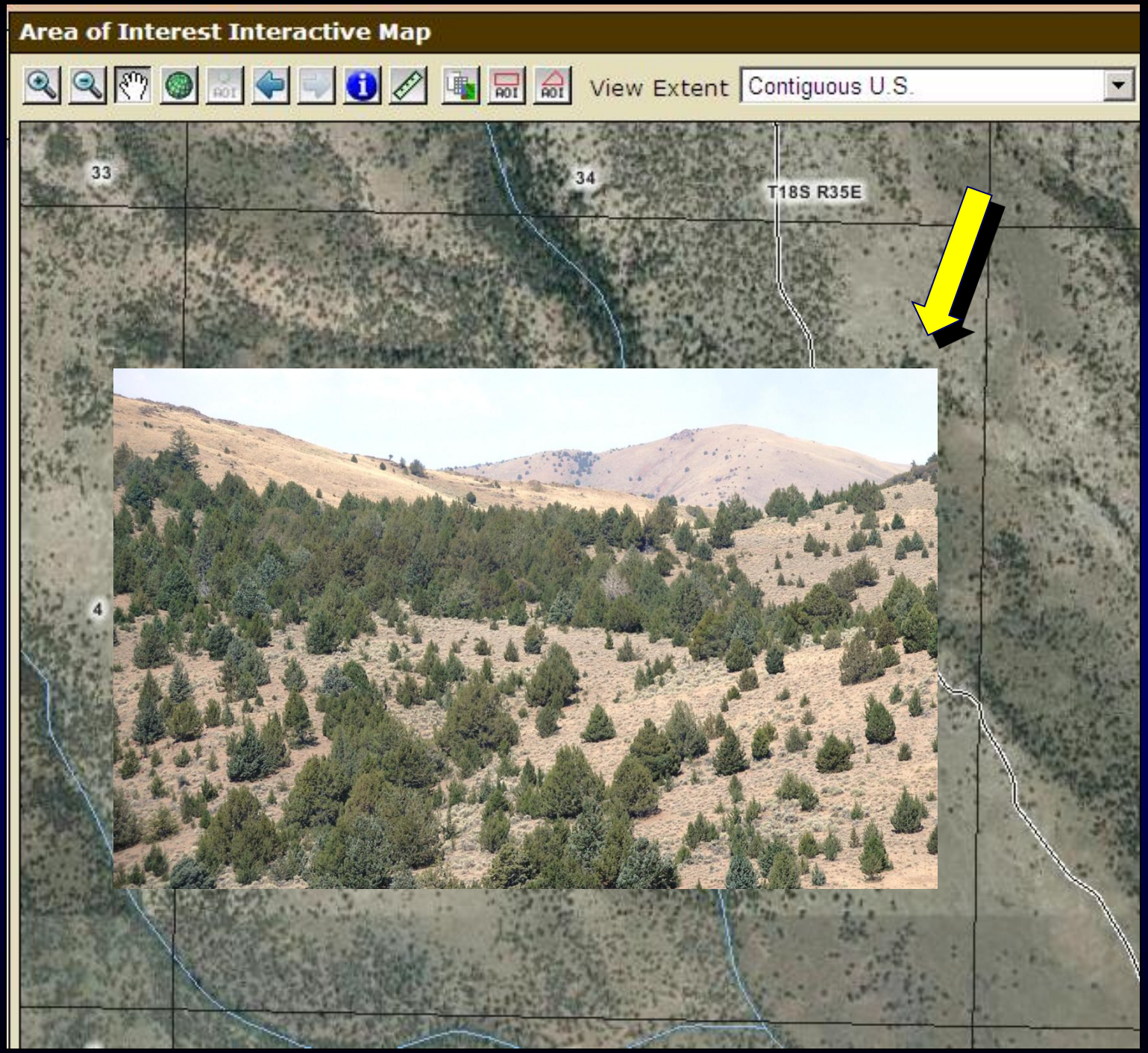
- Start Web Soil Survey (WSS)
- Know the requirements for running Web Soil Survey
- Know whether my web browser works with Web Soil Survey
- Know the Web Soil Survey hours of operation
- Find what areas of the U.S. have soil data

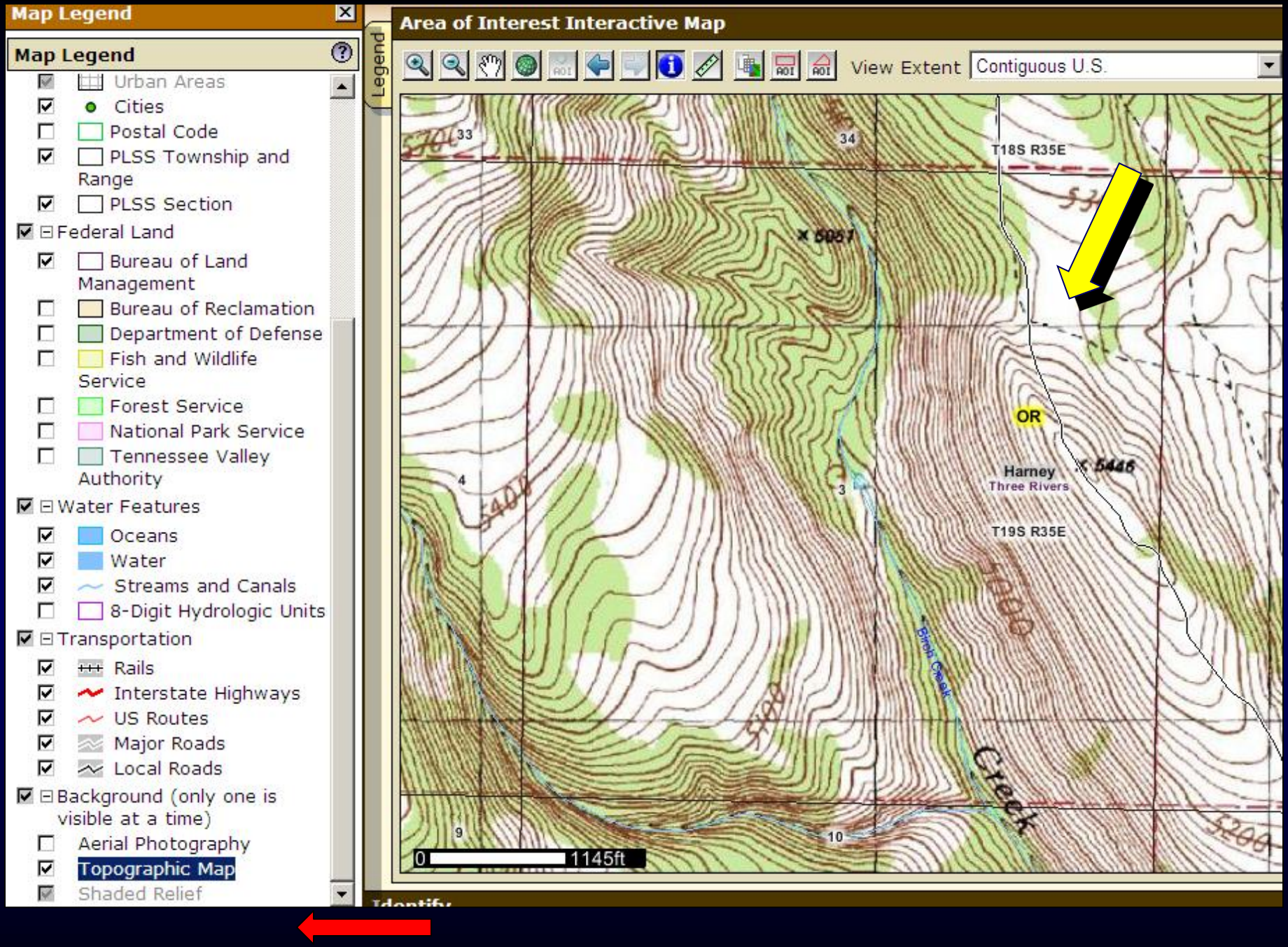
Announcements/Events

- Web Soil Survey 2.0 has been released! View description of new



Navigate to a BLM Field Office in priority sage-grouse habitat to select a treatment area.


Area of Interest Interactive Map
View Extent
Contiguous U.S.
33
34
T18S R35E
4


Map Legend
Map Legend
Urban Areas
Cities
Postal Code
PLSS Township and Range
PLSS Section
Federal Land
Bureau of Land Management
Bureau of Reclamation
Department of Defense
Fish and Wildlife Service
Forest Service
National Park Service
Tennessee Valley Authority
Water Features
Oceans
Water
Streams and Canals
8-Digit Hydrologic Units
Transportation
Rails
Interstate Highways
US Routes
Major Roads
Local Roads
Background (only one is visible at a time)
Aerial Photography
Topographic Map
Shaded Relief
Legend
Area of Interest Interactive Map
View Extent
Contiguous U.S.
T18S R35E
T19S R35E
OR
Harney
Three Rivers
5446
5057
5406
5200
33
34
4
3
9
10
0
1145ft

Soil Map Units—Restoration Potential?

Search

Map Unit Legend

Harney County Area, Oregon (OR628)

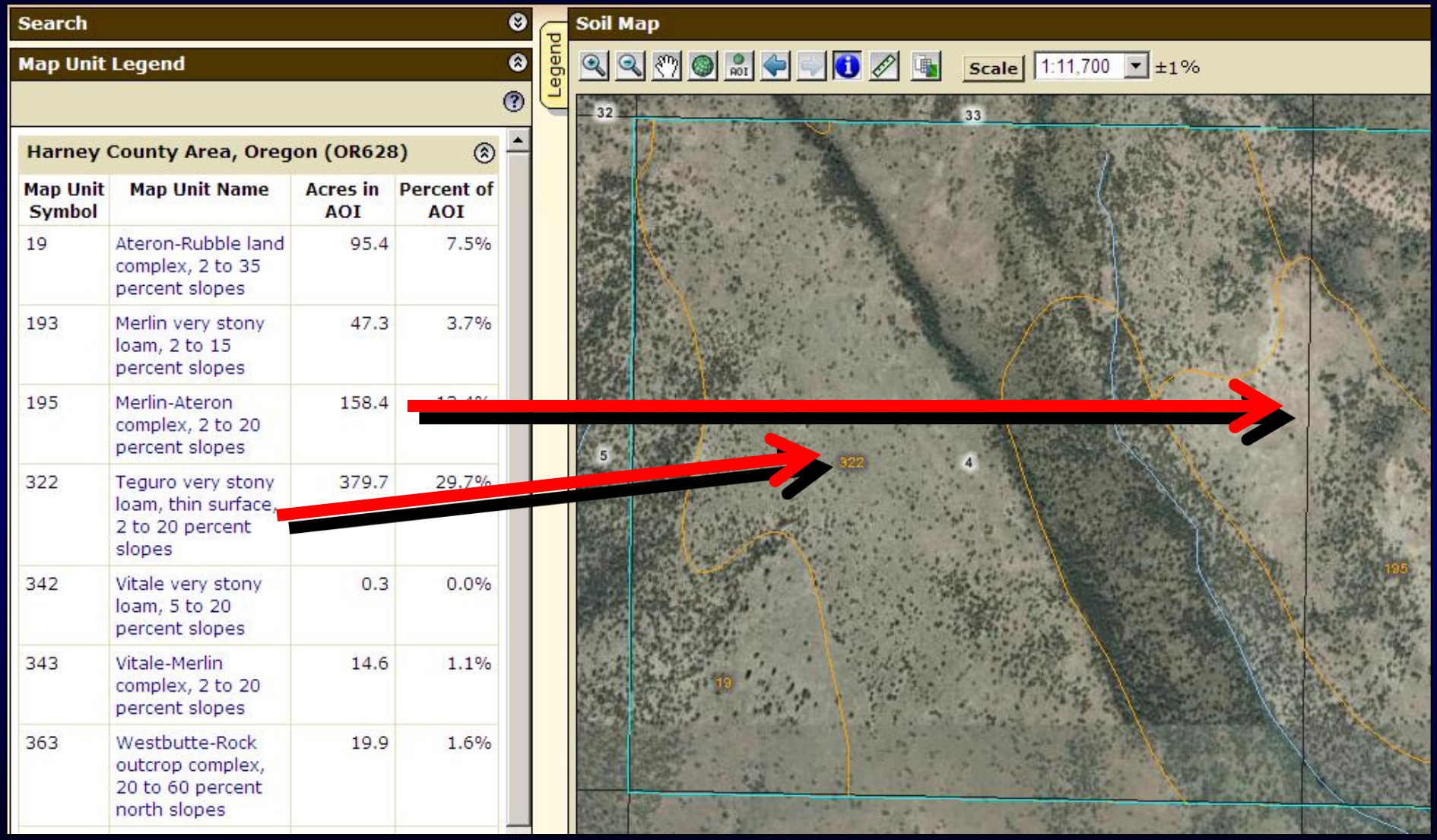
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
19	Ateron-Rubble land complex, 2 to 35 percent slopes	95.4	7.5%
193	Merlin very stony loam, 2 to 15 percent slopes	47.3	3.7%
195	Merlin-Ateron complex, 2 to 20 percent slopes	158.4	12.4%
322	Teguro very stony loam, thin surface, 2 to 20 percent slopes	379.7	29.7%
342	Vitale very stony loam, 5 to 20 percent slopes	0.3	0.0%
343	Vitale-Merlin complex, 2 to 20 percent slopes	14.6	1.1%
363	Westbutte-Rock outcrop complex, 20 to 60 percent north slopes		

Legend

Soil Map

Scale 1:11,700 ±1%

Soil Map Units—Restoration Potential?



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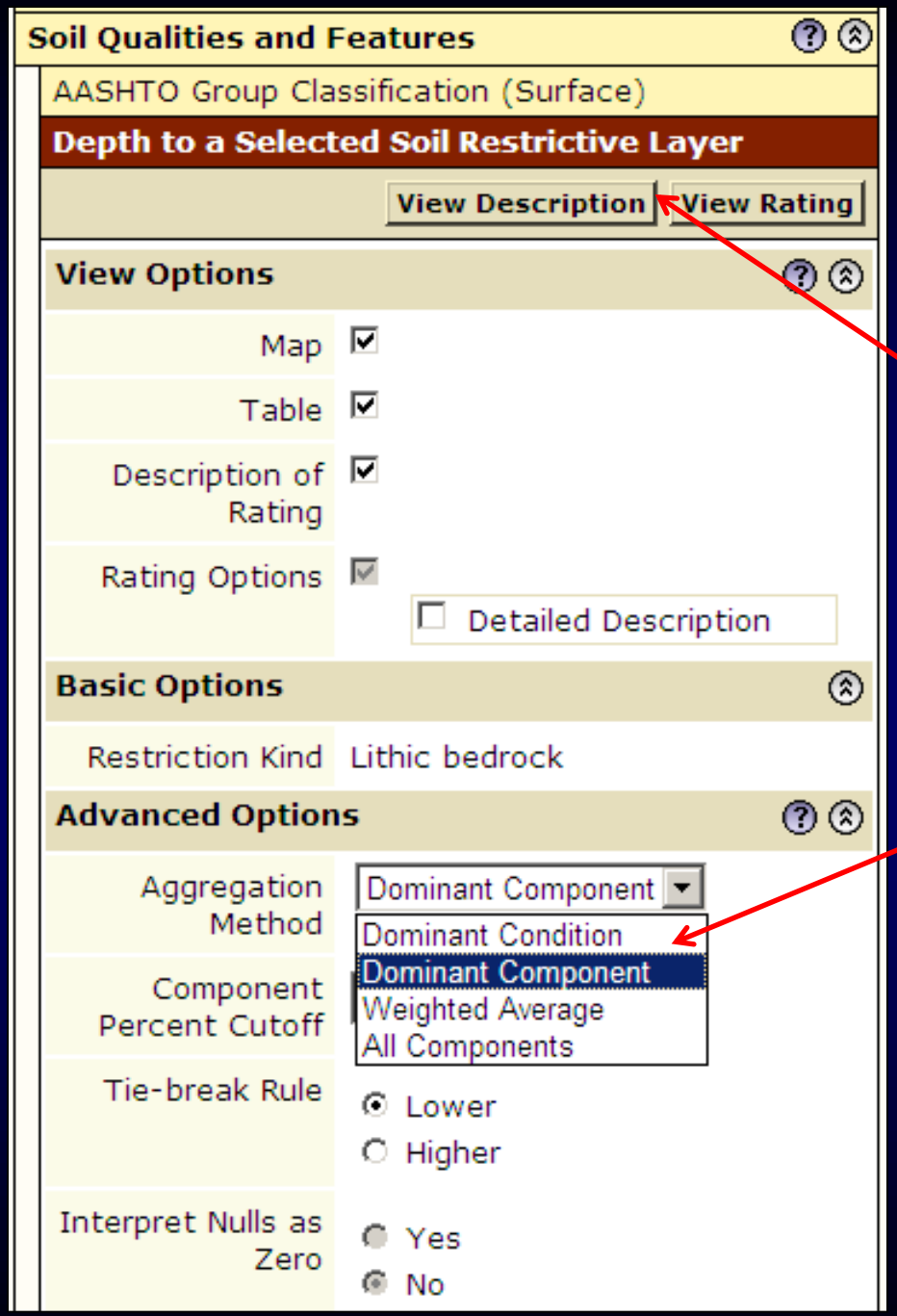
363	Westbutte-Rock outcrop complex, 20 to 60 percent north slopes	19.9	1.6%

Depth to a Soil Restriction Layer

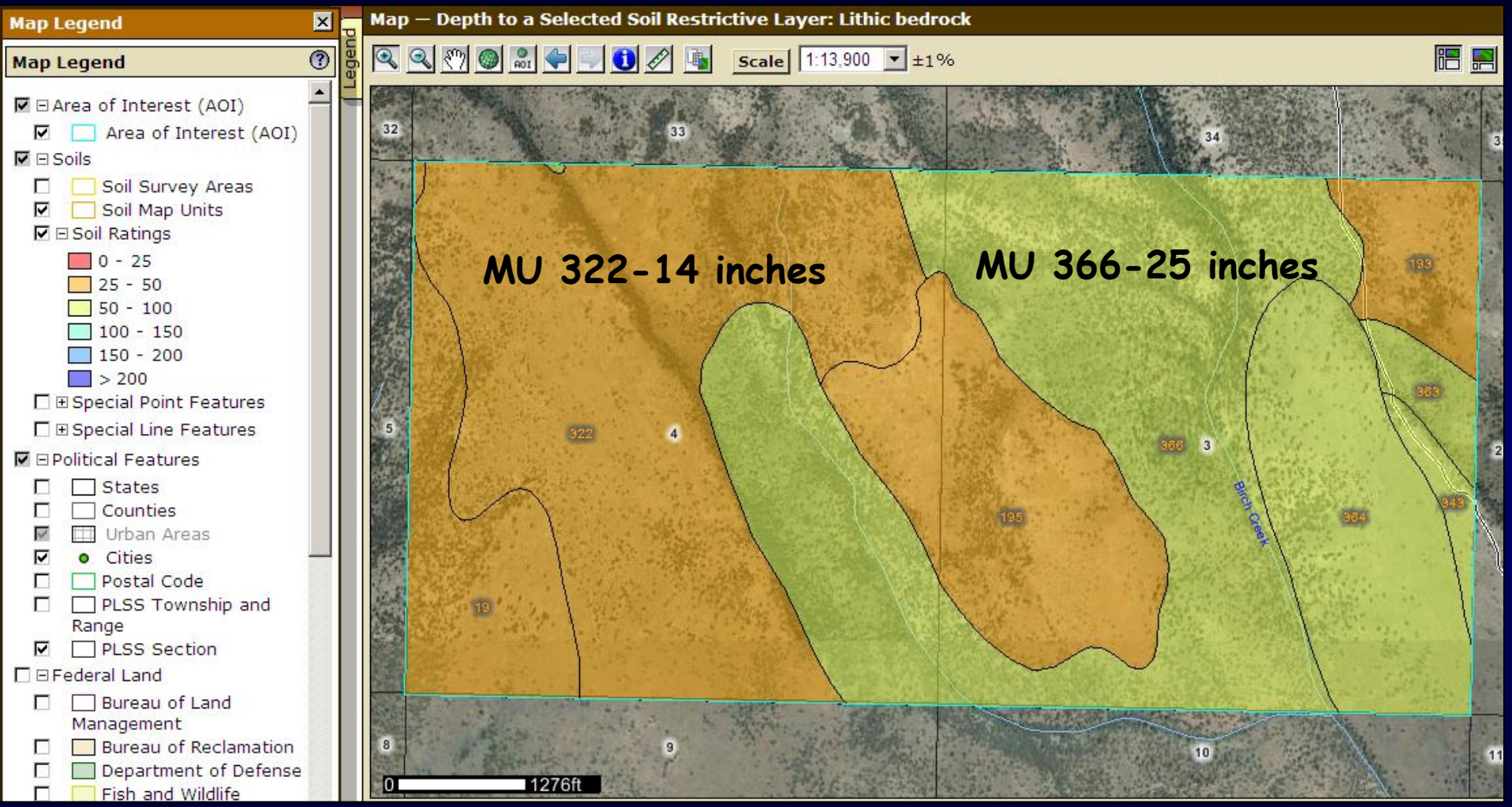


Click on "View Description" to get more information about this soil property.

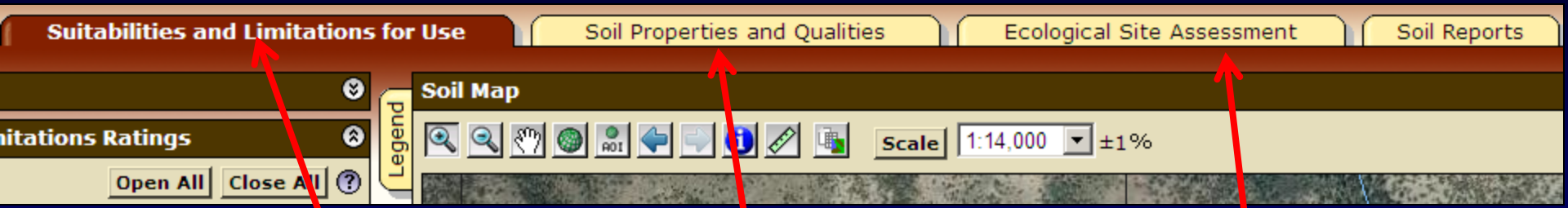
Click on "View Rating" to generate a map and report.

Choice list for Aggregation Method

Depth to Lithic Bedrock



The Soil Data Explorer tab provides multiple options for displaying soils and ecological site information.

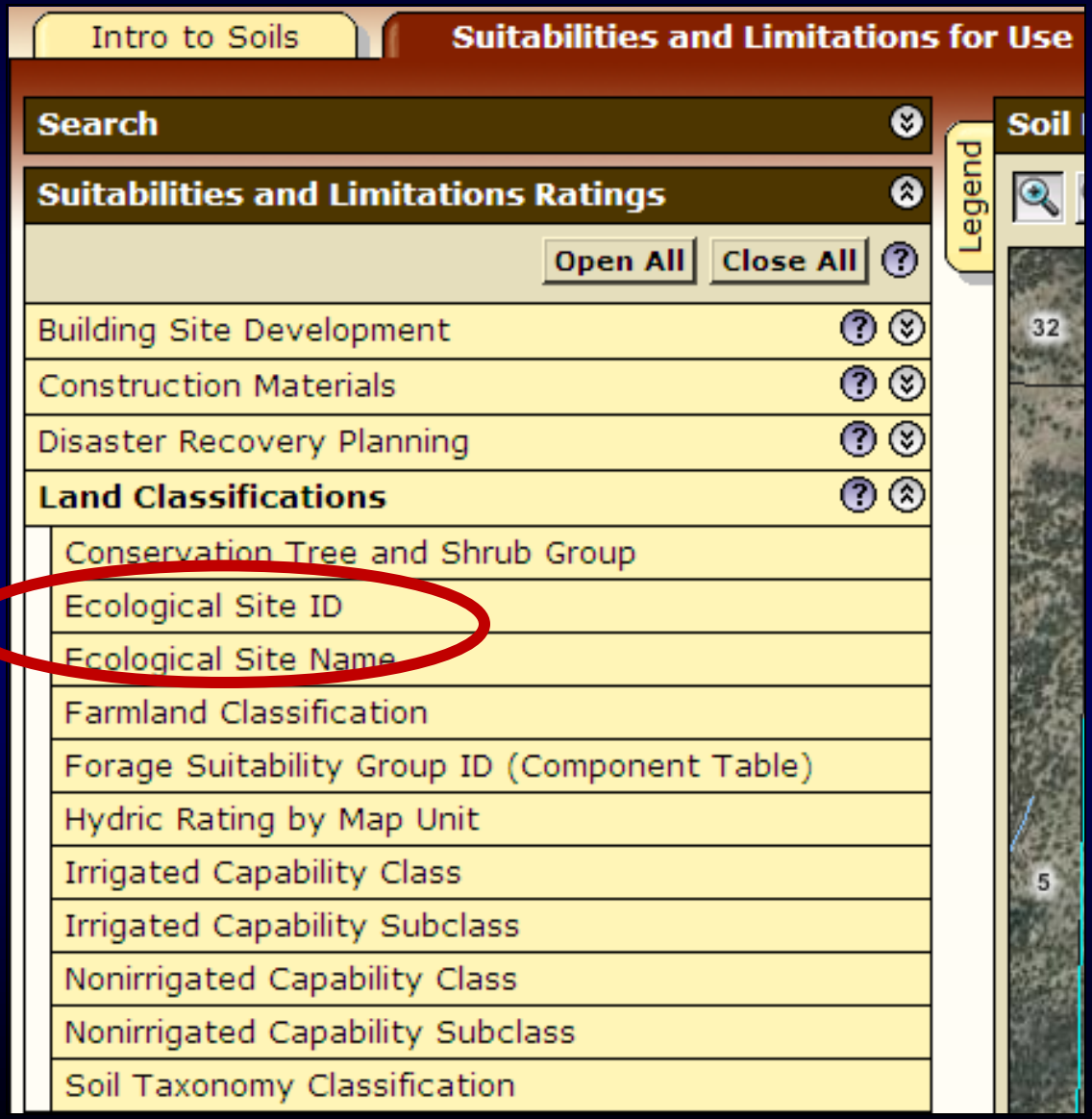


The "**Suitabilities Limitations for U** is used to create and reports of a interpretation su "Rangeland Seedi Great Basin Ecor

The "**Soil Properties and Qualities**" tab is used to create maps and reports for a sir soil property such as Percent Clay in the surface horizon.

The "**Ecological Site Assessment**" tab is used to view and print **sections** of Ecological Site Descriptions.

Ecological Site Information



The **Land Management** category contains numerous interpretations related to restoration practices.

Land Management
Chaining Suitability
Construction Limitations for Haul Roads and Log Landings
Erosion Hazard (Off-Road, Off-Trail)
Erosion Hazard (Road, Trail)
Fencing
Fire Damage Susceptibility
Fugitive Dust Resistance
Harvest Equipment Operability
Mechanical Site Preparation (Deep)
Mechanical Site Preparation (Surface)
Mechanical Treatment, Rolling Drum
Mechanical Treatment, Shredder
Medusahead Invasion Susceptibility

Potential for Damage by Fire
Potential for Seedling Mortality
Pygmy Rabbit Habitat Potential
Rangeland Drill
Rangeland Seeding, Great Basin Ecoregion
Site Degradation Susceptibility
Soil Compaction Resistance
Soil Restoration Potential
Soil Rutting Hazard
Suitability for Hand Planting
Suitability for Log Landings (OR)
Suitability for Mechanical Planting
Suitability for Roads (Natural Surface) (OR)
Yellow Star-thistle Invasion Susceptibility

Description: Mechanical Treatment, Shredder

Description — Mechanical Treatment, Shredder

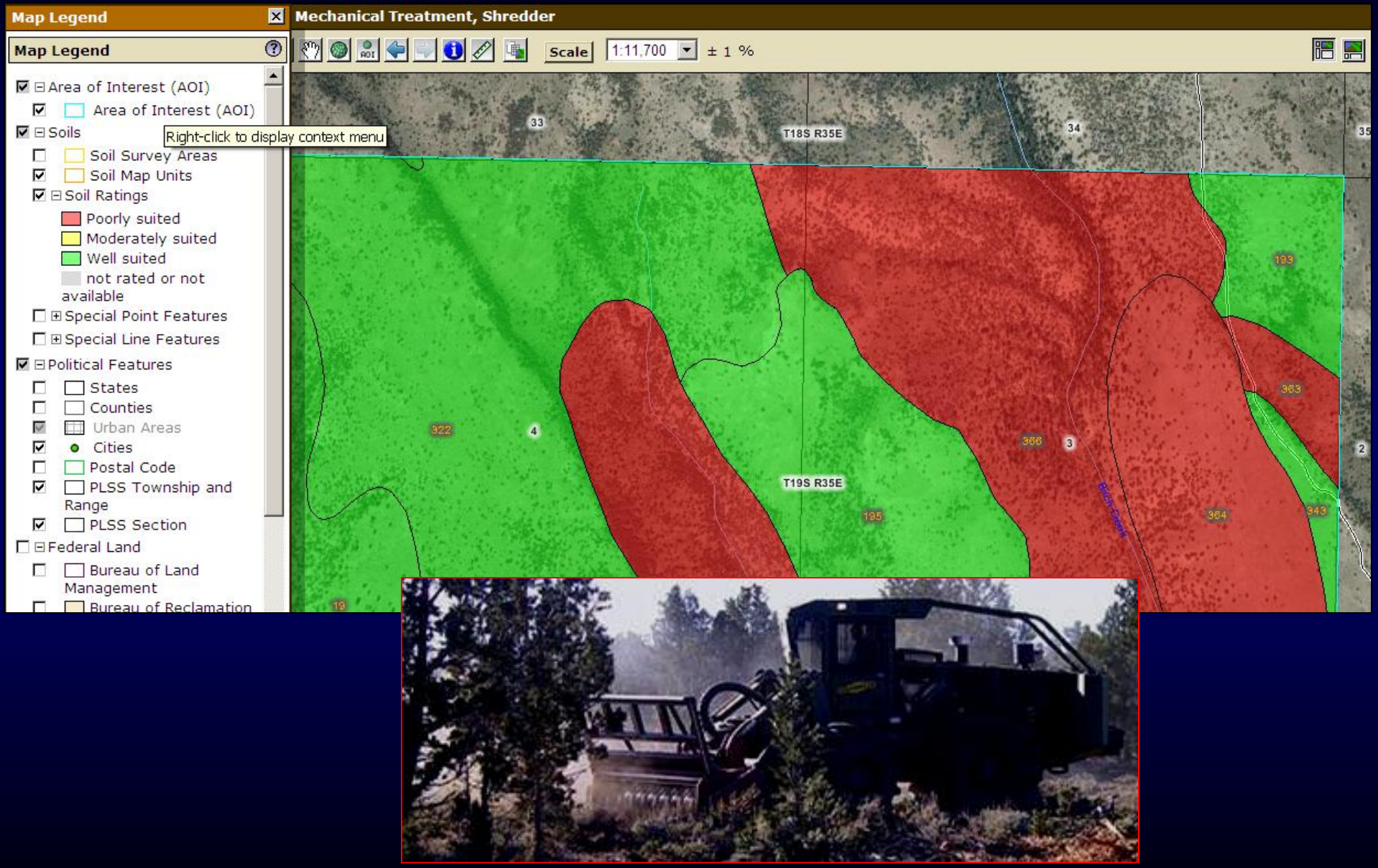
This interpretation rates each soil for its suitability for a shredder mechanical treatment which is commonly practiced, sometimes in combination with seeding, for rangeland restoration. The shredder mechanical treatment ratings represent the relative physical limitations of soil factors upon use of shredder implements suitable for treatment of rangeland sites. This rating should be used in conjunction with the rangeland seeding ratings or the soil restoration potential rating depending upon whether seeding or natural regeneration will be utilized on the site.

The shredder mechanical treatment is often implemented in sagebrush, mountain shrub, and pinyon-juniper vegetation types to reduce the size and composition of dense brush and trees up to 15-18 inches diameter, depending upon the equipment used. The treatment objectives can include reducing hazardous fuel loads, increasing forage for livestock and wildlife, increased infiltration, and reduced runoff and erosion. The equipment may also help bury seed broadcast prior to or during treatment.

There are several types of shredder equipment used for these treatments. One of the most commonly used is a large, articulated tractor with a front-mounted, 6-8 foot wide, hydraulically controlled mower/mulcher head. The machine has rubber, flotation-type tires which are designed for minimal ground disturbance. The mower/mulcher head is lifted above the tree or shrub top and lowered quickly, usually completely chopping the plant in less than 15 seconds. The rubber tired machine can also be equipped with flail shredders which use blades attached to a long, rotating horizontal shaft. The rotating drum can be 3 to 6 feet wide by 2 feet in diameter and is often mounted on the end of a boom. The most common type of rubber-tired shredder can safely operate on slopes up to about 20%. Tracked vehicles are also used which can be crawler tractors or excavators equipped with a flail type or mower/shredder type attachment to shred the shrubs or trees. Excavators have the shredder attachment mounted on a boom that can extend in any direction. The tracked shredders can operate on slopes up to 30-35%. Large pieces of debris can be thrown 200-300 feet during shredder operation, so safety to bystanders is an issue.

Steep slopes increase the power requirements for the equipment and limit the ability to safely perform the shredder operation. Stones and rock outcrop make equipment operation more difficult. High water table affects the timing of tillage by limiting access to the site. On-site investigation is recommended before implementing any shredder mechanical treatment projects.

Potential for Mechanical Treatment with a Shredder



Map Unit Description report

19—Ateron-Rubble land complex, 2 to 35 percent slopes

Map Unit Setting

Elevation: 4,000 to 5,300 feet
Mean annual precipitation: 12 to 16 inches
Mean annual air temperature: 39 to 43 degrees F
Frost-free period: 50 to 80 days

Map Unit Composition

Ateron and similar soils: 50 percent
Rubble land: 35 percent

Description of Ateron

Setting

Landform: Hills
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum and colluvium weathered from basalt, andesite, rhyolite and/or welded tuff

Properties and qualities

Slope: 2 to 20 percent
Surface area covered with cobbles, stones or boulders: 1.6 percent
Depth to restrictive feature: 10 to 20 inches to lithic bedrock
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 1.7 inches)

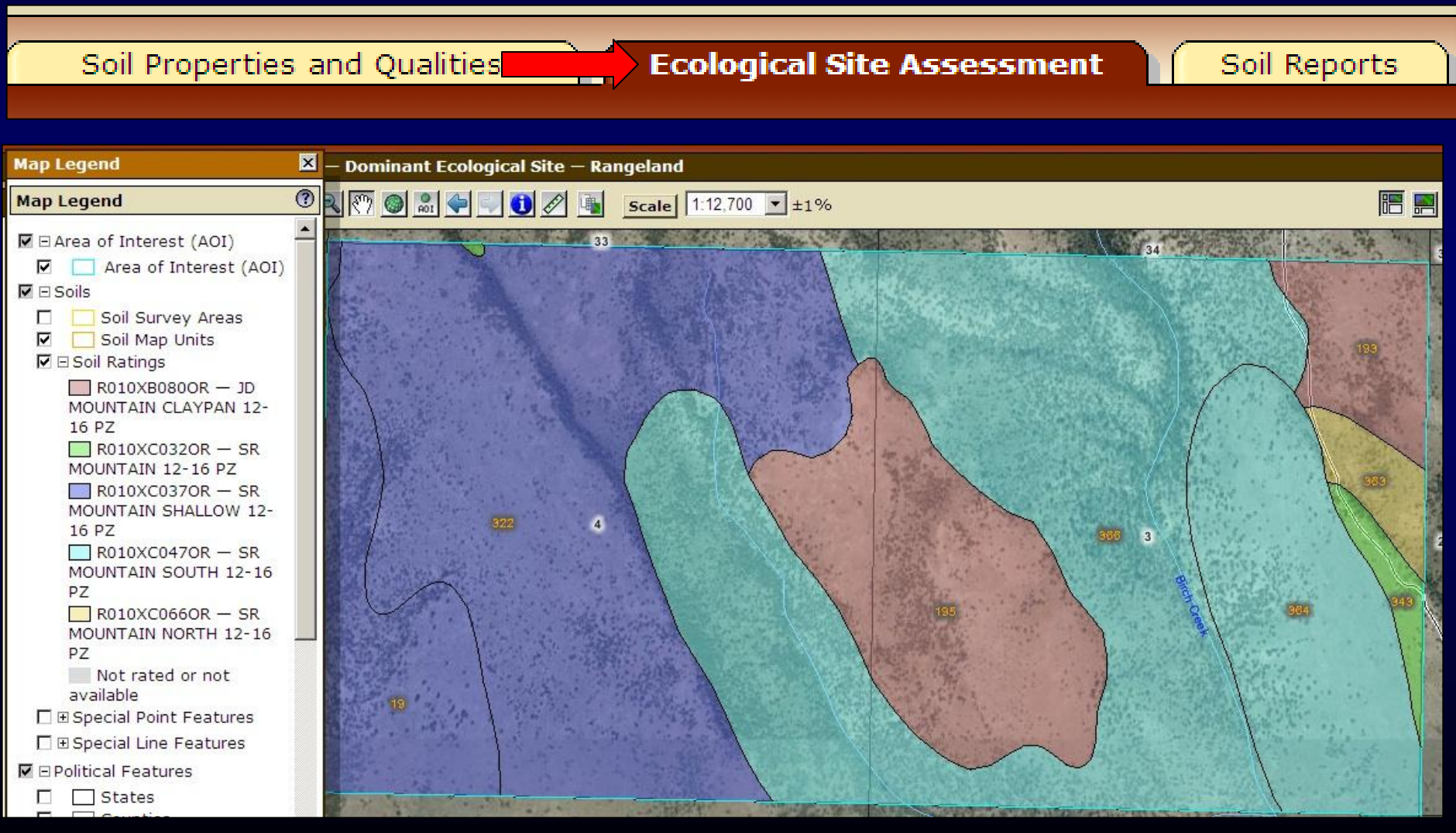
Interpretive groups

Land capability (nonirrigated): 7s
Ecological site: SR MOUNTAIN SHALLOW 12-16 PZ (R010XC037OR)

Typical profile

0 to 5 inches: Very stony loam
5 to 12 inches: Very cobbly clay loam
12 to 18 inches: Extremely stony clay
18 to 28 inches: Unweathered bedrock

The "**Ecological Site Assessment**" tab can be used to generate maps of the **dominant** ecological sites and reports of ecological site descriptions.



The "Ecological Site Assessment" tab includes a report of Ecological Sites in the Area of Interest

Table — Ecological Sites by Map Unit Component — Rangeland

Harney County Area, Oregon

Map unit symbol	Component name (percent)	Ecological site	Acres in AOI	Percent of AOI
19	Ateron (50%)	R010XC037OR — SR MOUNTAIN SHALLOW 12-16 PZ	93.6	7.3%
	Rubble land (35%)			
193	Merlin (85%)	R010XB080OR — JD MOUNTAIN CLAYPAN 12-16 PZ	47.0	3.7%
195	Merlin (60%)	R010XB080OR — JD MOUNTAIN CLAYPAN 12-16 PZ	158.4	12.4%
	Ateron (25%)	R010XC080OR — SR MAHOGANY MOUNTAIN LOAM 14-18 PZ		
322	Teguro, thin surface (85%)	R010XC037OR — SR MOUNTAIN SHALLOW 12-16 PZ	381.9	29.9%
342	Vitale (85%)	R010XC032OR — SR MOUNTAIN 12-16 PZ	0.4	0.0%
343	Vitale (50%)	R010XC032OR — SR MOUNTAIN 12-16 PZ	13.9	1.1%
	Merlin (35%)	R010XB080OR — JD MOUNTAIN CLAYPAN 12-16 PZ		

15%?

Ecological Sites

Open All | Close All

All Ecological Sites

R010XB080OR — JD MOUNTAIN CLAYPAN 12-16 PZ

R010XC032OR — SR MOUNTAIN 12-16 PZ

This Ecological Site

View Ecological Site Info

View Options

All Plant Community Photos ☑

State Transition Diagram ☑

Ecological Dynamics Description ☑

View Ecological Site Info

Reference Plant Community

R010XC037OR — SR MOUNTAIN SHALLOW 12-16 PZ

R010XC047OR — SR MOUNTAIN SOUTH 12-16 PZ

R010XC059OR — SR MAHOGANY ROCKLAND 12+ PZ

R010XC066OR — SR MOUNTAIN NORTH 12-16 PZ

R010XC080OR — SR MAHOGANY MOUNTAIN LOAM 14-18 PZ

Not the Full Ecological Site Description

All Plant Community Photos — R010XC032OR — SR

Reference Plant Community

Ecological Sites

Open All | Close All

All Ecological Sites

R010XB080OR — JD MOUNTAIN CLAYPAN 12-16 PZ

R010XC032OR — SR MOUNTAIN 12-16 PZ

This Ecological Site

View Ecological Site Info

View Options

- All Plant Community Photos ☑
- State Transition Diagram ☑
- Ecological Dynamics Description ☑

View Ecological Site Info

Reference Plant Community

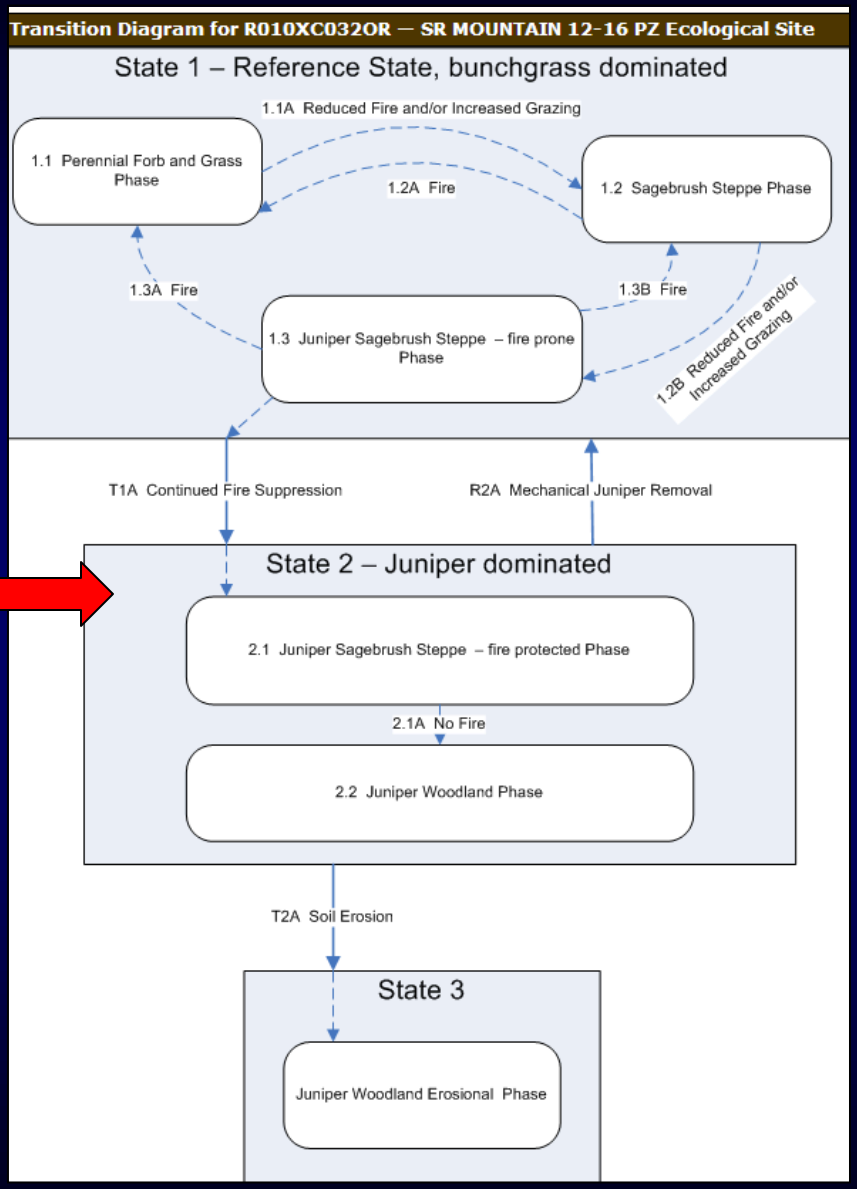
R010XC037OR — SR MOUNTAIN SHALLOW 12-16 PZ

R010XC047OR — SR MOUNTAIN SOUTH 12-16 PZ

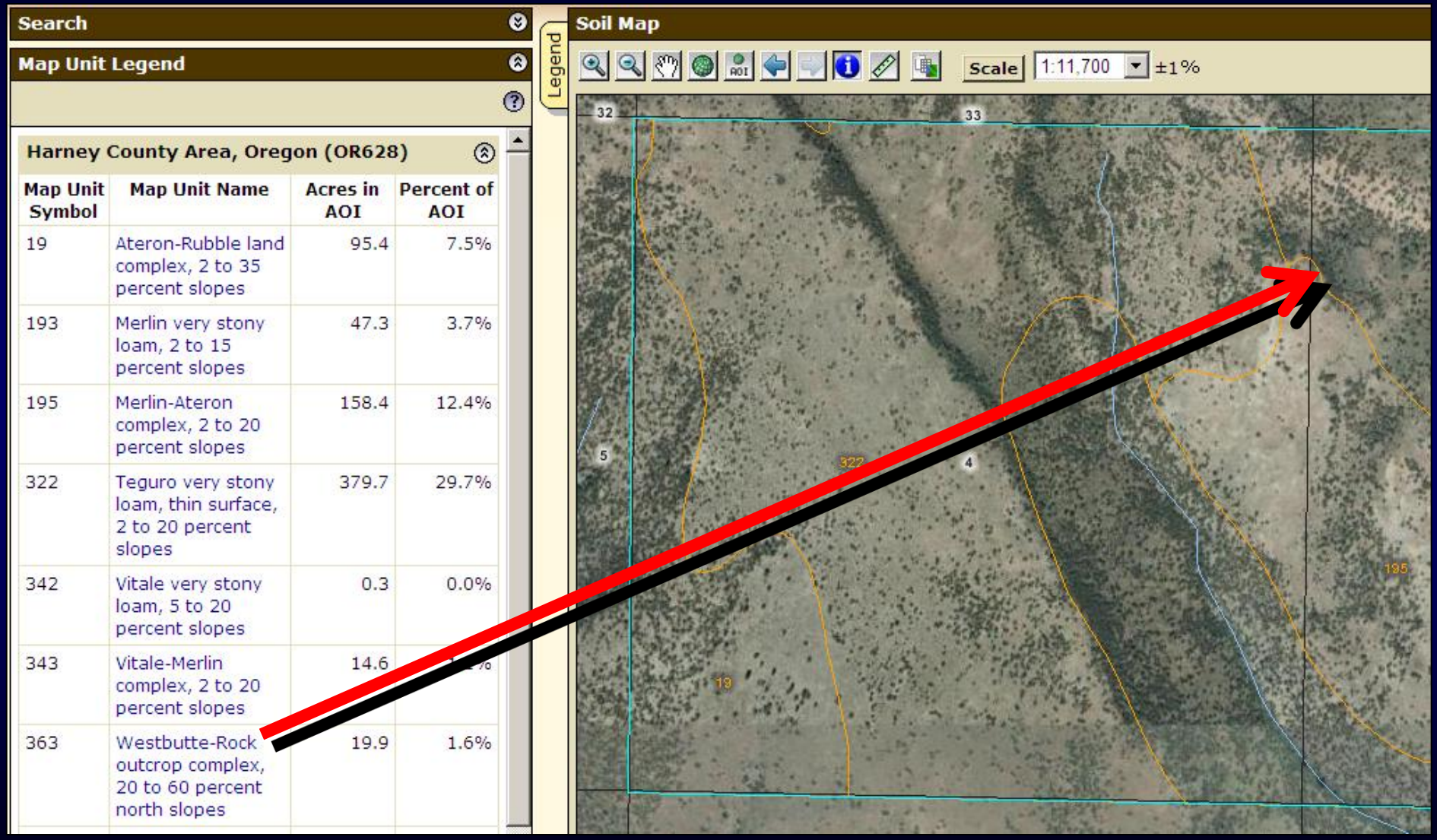
R010XC059OR — SR MAHOGANY ROCKLAND 12+ PZ

R010XC066OR — SR MOUNTAIN NORTH 12-16 PZ

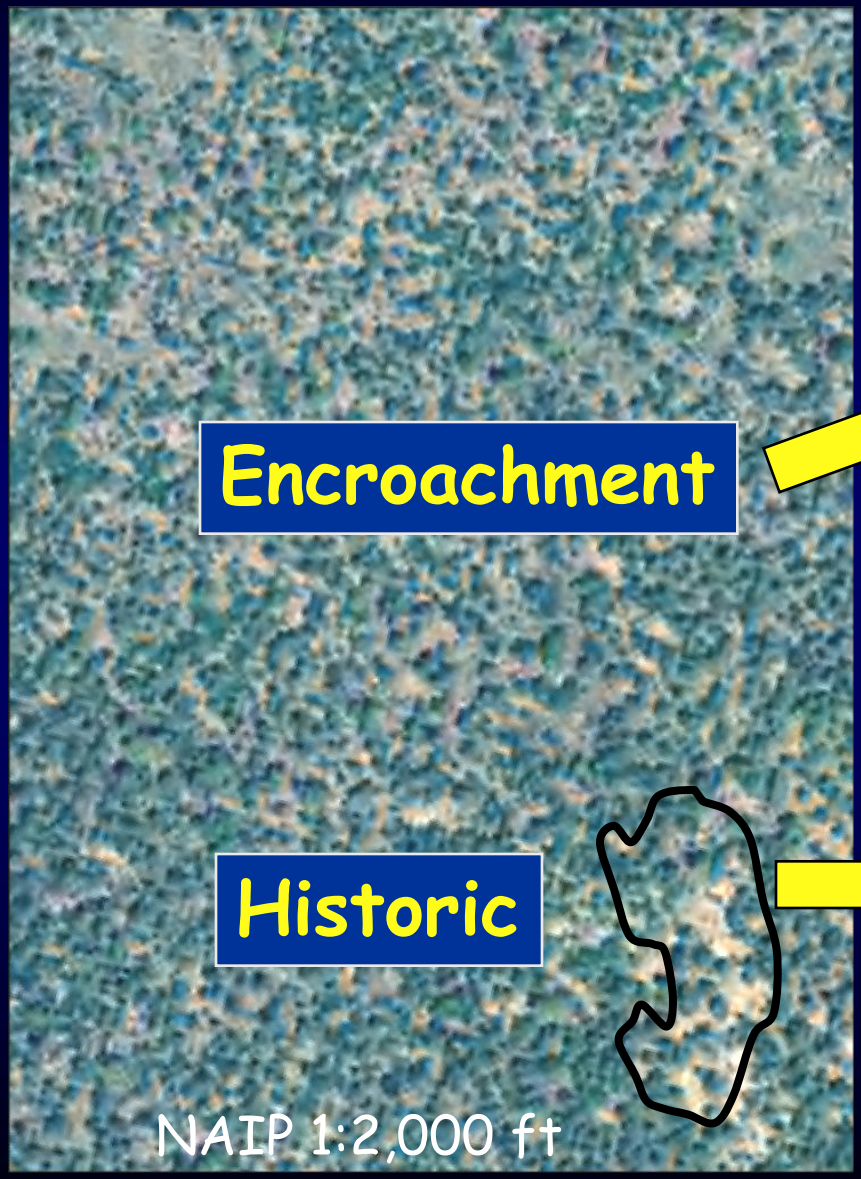
R010XC080OR — SR MAHOGANY MOUNTAIN LOAM 14-18 PZ

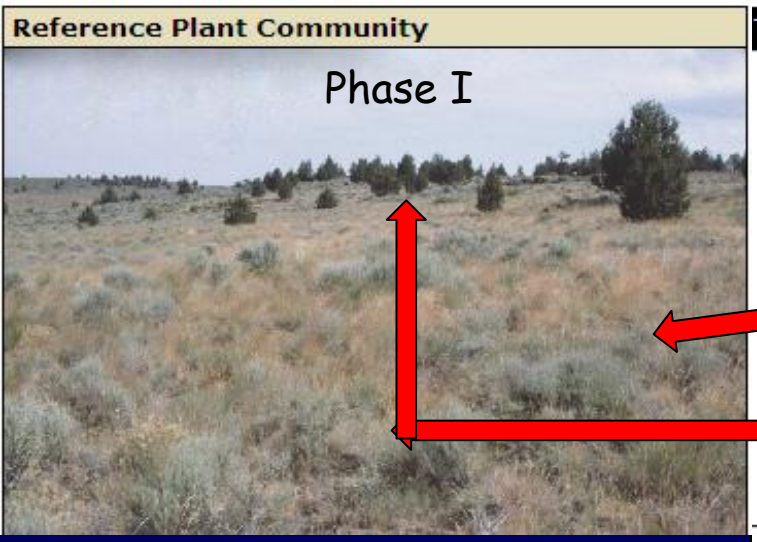


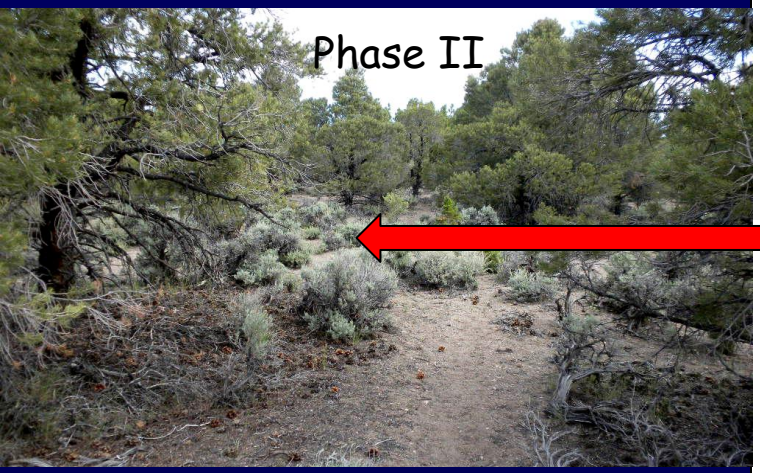
Historic Juniper Woodlands-Where do they occur?



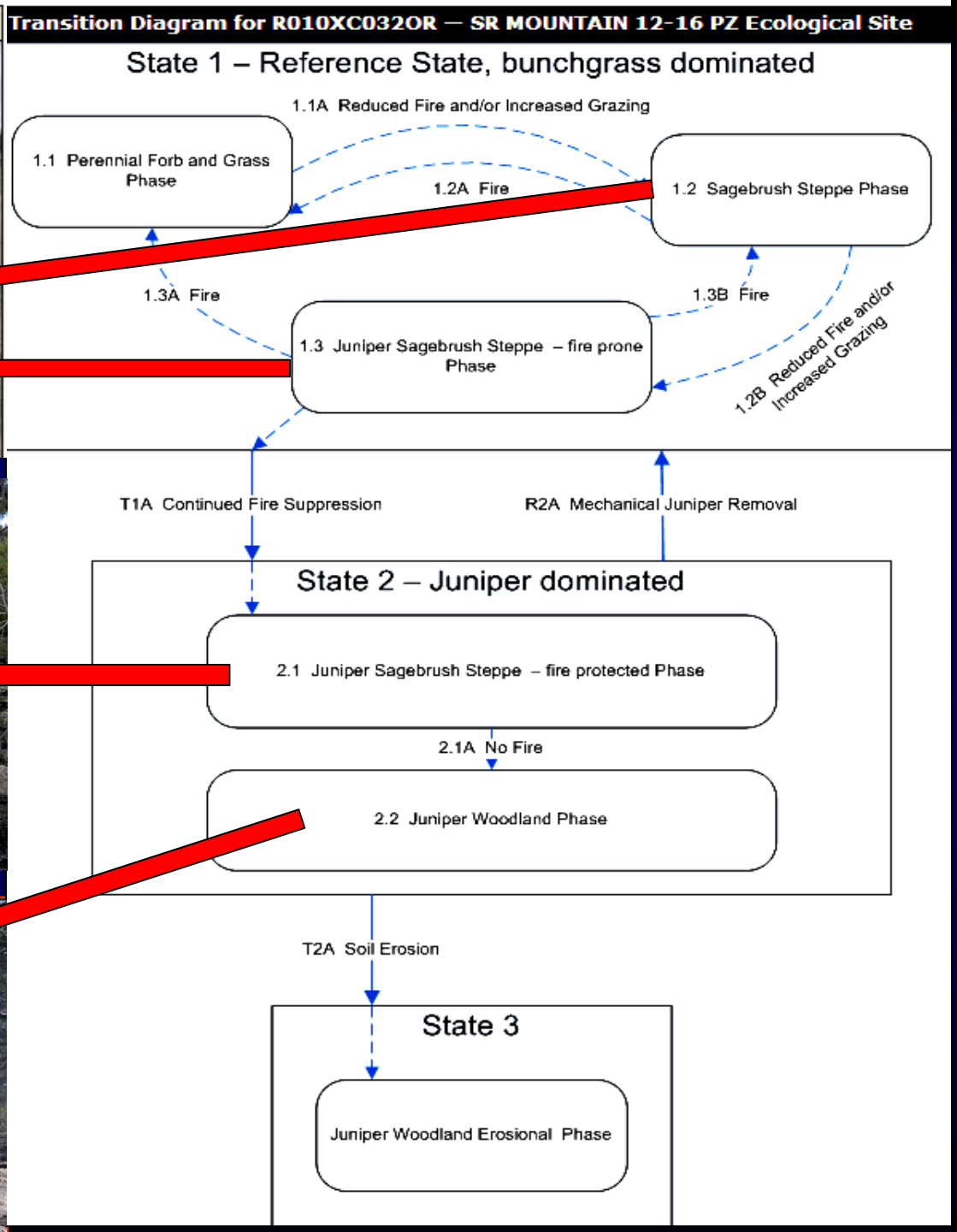
Use 1 m^2 NAIP Imagery to Plan Appropriate Site-Level Treatments



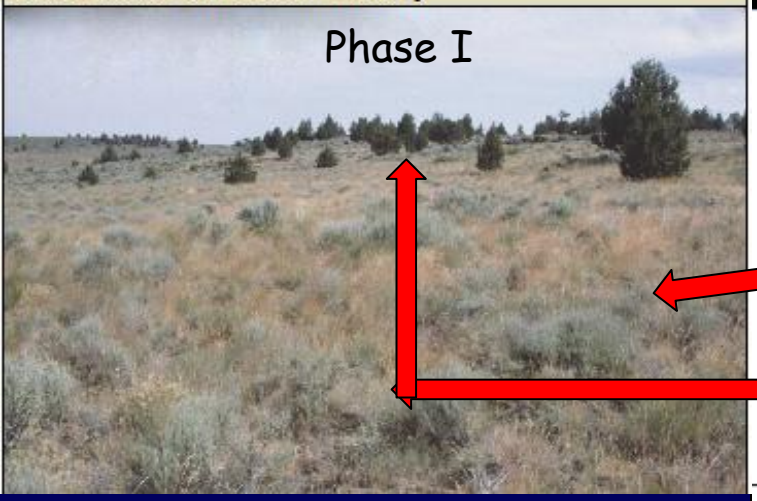

Reference Plant Community
Phase I


Phase II


Phase III


Transition Diagram for R010XC032OR — SR MOUNTAIN 12-16 PZ Ecological Site
State 1 – Reference State, bunchgrass dominated
1.1A Reduced Fire and/or Increased Grazing
1.1 Perennial Forb and Grass Phase
1.2A Fire
1.2 Sagebrush Steppe Phase
1.3A Fire
1.3B Fire
1.3 Juniper Sagebrush Steppe – fire prone Phase
1.2B Reduced Fire and/or Increased Grazing
T1A Continued Fire Suppression
R2A Mechanical Juniper Removal
State 2 – Juniper dominated
2.1 Juniper Sagebrush Steppe – fire protected Phase
2.1A No Fire
2.2 Juniper Woodland Phase
T2A Soil Erosion
State 3
Juniper Woodland Erosional Phase

Reference Plant Community



Transition Diagram for R010XC032OR — SR MOUNTAIN 12-16 PZ Ecological Site

State 1 – Reference State, bunchgrass dominated

1.1 Perennial Forb and Grass Phase

1.2 Sagebrush Steppe Phase

1.3 Juniper Sagebrush Steppe – fire prone Phase

1.1A Reduced Fire and/or Increased Grazing

1.2A Fire

1.3A Fire

1.3B Fire

1.2B Reduced Fire and/or Increased Grazing

T1A Continued Fire Suppression

R2A Mechanical Juniper Removal

State 2 – Juniper dominated

2.1 Juniper Sagebrush Steppe – fire protected Phase

2.1A No Fire

2.2 Juniper Woodland Phase

T2A Soil Erosion

State 3

Juniper Woodland Erosional Phase

Thresholds in Pinyon Pine/Juniper Encroachment into Sagebrush Steppe

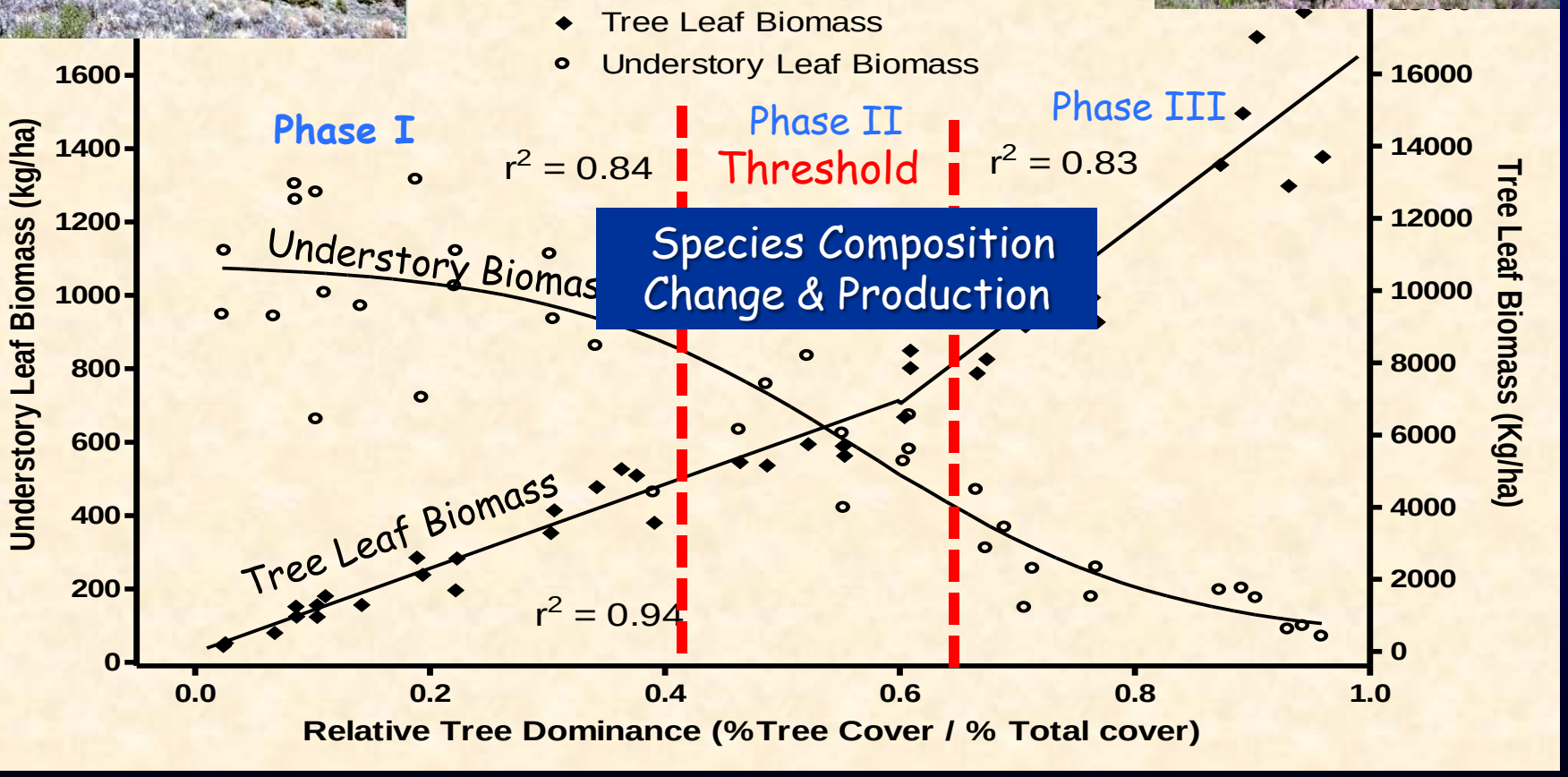
Underdown 1973

Joint Fire Science Program

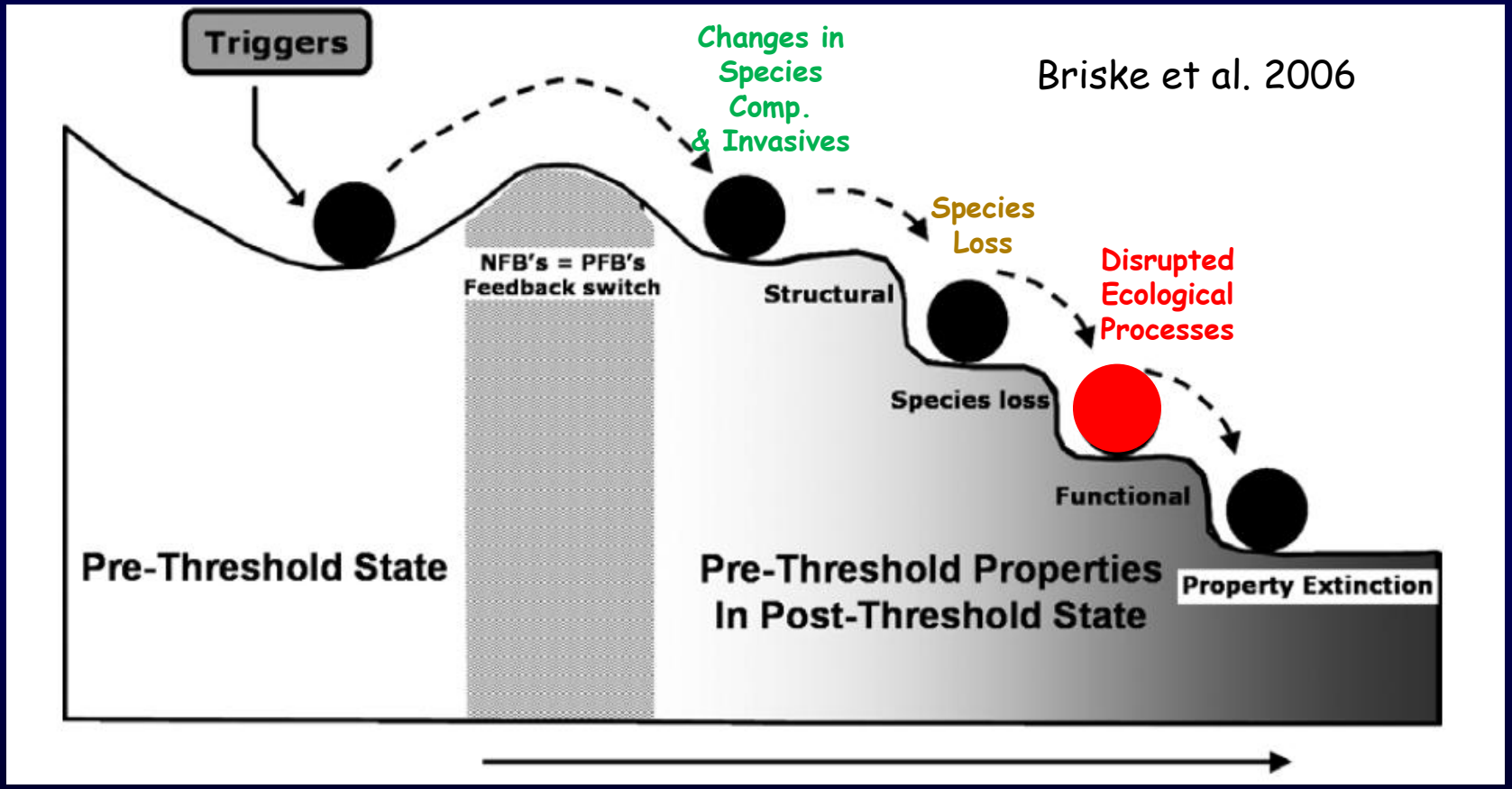
Sagebrush Steppe SageSTEP Treatment Evaluation Project

Underdown 2005

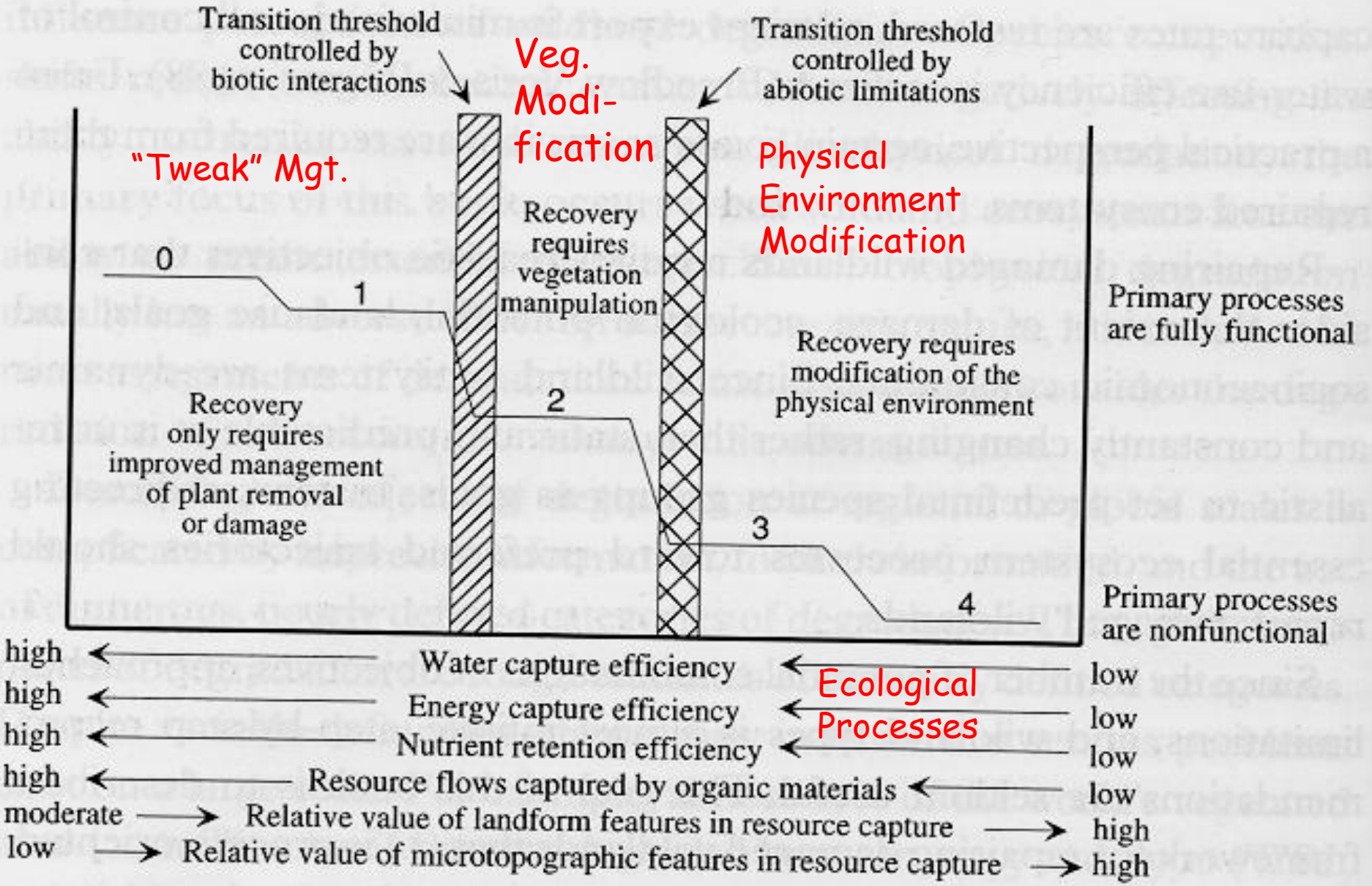
Underdown Canyon Demonstration Area
Woodland Dynamics



Threshold Progression



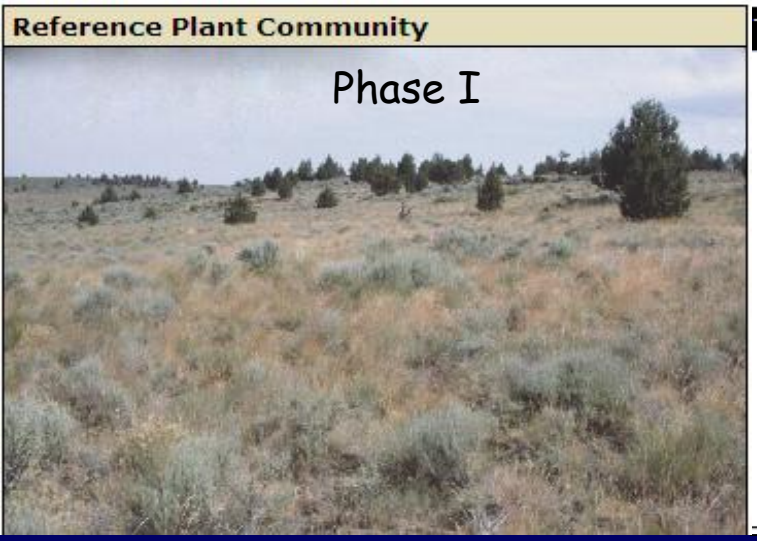
Whisenant (1999) "Repairing Damaged Wildlands"

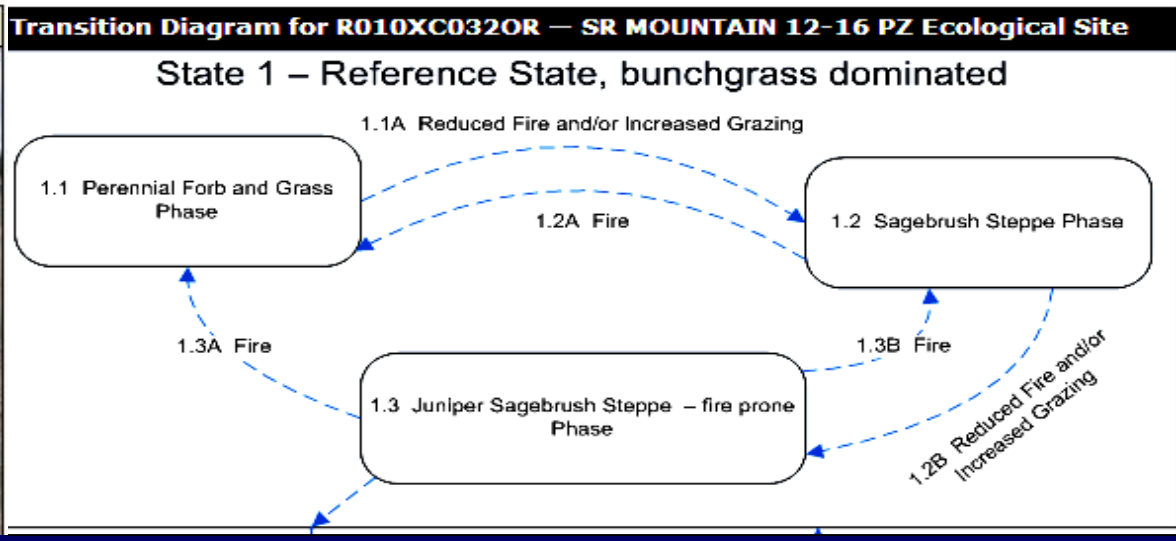


Restoration-Is reestablishing previous plant composition & lost species adequate…?

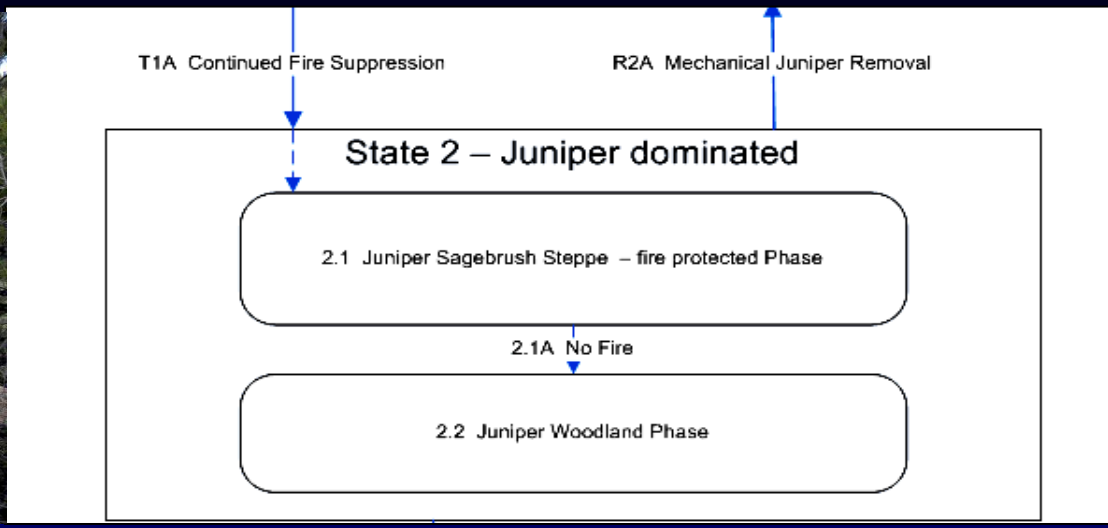
…or has the site potential declined (soil loss) to the point that reseeding may not be the first treatment?

Restoration Options



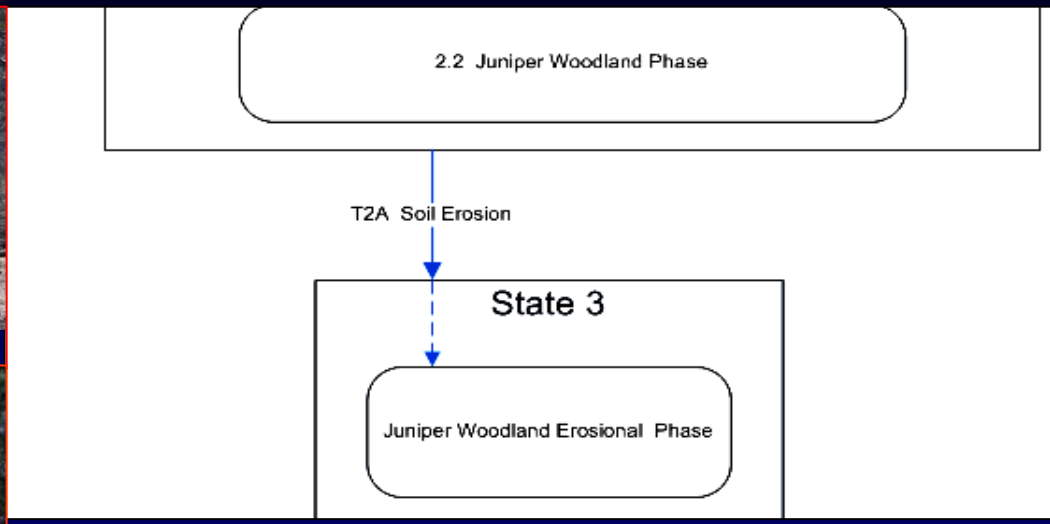


Restoration Options



Chainsaw & Mastication but Fire?

Restoration Options



Chaining, Mastication Not Fire & Requires reseeding Herbaceous/Sagebrush

What to seed?

Tables — Reference Plant Community

Annual Production (Lbs/Acre)

Plant Type	Low	Representative Value	High
Grass/Grasslike	900	1,200	1,500
Forb	120	160	200
Shrub/Vine	180	240	300
Totals	**1,200**	**1,600**	**2,000**

Plant Species Composition (Lbs/Acre)

Grass/Grasslike

Group	Plant Common Name	Plant Scientific Name	Annual Production Pounds Per Acre	
			Low	High
1: Dominant deep rooted bunchgrass			**960**	**1280**
	Idaho fescue	Festuca idahoensis	960	1280
2: Sub-dominant deep rooted bunchgrass			**32**	**320**
	bluebunch wheatgrass	Pseudoroegneria spicata ssp. spicata	32	320
3: Sub-dominant shallow rooted perennial grass			**32**	**80**
	Sandberg bluegrass	Poa secunda	32	80
4: Other perennial grasses			**64**	**384**
	western needlegrass	Achnatherum occidentale	0	32
	Thurber's needlegrass	Achnatherum thurberianum	32	128
	mountain brome	Bromus marginatus	0	32
	threadleaf sedge	Carex filifolia	0	32
	squirreltail	Elymus elymoides	0	32
	prairie Junegrass	Koeleria macrantha	16	48
	basin wildrye	Leymus cinereus	16	48
	oniongrass	Melica bulbosa	0	32

Evaluate where you are in relation to ESD and appropriate species to seed

Forb				
Group	Plant Common Name	Plant Scientific Name	Annual Production Pounds Per Acre	
			Low	High
7: Dominant perennial forbs			**32**	**48**
	arrowleaf balsamroot	Balsamorhiza sagittata	32	48
8: Sub-dominant perennia forbs			**112**	**224**
	common yarrow	Achillea millefolium	16	32
	milkvetch	Astragalus	16	32
	fleabane	Erigeron	16	32
	buckwheat	Eriogonum	16	32
	desertparsley	Lomatium	16	32
	lupine	Lupinus	16	32
	phlox	Phlox	16	32
9: All other perennial forbs			**30**	**200**
	agoseris	Agoseris	2	10
	onion	Allium	2	10
	pussytoes	Antennaria	2	10
	brodiaea	Brodiaea	2	10
	mariposa lily	Calochortus	2	10
	Indian paintbrush	Castilleja	2	10
	bastard toadflax	Comandra	2	16
	bushy bird's beak	Cordylanthus ramosus	2	10
	tapertip hawksbeard	Crepis acuminata	2	16
	waterleaf	Hydrophyllum	0	16

Shrub/Vine				
Group	Plant Common Name	Plant Scientific Name	Annual Production Pounds Per Acre	
			Low	High
11: Dominant evergreen shrub			**48**	**128**
	mountain big sagebrush	Artemisia tridentata ssp. vaseyana	48	128
12: Subdominant evergreen shrub			**16**	**48**
	basin big sagebrush	Artemisia tridentata ssp. tridentata	16	48
15: Other shruds			**32**	**320**
	Saskatoon serviceberry	Amelanchier alnifolia	0	32
	threetip sagebrush	Artemisia tripartita	0	32
	big sagebrush	Artemisia tridentata ssp. xericensis	0	32
	yellow rabbitbrush	Chrysothamnus viscidiflorus	0	32
	squaw apple	Peraphyllum ramosissimum	0	32
	antelope bitterbrush	Purshia tridentata	0	32
	wax currant	Ribes cereum	0	32
	Woods' rose	Rosa woodsii	0	32
	common snowberry	Symphoricarpos albus	0	32
	horsebrush	Tetradymia	0	32
Tree				
Group	Plant Common Name	Plant Scientific Name	Annual Production Pounds Per Acre	
			Low	High
16: Evergreen sub-dominant trees			**0**	**64**
	western juniper	Juniperus occidentalis	0	32
	ponderosa pine	Pinus ponderosa	0	32

The **Land Management** category contains numerous interpretations related to restoration practices.

Land Management
Chaining Suitability
Construction Limitations for Haul Roads and Log Landings
Erosion Hazard (Off-Road, Off-Trail)
Erosion Hazard (Road, Trail)
Fencing
Fire Damage Susceptibility
Fugitive Dust Resistance
Harvest Equipment Operability
Mechanical Site Preparation (Deep)
Mechanical Site Preparation (Surface)
Mechanical Treatment, Rolling Drum
Mechanical Treatment, Shredder
Medusahead Invasion Susceptibility

Potential for Damage by Fire
Potential for Seedling Mortality
Pygmy Rabbit Habitat Potential
Rangeland Drill
Rangeland Seeding, Great Basin Ecoregion
Site Degradation Susceptibility
Soil Compaction Resistance
Soil Restoration Potential
Soil Rutting Hazard
Suitability for Hand Planting
Suitability for Log Landings (OR)
Suitability for Mechanical Planting
Suitability for Roads (Natural Surface) (OR)
Yellow Star-thistle Invasion Susceptibility

USGS Excel Seed Mix Calculator
VegSpec is Gone

	A	B	C	D	E	F	G	H	I	J
2	**Seed Mix Calculator**									
3	**Project Name:**	Class								
4										
5	**Mixture Name:**	Mixture								
6										
7	**How many acres will be seeded?**	425								
8										
9	**Will this mix be Drilled or Broadcast?**	Drill								
10										
11	**How many inches between drill rows?**	12								
12										
13	STEP 1	STEP 2					STEP 3			
14										
15		Calculate % PLS			OR		Fully Occupied Seed Rate?			
16	Species	Total % Germination	% Purity	% Pure Live Seeds (PLS)	Enter % PLS	Seeds per pound	Use Standard Seed Rate (Yes/No)	Standard Fully Occupied PLS/sq ft	Enter Fully Occupied Seed Rate (Seeds/Sq Ft)	Calculated Fully Occupied Seed Rate (lbs/ac)
17	Achillea millefolium	85	92	78.2		2852012	Yes	45		0.687304
18	Crepis acuminata	80	87	69.6		800000	Yes	45		2.45025
19	Poa secunda	92	95	87.4		1046960	Yes	45		1.872278
20	Elymus elymoides	90	98	88.2		192000	Yes	25		5.671875
21	Pseudoroegneria spicata ssp. spicata	94	95	89.3		125680	Yes	25		8.664863
22	Artemisia tridentata ssp. wyomingensis	83	85	70.55		1700963	Yes	45		1.152406

Incorporating ESDs (including Reference Sheets) and Soil Survey into a Sagebrush Restoration Strategy

Pyke, D. A. 2011. **Restoring and rehabilitating sagebrush habitats.** Pp. 531–548 *in* S. T. Knick and J. W. Connelly (editors). Greater Sage-Grouse: ecology and conservation of a landscape species and its habitats. Studies in Avian Biology (vol. 38), University of California Press, Berkeley, CA. (online at www.sagemap.gov)

Ecologically Based Invasive Plant Management Project
www.ebipm.org

Pyke, D. A. 2011.

TABLE 23.1

Potential sagebrush grassland intervention grid for identifying appropriate restoration interventions (modified from Hobbs and Kristjanson 2003).

Departure from the reference state is assigned using a land status assessment similar to Interpreting Indicators of Rangeland Health (Pyke et al. 2002, Pellant et al. 2005). Information from state and transition models is employed to identify probability of recovery (Fig. 23.1).

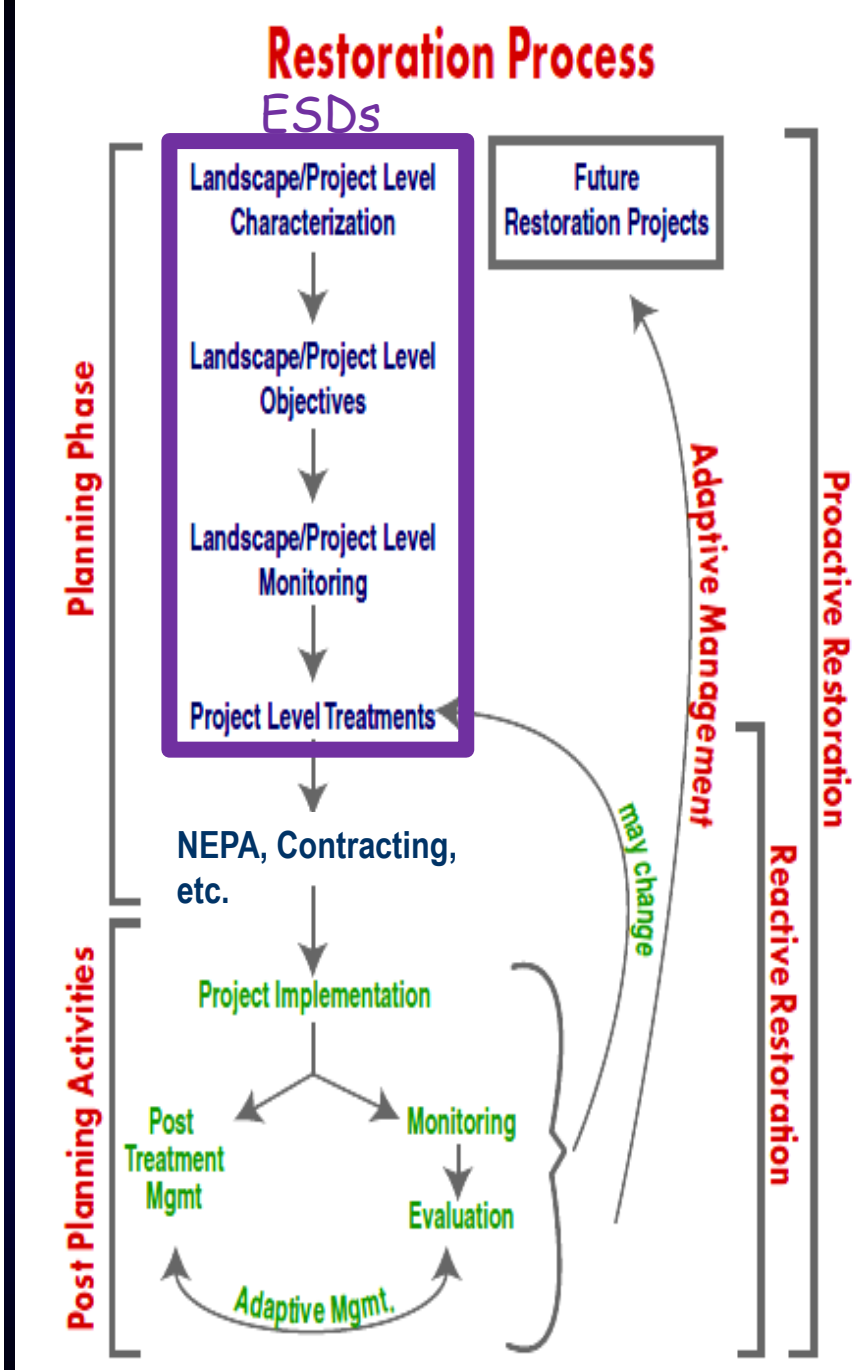
	Departure from the reference state		
	None to slight	Moderate	State change occurred
Probability of recovery or restoration	All plant functional and structural plant groups are present, but may not be in desired composition.	Some functional or structural plant groups are missing or under represented; invasive species common, but not dominant.	Invasive plants dominate; sagebrush or tall grasses are rare; soil stability and hydrologic functioning may be impaired.
High	**No Action.** Maintain status; monitor to prevent changes. Adjust management as necessary.	**Attempt Passive Restoration** if feasible: If unsuccessful use active restoration.	**Active Restoration.** Potential for successful restoration is high because of deep soils and higher precipitation. Potential for invasive plant control is high.
Medium	**No Action.** Monitor frequently to ensure that management is adjusted before habitat quality is impaired.	**Attempt Passive Restoration** if feasible. If unsuccessful use active restoration.	**Active Restoration**, but lower priorty because of lower probability of success.
Low	**No Action.** Monitor frequently to ensure that management is adjusted before habitat quality is impaired.	**No Action.**	**Conduct Inventory** and adjust management to fit new site and conditions.

Pyke, D. A. 2011

TABLE 23.2

Guidelines for conducting a restoration project for improving Greater Sage-Grouse habitat

Steps in the process	Questions to be asked	How to answer the question
I. Identify landscape priorities and ecological sites	1. Where are priority sites for restoration?	Conduct a landscape triage.
	2. What kind of soils are on the site?	Verify soils mapped to the location and provide further detail regarding the distribution of soil components at the site. This will require collecting information on soil texture and depth and some basic soil chemistry (pH, calcium carbonate presence).
	3. How will soils and physical features affect vegetation establishment and erosion?	Erosion is a major concern with any restoration project, especially if it is necessary to remove vegetation or disturb soils to conduct the project. Finer soils and steeper slopes generally have an increased risk of erosion. Soil descriptions will provide a guide regarding erosion risks on sites. Caution should be used in conducting soil disturbances on highly erosive sites. If revegetation is attempted, use fast-growing plants to protect and stabilize soils quickly. Generally, revegetation to protect soils from erosion takes many years and often does not provide adequate protection if high rainfall occurs (Robichaud et al. 2000).
	4. What is the native plant community for this site?	Match soil components on the site to their correlated ecological site description (ESD). Generally, there is only one ecological site mapped to a single soil component. The ESD will provide details on plant species and relative composition of these species in the community. This will provide an initial list of potential species for the site.
	5. Is old-growth juniper growing?	If yes, site may be a juniper site. Refer to Miller et al. (2007) for guidance. This site may not be appropriate for restoration. If no, proceed onward.
II. Determine current state of the site	6. Is site still within the reference state for the state and transition (S&T) model of this ecological site?	Compare current plant community on the site to those described in the S&T model. If plant community appears to fit in the reference state, and soil and hydrology of the site appear intact, then attempt passive restoration to improve habitat.
III. Select appropriate action	7. Does sagebrush dominate, yet herbaceous life-forms that should be co-dominant are missing from the site and annual invasive plants are rare?	This is a difficult situation. A need exists to reintroduce the herbaceous component of the habitat, but sagebrush competition may make revegetation difficult (Reichenberger and Pyke 1990). Consider restoring other higher-priority sites and wait to restore this site until fire burns sagebrush on the site.



Pyke, D. A. 2011

Steps in the process	Questions to be asked	How to answer the question
	8. Is sagebrush missing, but native herbaceous life-forms are present and dominant?	Although sagebrush seed could be added to this site, it might be more cost-effective to introduce small patches of sagebrush transplants. As those plants mature, they will reproduce and spread seed naturally.
	9. Do invasive annual grasses co-dominate with native plants on the site?	Consider passive restoration first to attempt to increase competitive ability of native plants. Otherwise, wait for a fire to occur and attempt active restoration with herbicide to control annual grasses.
	10. Do invasive annual grasses dominate the site while native life-forms are missing or severely underrepresented?	Active restoration is necessary to restore habitat.
IV. Determine post-treatment management	11. How long should the site be protected before land uses begin?	Although some authors believe that only a minimum of two years of protection is necessary (Stevens 1994), most believe that two years is too short when native plants are being used in the restoration (Stevens 2004, Shaw et al. 2005a). A good rule of thumb is to continue protection until two-thirds of the restored plants become reproductive. Stevens (2004) provides some guidelines for increasing the time of protection depending on the ecosystem and precipitation after seeding. Uses should aim to minimize defoliation and trampling during the most active growing period (from just before reproduction until after seed dispersal).
	12. How will monitoring occur?	Monitoring of effectiveness of restoration treatments requires that a complete set of monitoring elements be completed such that an analysis and report are completed.
	13. Are adjustments to the restoration recommended?	Adaptive management is complete when lessons learned from the previous project can be applied in future projects. This requires completion of reports and meta-analyses of these reports to provide spatial recommendations based on consistent findings in multiple locations. This can be expedited through a common database for restoration monitoring reports.

Reference Sheet-Applications to Restoration

Reference Sheet

Author(s)/participant(s): P.Novak-Echenique

Contact for lead author: State Rangeland Management Specialist

Date: 12/17/2009 **MLRA:** 024X **Ecological Site:** LOAMY 8-10 P.Z. R024XY005NV This *must* be verified based on soils and climate (see Ecological Site Description). Current plant community cannot be used to identify the ecological site.

Composition (indicators 10 and 12) based on: X Annual Production, Foliar Cover, Biomass

Indicators. For each indicator, describe the potential for the site. Where possible, (1) use numbers, (2) include expected range of values for above- and below-average years for **each** community and natural distrurbance regimes within the reference state, when appropriate and (3) cite data. Continue descriptions on separate sheet.

1. **Number and extent of rills:** Rills are none to rare. A few can be expected on steeper slopes in areas subjected to summer convection storms or rapid spring snowmelt.
2. **Presence of water flow patterns:** Water flow patterns are none to rare.
3. **Number and height of erosional pedestals or terracettes:** Pedestals are none to rare. Occurrence is usually limited to areas of water flow patterns. Frost heaving of shallow rooted plants should not be considered a "normal" condition.
4. **Bare ground from Ecological Site Description or other studies (rock, litter, standing dead, lichen, moss, plant canopy are not bare ground):** Bare Ground ± 50%.
5. **Number of gullies and erosion associated with gullies:** None
6. **Extent of wind scoured, blowouts and/or depositional areas:** None
7. **Amount of litter movement (describe size and distance expected to travel):** Fine litter (foliage from grasses and annual & perennial forbs) expected to move distance of slope length during intense summer convection storms or rapid snowmelt events. Persistent litter (large woody material) will remain in place except during large rainfall events.
8. **Soil surface (top few mm) resistance to erosion (stability values are averages - most sites will show a range of values):** Soil stability values should be 3 to 6 on most soil textures found on this site. (To be field tested.)
9. **Soil surface structure and SOM content (include type and strength of structure, and A-horizon color and thickness):** Surface structure is medium to thick platy, granular, or massive. Soil surface colors are light brownish grays and soils are typified by an ochric epipedon. Organic matter of the surface 2 to 3 inches is typically 1 to 1.5 percent dropping off quickly below. Organic matter content can be more or less depending on micro-topography.
10. **Effect on plant community composition (relative proportion of different functional groups) and spatial distribution on infiltration and runoff:** Perennial herbaceous plants (especially deep-rooted bunchgrasses [i.e., Thurbers needlegrass] slow runoff and increase infiltration. Shrub canopy and associated litter break raindrop impact and provide opportunity for snow catch and accumulation on site.
11. **Presence and thickness of compaction layer (usually none; describe soil profile features which may be mistaken for compaction on this site):** Compacted layers are none. Platy, subangular blocky, prismatic, or massive sub-surface horizons or subsoil argillic horizons are not to be interpreted as compacted layers.
12. **Functional/Structural Groups (list in order of descending dominance by above-ground weight using symbols: >>, >, = to indicate much greater than, greater than, and equal to) with dominants and sub-dominants and "others" on separate lines:**
    Dominant: Reference Plant Community: Deep-rooted, cool season, perennial bunchgrasses > Wyoming big sagebrush
    Sub-dominant: Associated shrubs > shallow-rooted, cool season, perennial bunchgrasses > deep-rooted, cool season, perennial forbs > fibrous, shallow-rooted, cool season, perennial and annual forbs
    Other:
    Additional:
13. **Amount of plant mortality and decadence (include which functional groups are expected to show mortality or decadence):** Dead branches within individual shrubs common and standing dead shrub canopy material may be as much as 25% of total woody canopy; some of the mature bunchgrasses (<20%) have dead centers.
14. **Average percent litter cover (20 %) and depth (0.5 inches):** Within plant interspaces (± 20%) and depth of litter is <½ inch.
15. **Expected annual production (this is TOTAL above-ground production, not just forage production):** For normal or average growing season (end of May) ± 600 lbs/ac; Spring moisture significantly affects total production. Favorable years 800 lbs/ac and unfavorable years 400 lbs/ac.
16. **Potential invasive (including noxious) species (native and non-native). List Species which BOTH characterize degraded states and have the potential to become a dominant or co-dominant species on the ecological site if their future establishment and growth is not actively controlled by management interventions. Species that become dominant for only one to several years (e.g., short-term response to drought or wildfire) are not invasive plants. Note that unlike other indicator, we are describing what in NOT expected in the reference state for the ecological site:** Potential invaders include cheatgrass, halogeton, Russian thistle, bassia, annual mustards, and knapweeds.
17. **Perennial plant reproductive capability:** All functional groups should reproduce in average (or normal) and above average growing season years.

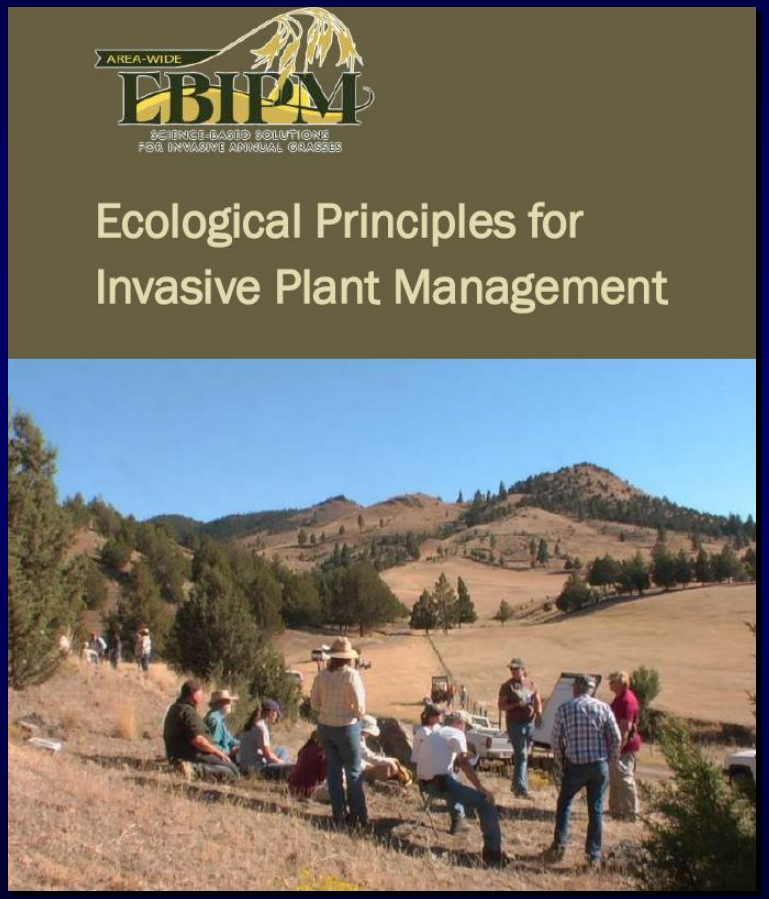
Reference Sheet Approval:

Approval	Date
P. Novak-Echenique	2/1/2008

Incorporating Reference Sheets into an Invasive Plant Strategy

AREA-WIDE EBIPM
SCIENCE-BASED SOLUTIONS FOR INVASIVE ANNUAL GRASSES

Addresses the spread of cheatgrass and medusahead in the Great Basin through the implementation of ecologically-based principles. (*www.**ebipm**.org*).



Step 1:
Complete Rangeland Health Assessment

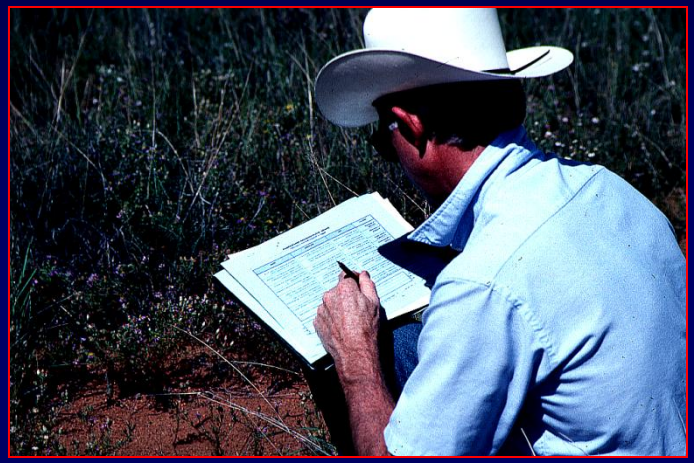
Step 2:
Identify Causes of Invasion and Associated Processes Not Functioning

Step 3:
Use Principles to Guide Decision Making

Step 4:
Choose Appropriate Tools and Strategies Based on Principles

Step 5:
Design and Execute a Plan Using Adaptive Management

AREA-WIDE
EBIPM
SCIENCE-BASED SOLUTIONS
FOR INVASIVE ANNUAL GRASSES



Assessment Worksheet

	Causes of Succession		
Rangeland Health Indicators	**Site Availability**	**Species Availability**	**Species Performance**
Rills, water flow patterns, pedestels, and/or terracettes, gullies, wind scoured, blowout depositions, litter movement	Extreme | Moderate to Extreme | Moderate | Slight to Moderate | None to Slight		
Bareground, soil surface loss or degradation	Extreme | Moderate to Extreme | Moderate | Slight to Moderate | None to Slight		Extreme | Moderate to Extreme | Moderate | Slight to Moderate | None to Slight
Plant Community Composition		Extreme | Moderate to Extreme | Moderate | Slight to Moderate | None to Slight	Extreme | Moderate to Extreme | Moderate | Slight to Moderate | None to Slight
Compaction Layer	Extreme | Moderate to Extreme | Moderate | Slight to Moderate | None to Slight		Extreme | Moderate to Extreme | Moderate | Slight to Moderate | None to Slight
Functional/Structural Groups		Extreme | Moderate to Extreme | Moderate | Slight to Moderate | None to Slight	
Plant mortality/ decadence	Extreme | Moderate to Extreme | Moderate | Slight to Moderate | None to Slight		Extreme | Moderate to Extreme | Moderate | Slight to Moderate | None to Slight
Litter Amount			Extreme | Moderate to Extreme | Moderate | Slight to Moderate | None to Slight
Annual production			Extreme | Moderate to Extreme | Moderate | Slight to Moderate | None to Slight
Invasive plants		Extreme | Moderate to Extreme | Moderate | Slight to Moderate | None to Slight	
Reproductive Capacity of Perennial Plants		Extreme | Moderate to Extreme | Moderate | Slight to Moderate | None to Slight	Extreme | Moderate to Extreme | Moderate | Slight to Moderate | None to Slight

Summary

- ESDs and soil surveys are integral in restoration planning.
- Soil surveys (Web Soil Survey) provides the essential, detailed information on soil limitations and properties necessary for restoration planning and implementation.
- ESDs provide the ecological background to understand community pathways and develop restoration strategies to meet management objectives.