U.S. Sheep Experiment Station Grazing and Associated Activities Project 2009

Rangeland Assessment Report

Prepared by:
Troy Grooms
Range Conservation Specialist

for:

U.S. Sheep Experiment Station
Agricultural Research Service, Southern Region

August 27, 2009

Table of Contents

List of Tables

List of Figures

Scientific / Common Names of species referenced in this document

Scientific Name	Common name
Abies bifolia	Subalpine fir
Achillea millefolium	Yarrow
Achnatherum hymenoides (Roemer & J.A. Shultes) Barkworth	Indian rice grass
Agoseris glauca	Pale dandelion
Agropyron cristatum	Crested wheatgrass
Agropyron inerme	Beardless bluebunch wheatgrass
Allium canadense L.	Wild onion
Angelica pinnata	Small-leaf angelica
Arabis drummondii	Drummonds rockcress
Artemesia tridentata sspp. vaseyana	Mountain big sagebrush
Artemisia arbuscula	Little sagebrush
Artemisia ludoviciana	White sagebrush
Artemisia tridentata	Three-tip sagebrush
Artemisia tridentata Nutt. sspp. *tridentata*	Basin big sagebrush
Artemisia tridentata sspp. wyomingensis	Wyoming big sagebrush
Aster foliaceus	Parry's aster
Aster integrifolius	Aster
Astragalus spp.	Astragalus
Balsamorhiza incana	Hoary balsamroot
Balsamorhiza sagittata	Arrowleaf balsamroot
Brassica cretica	Mustard
Bromus inermis	Smooth brome
Bromus inermus pumpellianus	Arctic brome
Bromus marginatus	Mountain brome
Bromus tectorum L.	Cheatgrass
Calochortus nuttallii	Sego lily
Carduus spp.	Native thistle
Carex spp.	Dryland sedge
Castilleja spp.	Indian paintbrush
Chrysothamnus nauseosus subspp. *albicaulis* and subspp. *consimilis*	Rabbit brush
Cyperaceae spp.	Sedge
Delphinium glaucum	Sierra larkspp.ur
Delphinium spp.	Larkspp.ur
Elymus caninus	Bearded wheatgrass
Elymus smithii	Western wheat grass
Erigeron spp.	Fleabane
Eriogonum umbellatum	Buckwheat spp.ecies
Festuca brachypylla	Alpine fescue
Festuca idahoensis	Idaho fescue
Frasera spp.	Green gentian
Galium boreale	Northern bedstraw
Geranium viscosissimum	Sticky geranium
Geum spp.	Geum
Gilia spp.	Gilia spp.ecies
Gutierrezia sarothrae (Pursh) Britt. & Rusby	Broom snakeweed
Hackelia floribunda	Manyflower stickseed
Helianthella quinquenervis	Little sunflower

Scientific Name	Common name
Heliomeris multiflora	Showy goldeneye
Hespp.erostipa comata	Needle and thread
Hespp.erostipa spp.	Needle grass
Iris spp.	Rocky mountain iris
Juncus bufonius var. bufonius	Short-beaked agoseris
Koeleria macrantha	Prairie june grass
Ligusticum filicinum	Fernleaf licoriceroot
Lupinus argenteus	Lupine
Melica spp.ectabilis	Oniongrass (purple oniongrass)
Muhlenbergia spp.	Deer grass
Phleum alpinum	Alpine timothy
Phlox spp.	Phlox
Pinus albicaulis	Whitebark pine
Poa fendleriana	Mutton grass
Poa nevadensis	Nevada blue grass
Poa pretense	Kentucky bluegrass
Poa secunda	Sandberg bluegrass
Poa spp	Big bluegrass
Polygonum douglasii	Douglas' knotweed
Potentilla gracilis	Slender cinquefoil
Potentilla spp.	Cinquefoil
Pseudoroegneria spp.icata ,Elymus spp.icatus	Bluebunch wheatgrass
Purshia tridentata	Bitterbrush
Ribes montigenum	Gooseberry
Rudbeckia occidentalis	Western coneflower
Rumex spp.	Sorrel
Senecio integerrimus	Lambstongue ragwort
Silene spp.	Campion
Sphaeralcea *spp.*	Globemallow
Stipa lettermanii	Lettermans Needlegrass
Symphorocarpos spp.	Snowberry
Taraxicum officinale	Dandelion
Triticum aestivum	Streambank wheat
Wyethia probably helianthoides	Sunflower
Zigadenus venenosus S. Wats.	Death camas

Common / Scientific Names of species referenced in this document

Common name	Scientific Name
Alpine fescue	*Festuca brachypylla*
Alpine timothy	*Phleum alpinum*
Arctic brome	*Bromus inermus pumpellianus*
Arrowleaf balsamroot	*Balsamorhiza sagittata*
Aster	*Aster integrifolius*
Astragalus	Astragalus *spp*.
Ballhead sandwort	*Arenaria congesta*
Basin big sagebrush	*Artemisia tridentata* Nutt. spp. *tridentata*
Bearded wheatgrass	*Elymus caninus*
Beardless bluebunch wheatgrass	*Agropyron inerme*

Common name	Scientific Name
Big bluegrass	*Poa spp.*
Bitterbrush	*Purshia tridentata*
Bluebunch wheatgrass	*Pseudoroegneria spp.icata ,Elymus spp.icatus*
Broom snakeweed	*Gutierrezia sarothrae* (Pursh) Britt. & Rusby
Buckwheat spp.ecies	*Eriogonum umbellatum*
Campion	*Silene spp.*
Cheatgrass	*Bromus tectorum* L.
Cinquefoil	*Potentilla spp.*
Crested wheatgrass	*Agropyron cristatum*
Dandelion	*Taraxicum officinale*
Death camas	*Zigadenus venenosus* S. Wats.
Deer grass	*Muhlenbergia spp.*
Douglas' knotweed	*Polygonum douglasii*
Dryland sedge	*Carex spp.*
Drummonds rockcress	*Arabis drummondii*
Fernleaf licoriceroot	*Ligusticum filicinum*
Feabane	*Erigeron*
Geum	*Geum spp.*
Gilia spp.ecies	*Gilia spp.*
Globemallow	Sphaeralcea *spp.*
Gooseberry	*Ribes montigenum*
Green gentian	*Frasera spp.*
Hoary balsamroot	*Balsamorhiza incana*
Idaho fescue	*Festuca idahoensis*
Indian paintbrush	*Castilleja spp.*
Indian rice grass	*Achnatherum hymenoides* (Roemer & J.A. Shultes) Barkworth
Kentucky bluegrass	*Poa pretense*
Kittentails	*Synthyris spp.*
Lambstongue ragwort	*Senecio integerrimus*
Larkspp.ur	*Delphinium spp.*
Lettermans Needlegrass	*Stipa lettermanii*
Little sagebrush	*Artemisia arbuscula*
Little sunflower	*Helianthella quinquenervis*
Lupine	*Lupinus argenteus*
Manyflower stickseed	*Hackelia floribunda*
Mountain big sagebrush	*Artemesia tridentata spp. vaseyana*
Mountain brome	*Bromus marginatus*
Mustard	*Brassica cretica*
Mutton grass	*Poa fendleriana*
Native thistle	*Carduus spp.*
Needle and thread	*Hespp.erostipa comata*
Needle grass	*Hespp.erostipa spp.*
Nevada blue grass	*Poa nevadensis*
Northern bedstraw	*Galium boreale*
Oniongrass (purple oniongrass)	*Melica spp.ectabilis*
Pale dandelion	*Agoseris glauca*
Parry's aster	*Aster foliaceus*
Phlox	*Phlox spp.*
Prairie june grass	*Koeleria macrantha*

Common name	Scientific Name
Rabbit brush	*Chrysothamnus nauseosus* subspp. *albicaulis* and subspp. *consimilis*
Rocky mountain iris	*Iris spp.*
Sandberg bluegrass	*Poa secunda*
Sedge	*Cyperaceae spp.*
Sego lily	*Calochortus nuttallii*
Short-beaked agoseris	*Juncus bufonius var. bufonius*
Showy goldeneye	*Heliomeris multiflora*
Sierra larkspp.ur	*Delphinium glaucum*
Slender cinquefoil	*Potentilla gracilis*
Small-leaf angelica	*Angelica pinnata*
Smooth brome	*Bromus inermis*
Snowberry	*Symphorocarpos spp.*
Sorrel	*Rumex spp.*
Sticky geranium	*Geranium viscosissimum*
Streambank wheat	*Triticum aestivum*
Subalpine fir	*Abies bifolia*
Sunflower	*Wyethia probably helianthoides*
Three-tip sagebrush	*Artemisia tridentata*
Toad rush	*Juncus bufonius var. bufonius*
Western coneflower	*Rudbeckia occidentalis*
Western wheat grass	*Elymus smithii*
White sagebrush	*Artemisia ludoviciana*
Whitebark pine	*Pinus albicaulis*
Wild onion	*Allium canadense* L.
Wyoming big sagebrush	*Artemisia tridentata sspp. wyomingensis*
Yarrow	*Achillea millefolium*

Current Rangeland Assessment for the United States Sheep Experimental Station (USSES)

This rangeland assessment document evaluates and assesses livestock grazing management for the United States Sheep Experimental Station (USSES) outside of Dubois Idaho.

The rangelands were assessed for the Headquarters, Henninger, Humphrey, East Pasture and West Pasture Allotments by a U.S. Forest Service Enterprise Team interdisciplinary team consisting of rangeland management specialists, wildlife biologist, soil scientist, and hydrologist. Documents and publications used in the assessment process include the Soil Survey of Grant and Freemont County, Idaho (NRCS 1999), Ecological Site Descriptions (ESD) and Range Site Descriptions for Major Land Resource Area Bllb, Blla, B13 (NRCS 1982) Interpreting Indicators of Rangeland Health (USDI-BLM et al. 2000), Sampling Vegetation Attributes (USDI-BLM et al. 1996), and the National Range and Pasture Handbook (USDA-NRCS 1997). A complete list of references is included at the end of this document. All are available for public review at any land management agency during normal business hours.

The interdisciplinary team used rangeland monitoring data, professional observations, and photographs to assess rangeland conditions. All study sites were GPS located using the NAD 27 datum.

Quantitative cover, and species composition, data collected along each transect was used in conjunction with qualitative indicators of soil quality, hydrologic function, and biological health in order to assess existing condition of ecological sites at key areas within each pasture. Existing condition was compared to site specific reference conditions (thought to represent relatively undisturbed states within a given soil--plant community type) in order to determine the level of departure from the potential natural community.

Data was collected using the line point intercept method (see Figure 2). This method measures the distance on a line (measuring tape) occupied by different plant species, and from that, composition of species and their frequencies are extrapolated. It should be noted that the methodology for this technique differs from that of the NRCS (which is based on weight), resulting in differing plant frequencies.

Table 1 displays the location of study sites.

Table 1. List of study sites

Study Site Number	Date	Location	UTM (NAD 27)
HQ1	6/21/2009	Headquarters Pasture	404120E, 4898306N
HQ2			405824E, 4899114N
HQ3			401633E, 4903362
HQ4			404535E, 4896905N
HQ5			407336E, 4897489N
HQ6			407336E, 4897489N
HQ7			414384E, 4903720N
HE9	6/22/2009	Henninger Ranch Pastures	436504E, 4919257N
HE11			436770E, 4920422N
HE11b			436860E, 4919591N
HU13	6/23/2009	Humphrey Ranch Pastures	401679E, 4930883N
HU14			401659E, 4929364N
SE1	8/17/2009	Summer East Pasture/Toms Creek and	453475E, 4934528N
SES2			452532E, 4935742N
SW1	8/17/2009	West Summer Pasture/Odell Lake	437579E, 4930639N
SW2			438892E, 4931836N

Figure 1 displays the headquarters pasture study sites.

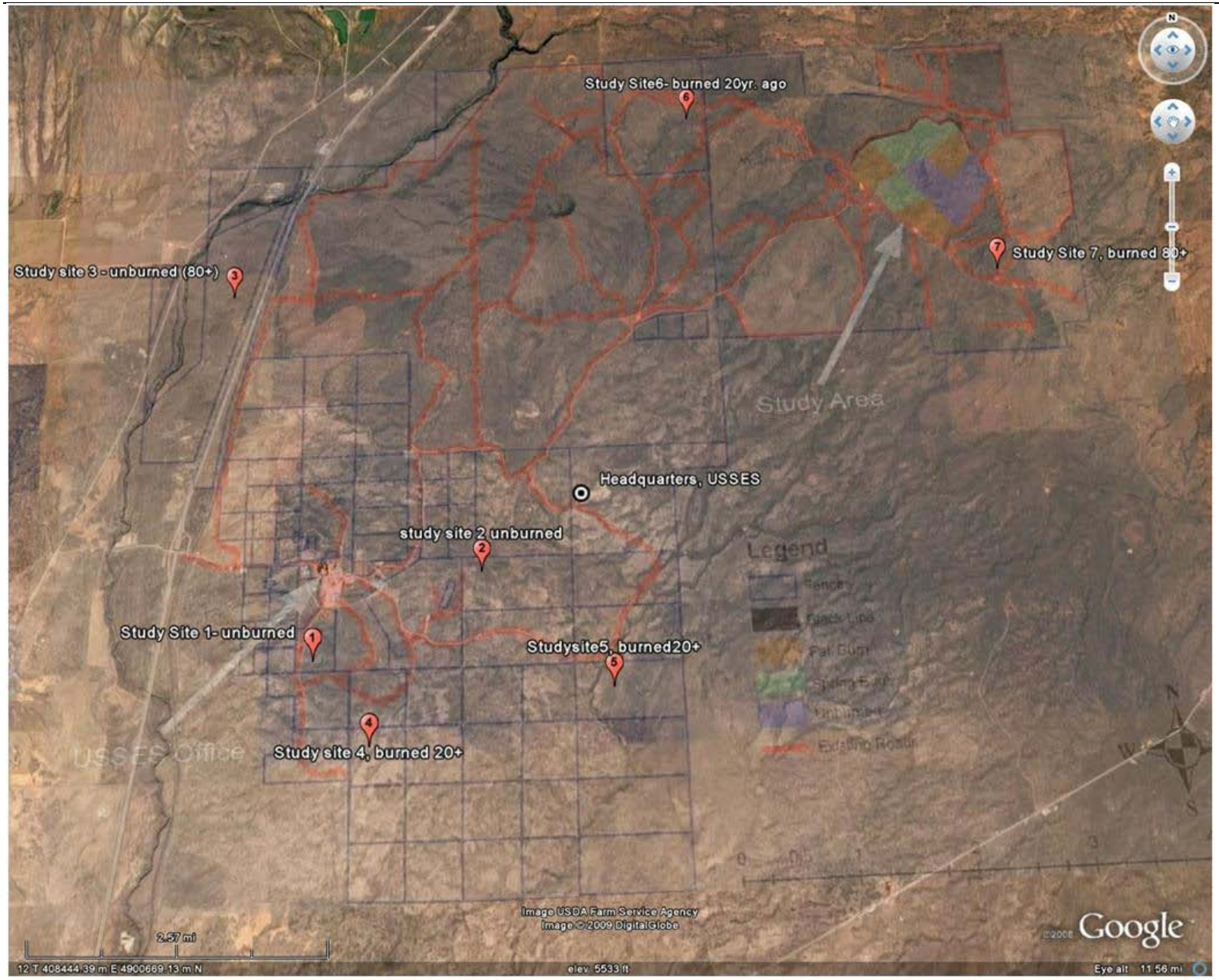

Figure 1. Location of Headquarters pasture study sites

Evaluation and Determination of Rangeland Health for the Headquarters Pastures.

Figure 2. Study Site HQ1 Headquarters Pasture

Study Site HQ1 (SS HQ1) (6/21/2009) is located south and west of the USSES headquarters at UTM 404120E, 4898306N. The soil is classified as EVC Eaglecone Vickton (see appendix I). This study site is located in an area that has not burned in recent history. Vegetative cover at SS HQ1 is just under 60 percent compared to the ecological site description (NRCS 2009). There is no recommended cover given for this site. The ecological site for this key area is a Loamy 12-16" P.Z. – R011BY010 ID – ARTRW8/PSSPS site (see appendix II). Vegetative cover at SS HQ1 is adequate to prevent the formations of rills and gullies and to maintain the soil in place. Plant composition based on cover indicates that the plant composition is 95 percent shrubs, five percent grasses, and one percent forbs. The dominant shrubs at this site are three-tip and basin big sagebrush. The dominant herbaceous component at the site is crested wheatgrass and bluebunch wheatgrass. The dominant forb is buckwheat.

Table 2. Summary of results for SS HQ1

Key area information	Species	Composition by species based on cover
Study Site HQ1 Range site: R011BY010 ID Desirable Cover For Site: Unknown Percent Cover Measured 2009: 59.58%	Three-tip sage	89%
	Basin big sage	5%
	Crested wheatgrass	3%
	Bluebunch wheatgrass	1%
	Buckwheat	1%
	Cheatgrass	<1%
	Mustard	<1%
	Wild onion	<1%

Composition by groups	
Shrubs	94%
Grasses	5%
Forbs	1%

Line intercept data collected at SS HQ1 indicates that major plant species[1] are lacking in the community such as needlegrass, wheatgrass and bottlebrush squirreltail as well as minor[2] forbs and other species listed in the ecological site description. The ecological site description states the recommended dynamics of the site at historic climax plant community should be in the range of 60-70 percent grasses, 15-25

[1] Major Plant Species are those species that should occur in high frequency based on soils type.
[2] Minor Plant Species are plant species that occur within a soil type but at lower frequencies due to competition from major plant species within that soil type.

percent forbs, and 10-20 percent shrubs. The key species appear to have decreased in areas not normally grazed or very lightly grazed by livestock.

Conclusion: In the absence of normal fire frequency (25 to 40 years) three-tip sagebrush can gradually increase on the site. Grasses and forbs will decrease as shrubs increase. With the continued absence of fire, these shrubs can displace many of the primary understory species.

Figure 3. Study Site HQ2 Headquarters pasture

Study Site HQ2 (6/21/2009) is located directly east of the USSES headquarters at UTM 405824E, 4899114N. The soil is classified as EVC Eaglecone Vickton. This study site is located in an area that has not burned in recent history. Vegetative cover at SS HQ2 is just over 33 percent, compared to the ecological site description (NRCS 2009). The approximate potential ground cover (basal and crown) according to the range site is 20-35 percent. The ecological site for this key area is a Fractured loamy 8-16" P.Z. – R011BY005 ID – ARTRW8/PSSPS Wyoming big sagebrush/bluebunch wheatgrass site (Appendix II). Vegetative cover at SS HQ2 is adequate to prevent the formations of rills and gullies and to maintain the soil in place. Plant distribution based on cover indicates that the composition is 71 percent shrubs, 24 percent grasses, and five percent forbs. The dominant shrubs at this site are three-tip and basin big sagebrush. The dominant herbaceous component at the site is bluebunch wheatgrass, Sandburg bluegrass, and Indian rice grass.

Table 3. Summary of results for SS HQ2

Key area information	Species	Composition by species based on cover
Study Site HQ2 Range site: R011BY005 ID Desirable Cover For Site: 20-35% Percent Cover Measured 2009: 33%	Three-tip	53%
	Bluebunch wheatgrass	17%
	Basin big sagebrush	11%
	Broomsnake weed	4%
	Sandburg bluegrass	3.4%
	Mustard	2.8%
	Indian rice grass	2.7%
	Cheatgrass	<1%
	Needle and thread	<1%
	Aster	<1%

Composition by groups	
Shrubs	71%
Grasses	24%
Forbs	5%

Line intercept cover data collected at SS HQ2 indicates that most of the major plant species are in the community as well as minor forbs and other species listed in the ecological site description. The ecological site description states the recommended dynamics of the site at historic climax plant community should be in the range of 35-50 percent grasses, 10-15 percent forbs, and 40-50 percent shrubs. The key species at this study site are present but appear to be in a state of decline due to the absence of disturbance.

Conclusion: In the absence of normal fire frequency (25 to 40 years) three-tip sagebrush can gradually increase on the site. Grasses and forbs will decrease as shrubs increase. With the continued absence of fire, these shrubs can displace many of the primary understory species.

Figure 4. Study Site HQ3 Headquarters Pasture

Study Site HQ3 (6/21/2009) is located directly west and north of the USSES headquarters across US highway 15 at UTM 401633E, 4903362N. This site is unfenced, not utilized by livestock and has not burned in recent history. The soil is classified as GAA Grassyridg-Bedrock Bllb-4-ID (Appendix I). Vegetative cover at Study Site HQ3 is just over 48 percent, compared to the ecological site description (NRCS 1979). The approximate potential ground cover (basal and crown) is not given. The ecological site for this key area is a Sandy 8-12" P.Z. – Bllb-4-I ARTRT/ACHY/HECO26 Basin big sagebrush/Indian ricegrass/Needle and thread site (Appendix II). Vegetative cover appropriate for the site is essential for maintaining proper soil surface stability, reducing compaction and improving overall water infiltration. Vegetative cover at SS HQ3 indicates the soils at the study site are stable and exhibit no outward signs of erosion. The soils at SS HQ3 exhibit no signs of erosion, rill or gulley formations. There is no evidence of plant pedestalling[3] or movement of soil. Overall the soils are stable. Cryptogrammic crust formations[4] are present within the pasture at SS HQ3. Plant distribution based on cover indicates that the plant composition is 81 percent shrubs, 16 percent grasses, and 3 percent forbs. Line intercept cover data collected at SS HQ3 indicates that most of the major plant species are in the community as well as minor forbs and other species listed in the ecological site description. The ecological site description states the recommended dynamics of the site at historic climax plant community should be in the range of 60-70 percent grasses, 10-20 percent forbs, and 15-25 percent shrubs. The key species at this study site are present but appear to be in a state of decline due to the absence of disturbance.

The dominant shrubs at this site are three-tip and basin big sagebrush, bitterbrush. The dominant herbaceous component at the site is bluebunch wheatgrass, Sandburg bluegrass, and crested wheatgrass.

[3] Pedestalling: An erosional surface developed at the foot of rooted vegetation causing the vegetation to appear elevated above the top soil.

[4] Cryptogrammic crust - are soil crusts which are formed by cryptogrammic plants, they harbor many different species, and composition varies with region and substrate. Algae are usually the dominant genera. Lichens and mosses are also important components of crusts on rangelands (Brotherson et al. 1983).

Table 4. Summary of results for SS HQ3

Key area information	Species	Composition by species based on cover
Study Site HQ3 Range site: Bllb-4-I Desirable Cover For Site: Unknown Percent Cover Measured 2009: 48.28%	Three-tip	52.3%
	Bitterbrush	19.2%
	Bluebunch wheatgrass	8.6%
	Rabbitbrush	4.7%
	Crested wheatgrass	4.5%
	Sandburg bluegrass	3.3%
	Little sagebrush	2.2%
	Cheatgrass	<1%
	Dandelion	<1%
	Mustard	<1%
	Phlox	<1%

Composition by groups	
Shrubs	81%
Grasses	16%
Forbs	3%

Conclusion: In the absence of normal fire frequency (25 to 40 years) three-tip sagebrush can gradually increase on the site. Grasses and forbs will decrease as shrubs increase. With the continued absence of fire, these shrubs can displace many of the primary understory species.

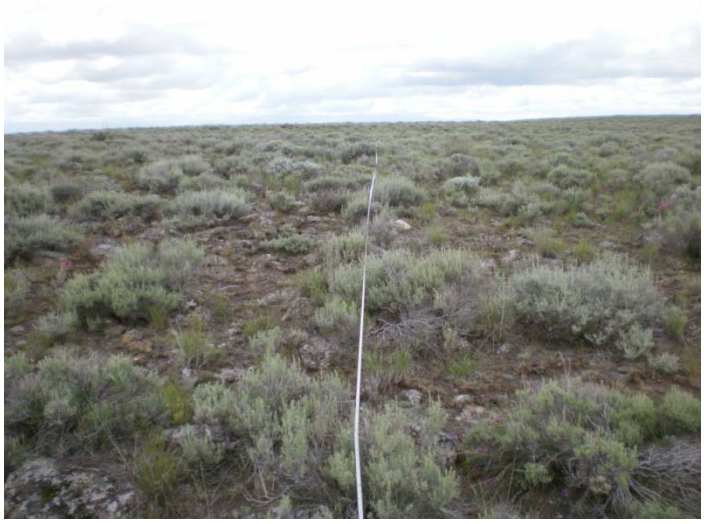

Figure 5. Study Site HQ6 Headquarters Pasture

Study Site HQ4 (6/21/2009) is located directly south of the USSES headquarters at UTM 404535E, 4896905N. The soil is classified as EVC Eaglecone Vickton. (Appendix I). Vegetative cover at Study Site 4 is just over 28 percent compared to the ecological site description (NRCS 2009). The approximate potential ground cover (basal and crown) according to the range site is 20-35 percent. The ecological site for this key area is a Fractured loamy 8-16" P.Z. – R011BY005 ID – ARTRW8/PSSPS Wyoming big sagebrush/Bluebunch wheatgrass site (Appendix II). Vegetative cover appropriate for the site is essential for maintaining proper soil surface stability, reducing compaction and improving overall water infiltration. Vegetative cover at SS HQ4 indicates the soils at the study site are stable and exhibit no outward signs of erosion. The soils at SS HQ4 exhibit no signs of erosion, rill, or gulley formations. There is no evidence of plant pedestalling or movement of soil, overall the soils are stable. Plant composition based on cover indicates that the plant composition is 90 percent shrubs, 8 percent grasses, and two percent forbs. Line intercept cover data collected at SS HQ4 indicates that most of the major plant species are present in the community as well as minor forbs and other species listed in the ecological site description. The range site description states the recommended dynamics of the site at historic climax plant community should be in the range of 35-50 percent grasses, 10-15 percent forbs, and 40-50 percent shrubs. The key species at this study site are present, and the site

appears stable. The dominant shrubs at this site are Wyoming sagebrush and three-tip sagebrush. The dominant herbaceous component at the site is bluebunch wheatgrass, Sandburg bluegrass, and Indian ricegrass.

Table 5. Summary of results for SS HQ4

Key area information	Species	Composition by species based on cover
Study site HQ4 Range site: 011BY005ID Desirable cover for site: 20-35% Percent cover measured 2009: 28.02%	Wyoming sagebrush	56%
	Three-tip sagebrush	31.7%
	Bluebunch wheatgrass	5%
	Rabbitbrush	2%
	Sandburg bluegrass	1.4%
	Alas2	<1%
	Phlox	0.9%
	Indian ricegrass	0.75%
	Crested wheatgrass	0.5%
	Mustard	0.5%
	Clover	0.4%
	Cheatgrass	0.32%
	Mutton grass	0.14%
	Aster	0.03%

Composition by groups	
Shrubs	90%
Grasses	8%
Forbs	2%

Conclusion: This site is a very rocky site with deposits of soil over old lava flows. In the absence of fire or some other disturbance Three-tip and Wyoming sagebrush will increase in frequency, outcompeting grasses and forbs, thus resulting in a woody dominated site. The last fire disturbance on this site occurred 20+ years ago. Fire historically occurs every 25-40 years (USDA 2009 ESD).

Figure 6. Study Site HQ5 Headquarters Pasture

Study Site HQ5 (6/21/2009) is located directly south and east of the USSES headquarters at UTM 407336E, 4897489N. The soil is classified as EMC (Appendix I). Vegetative cover at SS HQ5 is just over 32 percent, compared to the ecological site description (NRCS 1981). The approximate potential ground cover (basal and crown, litter and rock) according to the range site is 30-45 percent. The ecological site for this key area is a loamy 12-16" P.Z. – B11b-11-ID – ARTR4/PSSPS three-tip sagebrush/bluebunch wheatgrass site (Appendix II). Vegetative cover appropriate for the site is essential for maintaining proper soil surface stability, reducing compaction and improving overall water

infiltration. Vegetative cover at SS HQ5 indicates the soils at the study site are stable and exhibit no outward signs of erosion. The soils at SS HQ5 exhibit no signs of erosion, rill, or gulley formations. There is no evidence of plant pedestalling or movement of soil; overall, the soils are stable. Plant composition based on cover indicates that the plant composition is 83 percent shrubs, eight percent grasses, and nine percent forbs. Line intercept cover data collected at SS 5 indicates that most of the major plant species are present in the community as well as minor forbs and other species listed in the ecological site description. The range site description states the recommended dynamics of the site at historic climax plant community should be in the range of 60-65 percent grasses, 15-25 percent forbs, and 15-30 percent shrubs. The key species at this study site are present and the site appears stable.

The dominant shrubs at this site are Wyoming and three-tip sagebrush. The dominant herbaceous component at the site is bluebunch wheatgrass and Sandburg bluegrass.

Table 6. Summary of results for SS HQ5

Key area information	Species	Composition by species based on cover
Study site HQ5 Range site: B11b-11-ID Desirable Cover For Site: 30-45% Percent Cover Measured 2009: 32.45%	Three-tip sagebrush	42.6%
	Wyoming sagebrush	38%
	Lupine	6%
	Bluebunch wheatgrass	5.8%
	Astragalus	2.4 %
	Rabbitbrush	2%
	Sandburg bluegrass	1.8%
	Dandelion	1.8%
	Phlox	1.4%
	Mustard	0.9%
	Cheatgrass	0.7%

Composition by groups	
Shrubs	83%
Grasses	8%
Forbs	9%

Conclusion: This site is a very rocky site with deposits of soil over old lava flows. In the absence of fire or some other disturbance three-tip and Wyoming sagebrush will increase in frequency outcompeting grasses and forbs thus resulting in a woody dominated site. The last fire disturbance on this site occurred 20+ years ago. Fire historically occurs every 25-40 years (USDA ESD 2009).

Figure 7. Study Site HQ6 Headquarters Pasture

Study Site HQ6 (6/21/2009) is located directly south and east of the USSES headquarters at UTM 407336E, 4897489N. The soil is classified as LMC Lostine-Marotz-Marystown Bllb-4-ID. Vegetative cover at SS HQ6 is just over 47 percent, compared to the range site description (NRCS 1979). The approximate potential ground cover (basal and crown) is not given. The ecological site for this key area is a Sandy 8-12" P.Z. – Bllb-4-I ARTRT/ACHY/HECO26 Basin big sagebrush/Indian ricegrass/Needle and thread site (Appendix II). Vegetative cover appropriate for the site is essential for maintaining proper soil surface stability, reducing compaction and improving overall water infiltration. Vegetative cover at SS HQ6 indicates the soils at the study site are stable and exhibit no outward signs of erosion.. These are all indicators for a healthy range site. The soils at SS HQ6 exhibit no signs of erosion, rill or gulley formations. There is no evidence of plant pedestalling or movement of soil, overall the soils are stable. Plant distribution based on cover indicates that the plant composition is 77 percent shrubs, 20 percent grasses, and three percent forbs. Line intercept cover data collected at SS HQ6 indicates that most of the major plant species are present in the community as well as minor forbs and other species listed in the ecological site description. The ecological site description states the recommended dynamics of the site at historic climax plant community should be in the range of 60-70 percent grasses, 10-20 percent forbs, and 15-25 percent shrubs. The key species at this study site are present and the site appears stable.

Table 7. Summary of results for SS HQ6

Key area information	Species	Composition by species based on cover
Study site HQ6 Range site: b11b-4-id Desirable cover for site: unknown Percent cover measured 2009: 47.34%	Wyoming sagebrush	40%
	Bitterbrush	36.6%
	Needle and thread	15.5%
	Bluebunch wheatgrass	2.9%
	Buckwheat	2.7 %
	Sandburg bluegrass	1.2%
	Phlox	1%
	Yarrow	0.5%
	Carex	0.2%

Composition by groups	
Shrubs	77%
Grasses	20%
Forbs	3%

The dominant shrubs at this site are Wyoming sagebrush and, bitterbrush. The dominant herbaceous component at the site is bluebunch wheatgrass, needle and thread, dryland sedge, and Sandburg bluegrass. Also present at the site but not occurring within the transect were Indian ricegrass, bottlebrush squirreltail and globemallow.

Conclusion: The soils supporting this site are moderately deep to very deep. Erosion hazard by wind is very severe when plant cover is scarce or lacking. Cover at this site is adequate to protect soils and maintain a stable site. In the absence of normal fire frequency, basin big sagebrush, antelope bitterbrush, Utah juniper and three-tip sagebrush can gradually increase on the site. Grasses and forbs will decrease as shrub densities increase. Fire historically occurs every 50-70 years (USDA ESD 2009) on this site. The last fire occurrence was 20+ years ago.

Figure 8. Study Site HQ7 Headquarters Pasture

Study Site HQ7 (6/21/2009) is located north and east of the USSES headquarters at UTM 414384E, 4903720N. The soil is classified as LAC Latigo B13-29-ID (Appendix I). Vegetative cover at Study Site HQ7 is just over 57 percent, compared to the ecological site description (NRCS 1979). The approximate potential ground cover (basal, crown, litter and rock) is 20-40 percent. The ecological site for this key area is a Loamy 12-16" P.Z. – B13-29-ID - ARTRV/ACHY/FEID Basin big sagebrush/Indian ricegrass/Idaho fescue site (Appendix II). Vegetative cover appropriate for the site is essential for maintaining proper soil surface stability, reducing compaction and improving overall water infiltration. Vegetative cover at SS HQ7 indicates the soils at the study site are stable and exhibit no outward signs of erosion. The soils at SS HQ7 exhibit no signs of erosion, rill, or gulley formations. There is no evidence of plant pedestalling or movement of soil; overall, the soils are stable. Plant distribution based on cover indicates that the plant composition is 91 percent shrubs, five percent grasses, and four percent forbs. Line intercept cover data collected at SS HQ7 indicates that most of the major plant species are present in the community as well as minor forbs and other species listed in the ecological site description. The ecological site description states the recommended dynamics of the site at historic climax plant community should be in the range of 60-80 percent grasses, 10-20 percent forbs, and 10-20 percent shrubs. The key species are present, and the site appears stable.

The dominant shrubs at this site are Wyoming sagebrush and bitterbrush. The dominant herbaceous component at the site is bluebunch wheatgrass, needle grass, and Sandburg bluegrass. Also present at the site but not occurring within the transect were bottlebrush squirreltail and sticky geranium.

Conclusion: The soils supporting this site are moderately deep to very deep. Erosion hazard by wind is very severe when plant cover is scarce or lacking. Cover at this site is adequate to protect soils and maintain a stable site. In the absence of normal fire frequency, basin big sagebrush, antelope bitterbrush, Utah juniper and three-tip sagebrush can gradually increase on the site. Grasses and forbs will decrease as shrub densities increase. Fire historically occurs every 50-70 years (NRCS 1980) on this site. The last fire occurrence was 50+ years ago. This site is in a mid late seral state and is on the verge of crossing into a woody dominated site. This would result in a further reduction of the herbaceous component within the vegetative community.

Table 8. Summary of results for SS HQ7

Key area information	Species	Composition by species based on cover
Study site HQ7 Range site: b13-29-id Desirable cover for site: 20-40% Percent cover measured 2009: 57.63%	Wyoming sagebrush	72%
	Bitterbrush	19%
	Buckwheat	2.5%
	Sandburg bluegrass	2.2%
	Needle grass	1.8%
	Indian ricegrass	0.9 %
	Yarrow	0.3%
	Bluebunch wheatgrass	0.16%
	Mutton grass	0.1%
	Sedge	T
	Wild onion	T
	Native thistle	T
	Rabbitbrush	T

Composition by groups	
Shrubs	91%
Grasses	5%
Forbs	4%

Livestock Watering

Livestock watering occurs in areas where water is not readily accessible at the USSES Headquarters, water is trucked to the sheep and unloaded into water troughs 12 feet long, 12 inches high, and 12 inches wide. Troughs are moved as grazing progresses across the pastures. The number of troughs used at each grazing area depends on the number of sheep to water; up to 25 troughs may be used for large bands, two troughs are adequate where small numbers of sheep are grazed. There are 70 pastures at low elevation where water is trucked; about 80 watering sites are used. Each band has one watering site. Six to eight bands graze at the same time so that six to eight sites could be used at any given time. Watering sites are used for three to seven days and then moved. Areas up to ¼ acre in size are disturbed from sheep use around water troughs, and tend to have crested wheatgrass cover.

Summary for Headquarters Rangeland Sites

The Headquarters rangelands are currently in a transitional state of sagebrush range sites converting to woody dominated sites with a diminishing herbaceous understory. This is a natural seral condition as stated in the ecological site descriptions. The current seral state overall for the Headquarters pastures is a late mid seral state. As stated above the historical climax plant community for a majority of the rangeland sites should favor grasses over sagebrush.

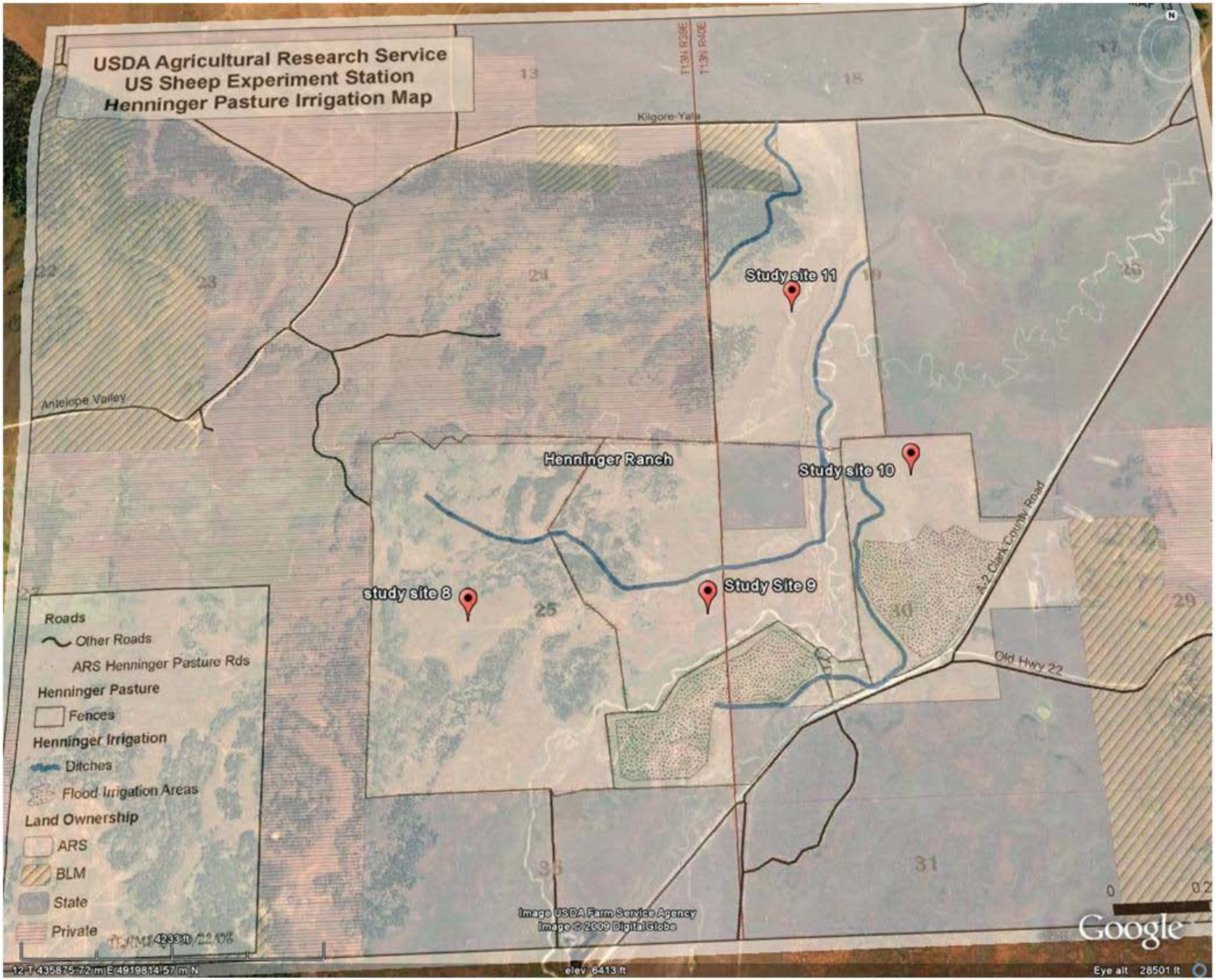

Figure 9. Location of Henninger pasture study sites

Evaluation and Determination of Rangeland Health for the Henninger Pastures.

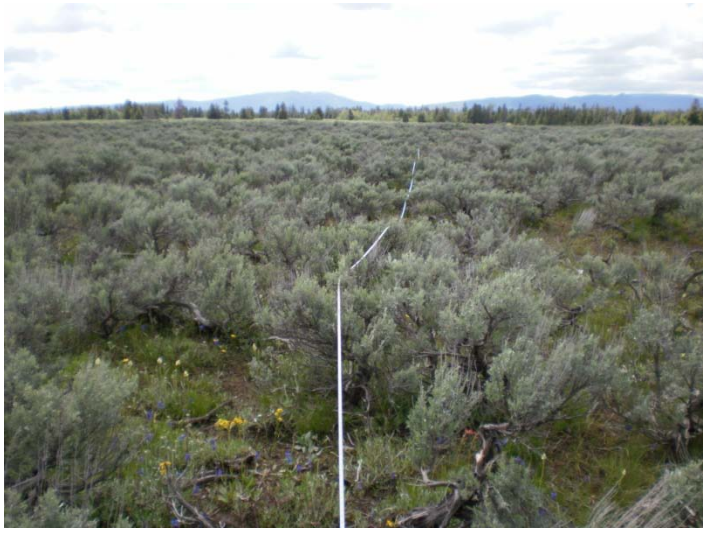

Figure 10. Study Site HE9 Henninger Pasture

Study Site HE9(6/22/2009) is located at the Henninger pasture just east of Kilgore Idaho at UTM 436504E, 4919257N. To date soils have not been mapped for this area. Vegetative cover at SS HE9 is just over 24 percent, compared to the ecological site description (NRCS 1982). The approximate potential ground cover (litter and vegetation) is 30-40 percent. The ecological site for this key area is a Steep stony slopes 16-22" P.Z. – B13-31-ID - ARTR/FEID Mountain Big sagebrush/Idaho fescue site (Appendix II). Vegetative cover appropriate for the site is essential for maintaining proper soil surface stability, reducing compaction and improving overall water infiltration. Vegetative cover at SS HE9 is deficient when compared to the ecological site description. The soils at the study site are stable and exhibit no outward signs of erosion. The soils at SS HE9 exhibit no signs of erosion, rill or gulley formations. There is no evidence of plant pedestalling or movement of soil, overall the soils are stable. Plant distribution based on cover indicates that the plant composition is 66 percent shrubs, eight percent grasses, and 26 percent forbs. Line intercept cover data collected at SS HE9 indicates that major grass and forb species are missing such as Idaho fescue, bluebunch wheatgrass, needlegrass, arrowleaf balsamroot, geranium, cinquefoil and, big bluegrass per the ecological site description. The ecological site description states the recommended dynamics of the site at historic climax plant community should be in the range of 50-60 percent grasses, 10-20 percent forbs, and 25-35 percent shrubs. Key species of shrubs are present, as stated above key herbaceous and forb species are absent from the site.

Table 9. Summary of results for SS HE9

Key area information	Species	Composition by species based on cover
Study site HE9 Range site: b13-31-id Desirable cover for site: 30-40% Percent cover measured 2009: 24.61%	Mountain big sagebrush	56%
	Buckwheat	20%
	Bitterbrush	10%
	Sandburg bluegrass	4%
	Smooth brome	3.6%
	Sedge	1.8%
	Death camas	1.1%
	Larkspur	0.3%
	Yarrow	0.3%
	Mustard	0.2%
	Onion	T

Composition by groups	
Shrubs	66%
Grasses	8%
Forbs	26%

The dominant shrubs at this site are mountain big sagebrush and, bitterbrush. The dominant herbaceous component at the site is Sandburg bluegrass and smooth brome an introduced perennial grass.

Conclusion: The soils supporting this site are generally shallow, well-drained, extremely stony loams. They have high runoff potential. Cover at this site is adequate to protect soils and maintain a stable site. There are several key herbaceous and forb species absent from the site that are key for site stability.

Study Site HE11 (6/22/2009) is located at the Henninger pasture just east of Kilgore Idaho at UTM 436770E, 4920422N. To date soils have not been mapped for this area. Vegetative cover at SS HE11 is just over 32 percent, compared to the ecological site description (NRCS 1982). The approximate potential ground cover (litter, rock and vegetation) is 50-70 percent. The ecological site for this key area is a Loamy 16-22" P.Z. – B13-23-ID - ARTRV/FEID Mountain Big sagebrush/Idaho fescue site (Appendix II). Vegetative cover appropriate for the site is essential for maintaining proper soil surface stability, reducing compaction and improving overall water infiltration. Vegetative cover at SS HE11 is deficient when compared to the ecological site description. The soils at the study site are stable and exhibit no outward signs of erosion. The soils at SS HE11 exhibit no signs of erosion, rill, or gulley formations. There is no evidence of plant pedestalling or movement of soil; overall, the soils are stable. Within one acre of this site is a seasonal streambed that is cutting upwards and expanding. This is threatening the stability of the meadow. Plant distribution based on cover indicates that the plant composition is 49 percent shrubs, 32 percent grasses, and 19 percent forbs. Line Intercept Cover data collected at SS HE11 indicates that major grass and forb species are missing such as Idaho fescue, bluebunch wheatgrass, needlegrass, arrowleaf balsamroot, geranium, cinquefoil and, big bluegrass per the ecological site description. The ecological site description states the recommended dynamics of the site at historic climax plant community should be in the range of 70-80 percent grasses, 10-20 percent forbs, and 5-15 percent shrubs. Key species of shrubs are present, and, as stated above, key herbaceous and forb species are absent from the site.

Figure 11. Study Site HE11 Henninger Pasture

Figure 12. Seasonal streambed in site HE11

The dominant shrubs at this site are mountain big sagebrush. The dominant herbaceous component at the site is Sandburg bluegrass and smooth brome an introduced perennial grass.

Table 10. Summary of results of SS HE11

Key area information	Species	Composition by species based on cover
Study site HE11 Range site: b13-23-id Desirable cover for site: 50-70% Percent cover measured 2009: 32.55%	Mountain big sagebrush	48.8%
	Smooth brome	22%
	Dandelion	12.5%
	Sandburg bluegrass	6.5%
	Yarrow	3.1%
	Sedge	2.1%
	Buckwheat	1.8%
	Larkspur	0.46%

Composition by groups	
Shrubs	49%
Grasses	32%
Forbs	19%

Conclusion: The soils supporting this site are generally deep to deep with loams to gravelly loam textures Cover at this site is adequate to protect soils and maintain a stable site. There are several key herbaceous and forb species absent from the site that are key for site stability. Smooth brome is an introduced perennial grass that is present. Based on visual estimates it appears to be increasing within the native community.

Figure 13. Study Site HE11B Henninger Pasture

Study Site HE11B (6/22/2009) is located at the Henninger pasture just east of Kilgore Idaho at UTM 436860E, 4919591N. To date soils have not been mapped for this area. Vegetative cover at Study Site HE11B is just over 32 percent, compared to the ecological site description (NRCS 1982). The approximate potential ground cover (litter and vegetation) is 30-40 percent. The ecological site for this key area is a Steep stony slopes 16-22" P.Z. – B13-31-ID - ARTRV/FEID Mountain big sagebrush/Idaho fescue site (Appendix II). Vegetative cover appropriate for the site is essential for maintaining proper soil surface stability, reducing compaction and improving overall water infiltration. Vegetative cover at SS HE11B is within the recommended guidelines when compared to the ecological site description. The soils at the study site are stable and exhibit no outward signs of erosion. The soils at SS HE11B exhibit no signs of erosion, rill, or gulley formations. There is no evidence of plant pedestalling or movement of soil, overall the soils are stable. Plant distribution based on cover indicates that the plant composition is 61 percent shrubs, four percent grasses, and 35 percent forbs. Line intercept cover data collected at SS HE11B indicates that major grass and forb species are missing such as Idaho fescue, bluebunch wheatgrass, needlegrass, arrowleaf balsamroot, geranium, cinquefoil, and big bluegrass per the ecological site description. The ecological site description states the recommended dynamics of the site at historic climax plant community should be in the range of 50-60 percent grasses, 10-20 percent

forbs, and 25-35 percent shrubs. Key species of shrubs are present, and, as stated above, key herbaceous and forb species are absent from the site.

The dominant shrubs at this site are mountain big sagebrush. The dominant herbaceous component at the site is Sandburg bluegrass and smooth brome an introduced perennial grass.

Table 11. Summary of results of SS HE11B

Key area information	Species	Composition by species based on cover
Study site HE11b Range site: b13-31-id Desirable cover for site: 30-40% Percent cover measured 2009: 32.38%	Mountain big sagebrush	60%
	Buckwheat	25%
	Sandburg bluegrass	2.9%
	Sedge	2.6%
	Yarrow	1.8%
	Smooth brome	1.2%
	Aster	1%
	Rabbitbrush	1%
	Phlox	0.8%
	Mustard	0.3%
	Larkspur	T

Composition by groups	
Shrubs	61%
Grasses	4%
Forbs	35%

Conclusion: The soils supporting this site are generally shallow, well drained, extremely stony loams. They have high runoff potential. Cover at this site is adequate to protect soils and maintain a stable site. There are several key herbaceous and forb species absent from the site that are key for site stability.

Livestock Watering

Henninger and Humphrey pastures have surface water available for watering sheep. Humphrey and Henninger have developed ditches to divert water onto grazing pastures while sheep are grazing the areas. Flood irrigation water is used to water sheep. Irrigation ditch locations and flood irrigated areas are found on Humphrey and Henninger pasture. Humphrey and Henninger were working ranches, purchased from the private sector in the 1940s. Irrigation practices were established and ongoing before ARS purchased the properties. Water is diverted, from Modoc Creek at Humphrey and from West Dry Creek at Henninger, with canvas dams, into diversion ditches to flood pastures at the time sheep graze in the area. Diverted irrigation water may be used annually; acres watered for each ranch varies, depending on stream flow at time of use. In dry years very little water is used. Diverted water is used to water sheep and irrigate for more green forage longer during the dry season. Number of days water is applied varies from one year to the next depending on needs and water availability. When sheep leave the pasture water diversion canvas dams are removed, and the diversion is shut off. There are about two miles of irrigation ditch at each ranch. Humphrey irrigation has rights for 4,000 cubic feet per second (CFS) from May 1 to October 15. The Humphrey pastures are grazed from May to October. While Henninger ranch has water use rights from May 1 to October 31; spring water use is not allowed until the water flow in Dry Creek no longer reaches Spring Creek in mid to late June. Average past ten year use is 675 CFS with a high of 1,125 CFS in 1999 and a low of 474 CFS in 2000. Diversion ditches are inspected and maintained annually.

Summary for Henninger Rangeland Sites

The trend for study sites HE9, HE11 and HE11B appears to be downward; this is partially due to constant grazing during the critical growing season with no rest rotation on the Henninger rangelands. Vegetative composition at all three key areas indicates that there is a lack of cool season plants within the ecological composition of the allotment. Grazing during the critical growing season is detrimental to cool season species where there is no rest rotation system in place. Currently they turn in livestock June 25 through July 29 and again from August 31 through September 15.

In addition, historical use on the allotment was primarily cattle up until purchased by the USSES in the late 1940s. The presence of smooth brome pastures indicates that it was planted for that purpose of cattle feed. Since sheep primarily browse with grazing being a minimum part of their diet the smooth brome is not being selected for herbivory and is spreading into the native areas and increasing in density.

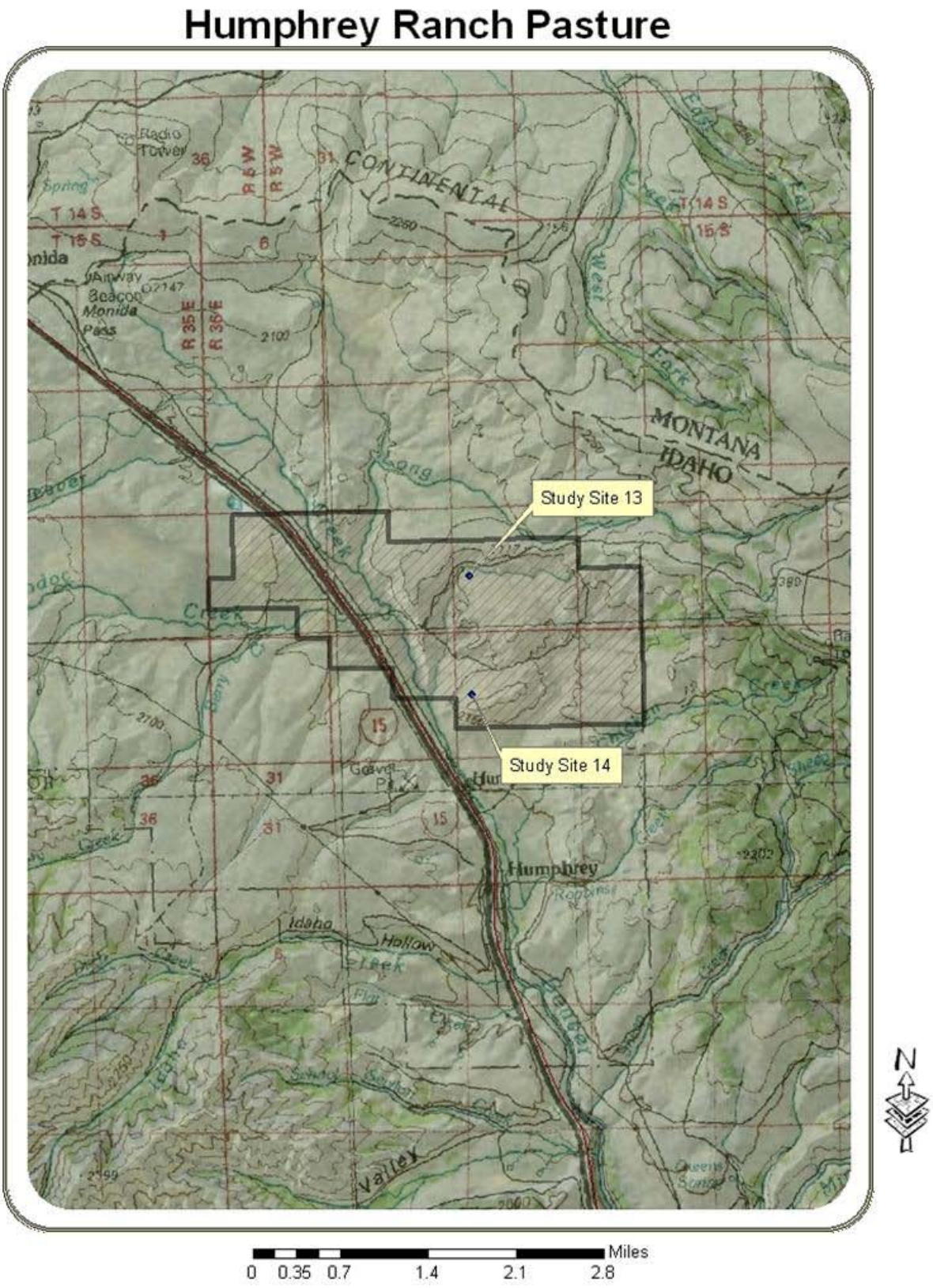

Figure 14. Location of Humphrey Ranch pasture study sites

Evaluation and Determination of Rangeland Health for the Humphrey Ranch Pastures.

Figure 15. Study Site HU13 Humphrey Ranch pastures

Study Site HU13 Humphrey Ranch (6/23/2009) is located at the Humphrey Ranch north of Spencer Idaho at UTM 401679E, 4930883N. The soil is classified as R013XY020ID (Appendix I). Vegetative cover at SS HU13 is just over 83 percent compared to the ecological site description (NRCS 1982). The approximate potential ground cover (litter and vegetation) is 60-90 percent. The ecological site for this key area is a Loamy Tall Brush 16-22" P.Z. – R013XY020ID - ACGL/BRMA4 (Appendix II). Vegetative cover appropriate for the site is essential for maintaining proper soil surface stability, reducing compaction and improving overall water infiltration. Vegetative cover at SS HU13 is within the recommended guidelines when compared to the ecological site description. The soils at the study site are stable and exhibit no outward signs of erosion. The soils at SS HU13 exhibit no signs of erosion, rill or gulley formations. There is no evidence of plant pedestalling or movement of soil, overall the soils are stable. Plant distribution based on cover indicates that the plant composition is 46 percent shrubs, 28 percent grasses, and 26 percent forbs. Line intercept cover data collected at SS HU13 indicates that most of the major plant species are present in the community as well as minor forbs and other species listed in the ecological site description. The ecological site description states the recommended dynamics of the site at historic climax plant community should be in the range of 15-25 percent grasses, 5-15 percent forbs, and 65-75 percent shrubs.

Table 12. Summary of results for SS HU13

Key area information	Species	Composition by species based on cover
Study site HU13 Range site: R013XY020ID Desirable cover for site: 60-90% Percent cover measured 2009: 83.7%	Three-tip sagebrush	22%
	Mountain big sagebrush	22%
	Mutton grass	21%
	Avens.spp	11%
	Cinquefoil	5.6%
	Mountain brome	5.3%
	Geranium	5.2%
	Buckwheat	3%
	White sagebrush	1.9%
	Big bluegrass	0.8%
	Lupine	0.4%
	Sedge	0.3%
	Yarrow	0.08%
	Kentucky bluegrass	T

Composition by groups	
Shrubs	46%
Grasses	28%
Forbs	26%

The dominant shrubs at this site are mountain big sagebrush. The dominant herbaceous component at the site is big bluegrass mutton grass and mountain brome.

Conclusion: This site is very stable and has an appropriate diversity of forbs, shrubs, and grasses. Fire has historically occurred on this site at intervals of 20-50 years. There has been fire on the site within the last 20 years.

Figure 16. Study Site HU14 Humphrey Ranch

Study Site HU14 Humphrey Ranch (6/23/2009) is located at the Humphrey Ranch north of Spencer Idaho at UTM 401659E, 4929364N. The soil is classified as R013XY020ID (Appendix I). Vegetative cover at SS HU14 is 40 percent, compared to the ecological site description (NRCS 1982). The approximate potential ground cover (litter and vegetation) is 60-90 percent. The ecological site for this key area is a loamy Tall Brush 16-22" P.Z. – R013XY020ID - ACGL/BRMA4 (Appendix II). Vegetative cover appropriate for the site is essential for maintaining proper soil surface stability, reducing compaction and improving overall water infiltration. Vegetative cover at HU14 is within the recommended guidelines when compared to the ecological site description. The soils at the study site are stable and exhibit no outward signs of erosion, vegetative cover appropriate for the site is essential for maintaining proper soil surface stability, reducing compaction and improving overall water infiltration. The soils at SS HU14 exhibit no signs of erosion, rill or gulley formations. There is no evidence of plant pedestalling or movement of soil, overall the soils are stable. Plant distribution based on cover indicates that the plant composition is 46 percent shrubs, 28 percent grasses, and 26 percent forbs. Line intercept cover data collected at SS HU14 indicates that most of the major plant species are present in the community as well as minor forbs and other species listed in the ecological site description. The ecological site description states the recommended dynamics of the site at historic climax plant community should be in the range of 15-25 percent grasses, 5-15 percent forbs, and 65-75 percent shrubs. The dominant shrubs at this site are white sagebrush. The dominant herbaceous component at the site is big bluegrass and mountain brome.

Conclusion: This site is very stable and has an appropriate diversity of forbs, shrubs and grasses. Fire has historically occurred on this site at intervals of 20-50 years (USDA ESD 2009). There has been fire on the site within the last 10 years. This plant community is dominated by mountain brome and big bluegrass. There is a wide variety of other grasses and forbs in small amounts. Some grasses have been killed by fire. Most shrubs are absent from the site due to recent fire.

Table 13. Summary of results for SS HU14

Key area information	Species	Composition by species based on cover
Study site HU14 Range site: R013XY020ID Desirable cover for site: 60-90% Percent cover measured 2009: 40%	Big bluegrass	60%
	White sagebrush	6.5%
	Dandelion	5.7%
	Mountain brome	3.8%
	Lupine	2.87%
	Geranium	2.5%
	Phlox	0.8%
	Wild iris	0.7%
	Yarrow	0.2%
	Sedge	0.2%
	Buckwheat	0.08%

Composition by groups	
Shrubs	7%
Grasses	74%
Forbs	19%

Livestock Watering

Henninger and Humphrey pastures have surface water available for watering sheep. Humphrey and Henninger Ranches have developed ditches to divert water onto grazing pastures while sheep are grazing the areas. Flood irrigation water is used to water sheep. Irrigation ditch locations and flood irrigated areas are located on Humphrey and Henninger pasture. Humphrey and Henninger Ranches were working ranches, purchased from the private sector in the 1940s. Irrigation practices were ongoing before ARS purchased the properties. Water is diverted, from Modoc Creek at Humphrey and from West Dry Creek at Henninger, with canvas dams, into diversion ditches to flood pastures at the time sheep graze in the area. Diverted irrigation water may be used annually, acres watered for each ranch varies, depending on stream flow at time of use. In dry years, very little water is used. Diverted water is used for watering sheep and irrigation provides more green forage longer during the dry season. Number of days water is applied varies from one year to next depending on needs and water availability. When sheep are moved out of the pasture water diversion canvas dams are removed, diversion is shut off. There are about two miles of irrigation ditch at each ranch. Humphrey irrigation has rights for 4,000 cubic feet per second (CFS) from May 1 to October 15. The Humphrey pastures are grazed from May to October. Henninger ranch has water use rights from May 1 to October 31; spring water use is not allowed until the water flow in Dry Creek no longer reaches Spring Creek in mid to late June. Average past ten year use is 675 CFS with a high of 1,125 CFS in 1999 and a low of 474 CFS in 2000. Diversion ditches are inspected and maintained annually.

Summary for Humphrey Rangeland Sites

The Humphrey Rangeland site is thriving in an early mid seral state. This site is very stable and has an appropriate diversity of forbs, shrubs and grasses. Fire has historically occurred on this site at intervals of 20-50 years. There has been fire on the site within the last 20 years.

Figure 17. Humphrey rangeland

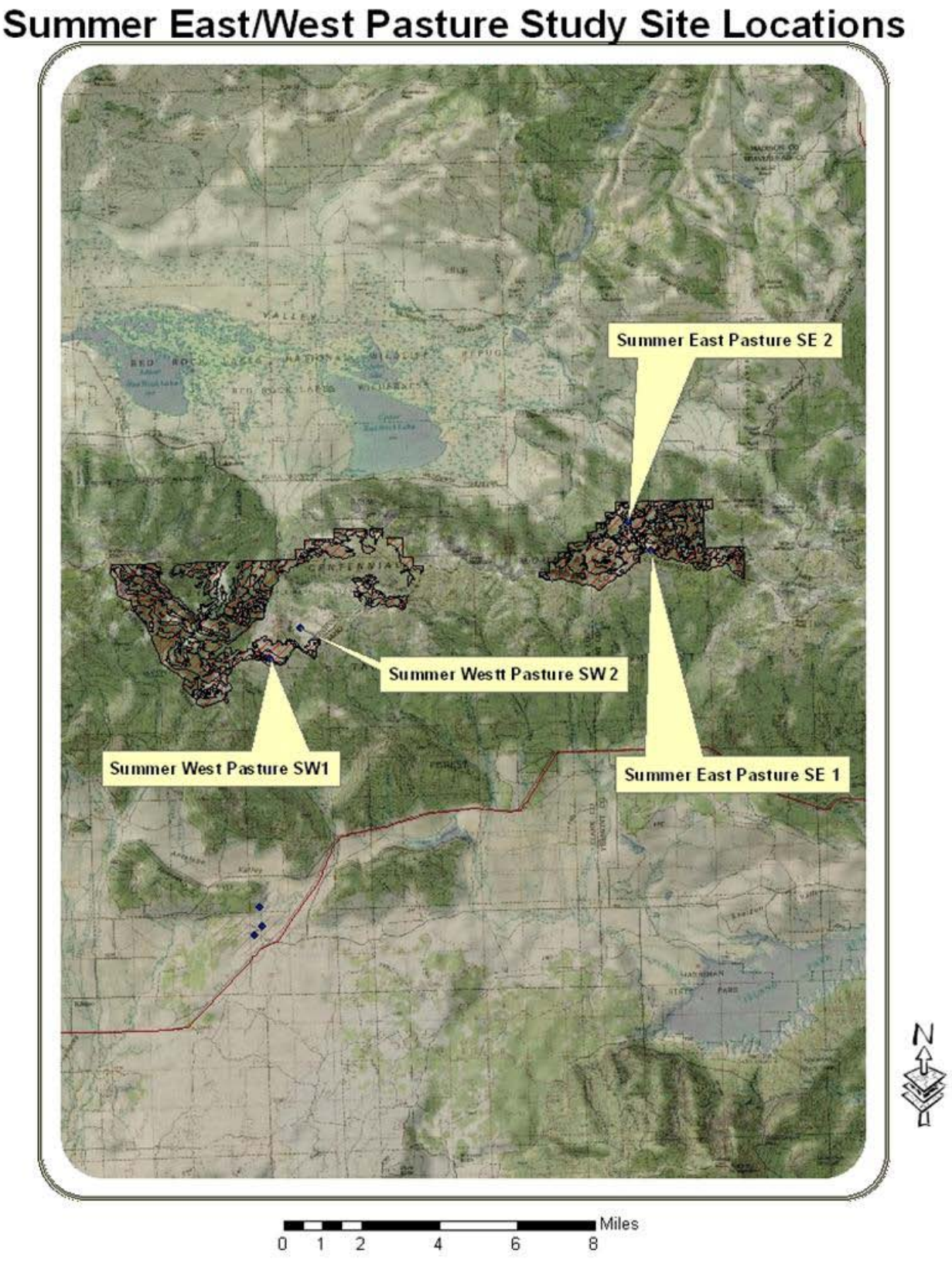

Figure 18. Location of Summer East and West Pasture study sites

Evaluation and Determination of Rangeland Health for the Summer East Pasture/Toms Creek and Summer West Pasture/Odell Lake.

Figure 19. Study Site SE1 Summer East Pasture/Tom's Creek

Study Site SE1 Summer East Pasture/ Toms Creek (8/17/2009) is located in the Centennial mountain range on the continental divide north of Kilgore Idaho at UTM 453475E, 4934528N. To date soils have not been mapped for this area. Vegetative cover at SS SE SE1 is just under 42 percent, compared to the ecological site description (NRCS 1982) the approximate potential ground cover (litter and vegetation) is +90 percent. The ecological site for this key area is a sandy, silty, clayey 20" plus P.Z.– II-E-8 (Appendix II). Vegetative cover appropriate for the site is essential for maintaining proper soil surface stability, reducing compaction and improving overall water infiltration. Vegetative cover at SS SE1 is deficient when compared to the ecological site description. The soils at the study site are stable and exhibit no outward signs of erosion. The soils at SS SE1 exhibit no signs of erosion, rill or gulley formations. There is no evidence of plant pedestalling or movement of soil, overall the soils are stable. Plant distribution based on cover indicates that the plant composition is zero percent shrubs, 20 percent grasses, and 80 percent forbs. Line intercept cover data collected at SS SE1 indicate that major grass and forb species are missing such as subalpine needlegrass, purple oniongrass, bearded wheatgrass, mountain brome, and rocky mountain iris per the ecological site description. These plants decrease in frequency under grazing pressure (decreasers) except needlegrass, which increases in frequency (increaser). Other species that are present but in small numbers that are also decreasers to sheep grazing is sticky geranium and larkspur. Other species present on the site but outside the transect are whitebark pine, dandelion, alpine timothy, and Kentucky bluegrass. The ecological site description states the recommended dynamics of the site at historic climax plant community should be in the range of 65 percent grasses, 15 percent forbs, and 20 percent woody species. There are no woody species present at this site.

The dominant herbaceous component at the site is alpine fescue and alpine bluegrass.

Conclusion: Early stages of degradation will tend to change the historic climax plant community to a community dominated by medium and short grasses and sedges such as Sandburg bluegrass and some fescues. Most of the taller and more palatable plants such as big bluegrass, tall needlegrass, and oniongrass will decrease or disappear from the site. Biomass production and litter become reduced on the site as taller grasses are replaced by shorter ones. Under these conditions, evapotranspiration tends to increase, moisture retention is reduced, and soil surface temperatures increase. Increased amounts of bare soil can result in continued degradation of this range site. This site type should be highly resilient to disturbance as it has very few soil limitations for plant growth.

Table 14. Summary of results for SS SE1

Key area information	Species	Composition by species based on cover
Study site SE1 Range site: r ii-e-8. Desirable cover for site: +90% Percent cover measured 2009: 41.94%	Carex	37.7%
	Alpine fescue	14.5%
	Lupine	10.6%
	Yarrow	6.4%
	Alpine bluegrass	5.5%
	Geum	4.5%
	Toad rush	3.5%
	Short-beaked agoseris	2.7%
	Fleabane	2.7%
	Phlox	1.8%
	Mullee	1.6%
	Ballhead sandwort	0.95%
	Kittentails	0.88%
	Cinquefoil	0.4%
	Sticky geranium	0.4%
	Green gentian	0.2%
	Drummonds rockcress	T

Composition by groups	
Shrubs	0%
Grasses	20%
Forbs	80%

Figure 20. Study Site SE2 Summer East Pasture/Tom's Creek

Study Site SE2 Summer East Pasture/ Toms Creek (8/17/2009) is located in the Centennial mountain range on the continental divide north of Kilgore Idaho at UTM 452532E, 4935742N NAD 27. To date soils have not been mapped for this area Vegetative cover at SS SE2 is just over 48 percent, compared to the ecological site description the approximate potential ground cover (litter and vegetation) is +90 percent. The ecological site for this key area is a Sandy, Silty, Clayey 20" plus P.Z (Appendix II. Vegetative cover appropriate for the site is essential for maintaining proper soil surface stability, reducing compaction and improving overall water infiltration. Vegetative cover at SS SE2 is deficient when compared to the range site description. The soils at the study site are stable and exhibit no outward signs of erosion. The soils at SS SE2 exhibit no signs of erosion, rill, or gulley formations. There is no evidence of plant pedestalling or movement of soil, overall the soils are stable. Plant distribution based on cover indicates that the plant composition is zero percent shrubs, four percent grasses, and 96 percent forbs. Line intercept cover data collected at SS SE2 indicates that major grass and forb species are missing such

as subalpine needlegrass, alpine foxtail, bearded wheatgrass, mountain brome, and rocky mountain iris per the range site description. These are all decreasers to sheep grazing except needlegrass this is an increaser. Other species that are present (in small numbers) that are also decreasers due to sheep grazing include larkspur and lupine. Other species present on the site but not within the transect include whitebark pine, campion, mountain sagebrush, subalpine fir, mountain gooseberry, Indian paintbrush, sorrel, larkspur, dandelion, alpine timothy, and Kentucky bluegrass. The range site description states the recommended dynamics of the site at historic climax plant community should be in the range of 65 percent grasses, 15 percent forbs, and 20 percent woody species.

The dominant herbaceous component on the site is oniongrass, which is a native grass that is a decreaser to grazing by sheep.

Table 15. Summary of results for SS SE2

Key area information	Species	Composition by species based on cover
Study site SE2 Range site: sandy,silty,clayey 20" p.z. Desirable cover for site: +90% Percent cover measured 2009: 44.48%	Slender cinquefoil	42.6%
	Lambstongue ragwort	23%
	Sticky geranium	19.4%
	Carex species	6.8%
	Oniongrass (purple oniongrass)	3.32%
	Lupine	2.65%
	Yarrow	2.3%
	Pale dandelion	1.6%
	Deer grass	0.18%
	Lettermans Needlegrass	0.18%
	Wheatgrass *species.*	0.15%
	Gilia species.	0.1%
	Buckwheat species	0.1%
	Sego lily	0.09%
	Douglas' knotweed	0.08%
	Aster	0.08%

Composition by groups	
Shrubs	0%
Grasses	4%
Forbs	96%

Conclusion: Early stages of degradation will tend to change the HCPC to a community dominated by medium and short grasses and sedges such as Sandburg bluegrass and some fescues. Most of the taller and more palatable plants such as big bluegrass, tall needlegrass and oniongrass will decrease or disappear from the site. Biomass production and litter become reduced on the site as taller grasses are replaced by shorter ones. Under these conditions, evapotranspiration tends to increase, moisture retention is reduced, and soil surface temperatures increase. Increased amounts of bare soil can result in continued degradation of this range site. This site type should be highly resilient to disturbance as it has very few soil limitations for plant growth.

Figure 21. Study Site SW1 Summer West Pasture/Odell lake

Study Site SW1 Summer Pasture/ Odell Lake (8/17/2009) is located in the Centennial mountain range on the continental divide north of Kilgore Idaho at UTM 437579E, 4930639N NAD 27. To date soils have not been mapped for this area. Vegetative cover at SS SW1 is just under 78 percent, compared to the range site description the approximate potential ground cover (litter and vegetation) in excellent condition is 95 percent. The ecological site for this key area is a subirrigated 20" plus P.Z (Appendix II). Vegetative cover appropriate for the site is essential for maintaining proper soil surface stability, reducing compaction and improving overall water infiltration. Vegetative cover at SS SW1 is deficient when compared to the range site description. The soils at the study site are stable and exhibit no outward signs of erosion. The soils at SS SW1 exhibit no signs of erosion, rill or gulley formations. There is no evidence of plant pedestalling or movement of soil, overall the soils are stable. Plant distribution based on cover indicates that the plant composition is zero percent shrubs, two percent grasses, and 98 percent forbs. Line intercept cover data collected at SS SW1 indicates that major grass and forb species are present. However, the herbaceous component is lacking compared to what is recommended by the range site description. Since this is principally used by sheep during the summer months when they primarily browse on forbs and woody material livestock are not a contributing factor to the herbaceous deficit. Recent fires on ARS lands that occurred during the fall would favor forb growth and coupled with the above average precipitation in the form of snow and rain and below average temperatures this year gave the forbs that much more of a boost in production. The forbs canopy appears to be double or triple the amount you would see in a normal year.

Due to high forb production herbaceous estimates are going to be skewed toward the larger and more frequent plants with a high leaf area index. The range site description states the recommended dynamics of the site at historic climax plant community should be in the range of 65 percent grasses, 15 percent forbs, and 20 percent woody species.

The dominant herbaceous component on the site is oniongrass, a native decreaser to grazing by sheep.

Conclusion: The forb production for this area is exceptionally high due to above average precipitation and cooler than normal temperatures. Also due to high forb production herbaceous estimates are going to be skewed toward the larger and more frequent plants with a high leaf area index. This is because the line intercept method measures the distance on a line (measuring tape) occupied by different plant species, and from that, composition of species and their frequencies are extrapolated. It should be noted that the methodology for this technique differs from that of the NRCS (which is based on weight), resulting in differing plant frequencies.

Table 16. Summary of results for SS SW1

Key area information	Species	Composition by species based on cover
Study site SW1 Range site: subirrigated 20” plus p.z. Desirable cover for site: +95% Percent cover measured 2009: 77.8%	Sticky geranium	56.0%
	Slender cinquefoil	25.0%
	Lambstongue ragwort	5.5%
	Manyflower stickseed	2.3%
	Sierra larkspur	2.0%
	Buckwheat species	1.6%
	Aster	1.3%
	Oniongrass (purple oniongrass)	1.2%
	Lupine	1.2%
	Yarrow	0.92%
	Western coneflower	0.87%
	Carex species.	0.77%
	Fernleaf licoriceroot	0.77%
	Dandelion	0.41%
	Beardless bluebunch wheatgrass	0.26%
	Pale dandelion	0.17%
	Geum species.	0.12%
	Douglas' knotweed	0.06%
	Arctic brome	0.05%
	Needle grass	0.04%
	Alpine timothy	0.01%

Composition by groups	
Shrubs	0%
Grasses	2%
Forbs	98%

The soils on this site are stable with no rill or gulley formations evident. Sheep grazing was evident nearby at the time this data was taken. Utilization appeared minimal with more of a trampling affect taking place. This site type should be highly resilient to disturbance as it has very few soil limitations for plant growth.

Figure 22. Study Site SW2 Summer West Pasture / Odell lake

Study Site SW2 Summer West Pasture/ Odell Lake (8/17/2009) is located in the Centennial mountain range on the continental divide north of Kilgore Idaho at UTM 438892E, 4931836N NAD 27. To date soils have not been mapped for this area. Vegetative cover at SS SW2 is just under 54 percent, compared to the ecological site description the approximate potential ground cover (litter and vegetation) in excellent condition is 95 percent. The ecological site for this key area is a Subirrigated 20" plus P.Z (Appendix II). Vegetative cover appropriate for the site is essential for maintaining proper soil surface stability, reducing compaction and improving overall water infiltration. Vegetative cover at SS SW2 is deficient when compared to the rangel site description. The soils at the study site are stable and exhibit no outward signs of erosion. The soils at SS SW2 exhibit no signs of erosion, rill or gulley formations. There is no evidence of plant pedestalling or movement of soil, overall the soils are stable. Plant distribution based on cover indicates that the plant composition is 25 percent shrubs, one percent grasses, and 74 percent forbs. Line intercept cover data collected at SS SW2 indicates that major grass and forb species are present. However, the herbaceous component is lacking compared to what is recommended by the range site description , which is 65 percent. Since sheep principally use this during the summer months when they primarily browse on forbs and woody material, livestock are not a contributing factor to the herbaceous deficit. Recent fires on ARS lands that occurred during the fall would favor forb growth; which, coupled with the above average precipitation in the form of snow and rain and below average temperatures this year, gave the forbs that much more of a boost in production. The forbs canopy appears to be double or triple the amount seen in a normal year.

Also due to high forb production herbaceous estimates are going to be skewed toward the larger and more frequent plants with a high leaf area index. The range site description states the recommended dynamics of the site at historic climax plant community should be in the range of 65 percent grasses, 15 percent forbs, and 20 percent woody species.

The dominant herbaceous components on the site are oniongrass and mountain brome, which are native grasses that are decreasers to grazing by sheep. Also present but not within the transect were arrowleaf balsamroot and little sunflower.

Conclusion: The forb production for this area is exceptionally high due to fires that occurred in the fall and above average precipitation and cooler than normal temperatures. Also due to high forb production herbaceous estimates are going to be skewed toward the larger and more frequent plants with a high leaf area index. This is because the line point intercept method measures the distance on a line (measuring tape) occupied by different plant species, and from that, composition of species and their frequencies are extrapolated. It should be noted that the methodology for this technique differs from that of the NRCS (which is based on weight), resulting in differing plant frequencies.

Table 17. Summary of results for SS SW2

Key area information	Species	Composition by species based on cover
Study site SW2 Range site: subirrigated 20” plus p.z. Desirable cover for site: +95% Percent cover measured 2009: 77.8%	Showy goldeneye	22%
	Sticky geranium	18.7%
	Snowberry	14%
	Mountain big sagebrush	10.6%
	Hoary balsamroot	6.3%
	Slender cinquefoil	5%
	Aster	3.9%
	Parry's aster	3.7%
	Small-leaf angelica	3.5%
	Sunflower	2.8%
	Lupine	2%
	Lambstongue ragwort	1.8%
	Fernleaf licoriceroot	1.7%
	Sierra larkspur	1.4%
	Yarrow	1%
	Carex species	0.66%
	Beardless bluebunch wheatgrass	0.61%
	Northern bedstraw	0.09%
	Brome species	0.07%
	Manyflower stickseed	0.05%
	Oniongrass (purple oniongrass)	0.05%
	Douglas' knotweed	0.04%

Composition by groups	
Shrubs	25%
Grasses	1%
Forbs	74%

The soils on this site are stable with no rill or gulley formations evident. Sheep grazing was evident nearby at the time this data was taken. Utilization appeared minimal with more of a trampling affect taking place. This site type should be highly resilient to disturbance as it has very few soil limitations for plant growth.

Livestock Watering

There are five water developments in the Montana portion of the Summer West Pasture in the Big Mountain area. Springs are developed with permanent troughs to collect water in low-flow areas needed to water 350 to 900 ewes and 1,250 to 1,400 lambs at one time. Water developments are also used by wildlife.

The five water development sites on the Summer West Pasture include four metal and one rubber trough. Four of the developments are flume type with metal troughs and metal (3) or wood (1) support structures. Flumes are 80 to 90 feet in length, approximately 20 to 24 inches in width, and 14 to 16 inches deep. The

fifth development is a series of round rubber troughs, with about 10 gallons capacity each, installed at springs.

Developed water site locations:

- Short Canyon = SENE 1/4 Section 6, T15S, T1W (Round rubber troughs).
- Lower Unit 3 = SENE Section 5, T15S, R1W (Flume trough).
- Unit 2 = SWNWNW Section 5, T15S, R1W (Flume trough).
- Upper Unit 3 = SESW Section 33, T14S, R1W (Flume trough).
- Unit 4 = NENESE Section 4, T15S, R1W (Flume trough).

Figure 23. Summer West Pasture

Conclusion: The Summer West Pasture has a high diversity of forbs, grasses and shrubs due to the high precipitation received in the form of snow and rain. The dominant plants are cool season plants due to the short growing season experienced at that elevation. Livestock grazing takes place during the summer only and is rotated between the Summer East and West Pastures which results in a pasture receiving rest one year in three. Line intercept cover data collected at both sites indicates that major grass and forb species are present. However, the herbaceous component is less than what is recommended by the range site description which is 65 percent. Since sheep principally use this during the summer months when they primarily browse on forbs and woody material, livestock are not a contributing factor to the herbaceous deficit. Recent fires on ARS lands that occurred during the fall would favor forb growth; and coupled with the above average precipitation in the form of snow and rain, and below average temperatures this year, gave the forbs that much more of a boost in production. The forbs canopy appears to be double or triple the amount seen in a normal year. The visual comparison of plants inside enclosures ungrazed for over 30 years; to plants outside the enclosures shows no difference in vegetative composition. There were select areas observed during the time that the monitoring data was collected showing heavier sheep use. These areas were small (less than 50 acres in size) and occurred in areas where the sheep trailing was bottlenecked due to terrain features.

References Cited

Brotherson, J.D., S.R. Rushforth, and J.R. Johnson. 1983. Effects of long term grazing on cryptogamic crust cover in Navajo National Monument Ariz. J. Range Manage.36(5): 579-581.

Daubenmire, R. 1968. Plant communities: a textbook of plant Synecology. Harper & Row, New York,New York.

National Research Council. 1994. Rangeland health: new methods to classify, inventory, and monitor rangelands. National Academy Press, Washington, DC. National Research Council. 180p.

NRCS Soil Quality Institute, NRCS Grazing Lands Technology Institute, NRCS National Soil Survey Center, USDA-ARS Jornada Experimental Range, USDI Bureau of Land Management. 2002. Rangeland soil quality information sheets (http://soils.usda.gov/sqi/sqiproductlist.html).

Sheley, R.L., J.K. Petroff, and M.M. Borman. 1999. Introduction. In R.L. Sheley and J.K. Petroff (eds). Biology and management of noxious rangeland weeds. Pages 1-3. Oregon State University Press, Corvallis, Oregon

Soil Science Society of America. 1997. Glossary of soil science terms. Soil Science Society of America. Madison, Wisconsin. 138p.

Society for Range Management. 1999. A glossary of terms used in range management. Society for Range Management. Denver, Colorado. 20p.

U.S. Department of Agriculture, Natural Resources Conservation Service. 1997. National range and pasture handbook. Washington, DC. U.S. Department of Agriculture.

USDA. 2009. Ecological Site Description (ESD) System. NRCS. Online. http://esis.sc.egov.usda.gov/esis_report/fsReport.aspx?approved=yes&id

USDA. 2009. MLRA Explorer. NRCS. Online. http://ceiwin5.cei.psu.edu/MLRA/pdf/rep634480610373776205.pdf

USDA. 2009. Soil Survey of Grant and Freemont County, Idaho. Natural Resource Conservation Service.

USDI. 1996. Sampling Vegetation Attributes. Bureau of Land Management.

USDI. 2000. Interpreting Indicators of Rangeland Health. Interagency Protocol (BLM, ARS, NRCS).

National Research Council. 1994. Rangeland health: new methods to classify, inventory, and monitor rangelands. National Academy Press, Washington, DC. National Research Council. 180p.

Vallentine, J.F. 1990. Grazing management. Academic Press, Berkeley, California.

Glossary

Abundance: The total number of individuals of a species in an area, population, or community (SRM 1999).

Accelerated erosion: Erosion in excess of natural rates, usually as a result of anthropogenic activities (SSSA 1997).

Age classes: The distribution of different ages of the same species or group of species on a site.

Annual plant: A plant that completes its life cycle and dies in 1 year or less (SRM 1999).

Annual production: The net quantity of aboveground vascular plant material produced within a year. Synonym: net aboveground primary production.

Assessment: The process of estimating or judging the value or functional status of ecological processes (e.g., rangeland health) in a location at a moment in time.

At risk: Rangelands that have a reversible loss in productive capability and increased vulnerability to irreversible degradation based upon an evaluation of current conditions of the soil and ecological processes (NRC 1994). At risk designation may point out the need for additional information needed to better quantify the functional status of an attribute.

Attribute: One of the three components, soil/site stability, hydrologic function, and biotic integrity that collectively define rangeland health.

Badland: A land type consisting of steep or very steep barren land, usually broken by an intricate maze of narrow ravines, sharp crests, and pinnacles resulting from serious erosion of soft geologic materials (SRM 1999).

Bare ground (bare soil): All land surface not covered by vegetation, rock, or litter (SRM 1999). As used in this document, visible biological crusts and standing dead vegetation are included in cover estimates or measurements and therefore are **not** bare ground (e.g., mineral soil).

Basal area (plants): The cross-sectional area of the stem or stems of a plant or of all plants in a stand. Herbaceous and small woody plants are measured at or near the ground level; larger woody plants are measured at breast or other designated height. *Synonym:* basal cover (SRM 1999).

Basal cover (plants): The percent of soil surface covered by plant bases. *Synonym:* basal area (SRM 1999).

Biological crust: Microorganisms (e.g., lichens, algae, cyanobacteria, microfungi) and non-vascular plants (e.g., mosses, lichens) that grow on or just below the soil surface. *Synonym:* microbiotic crust and cryptogamic crust.

Biomass (plants): The total amount of living plants above and below ground in an area at a given time (SRM 1999). As used in this document, biomass refers only to parts of standing living plants above ground, and not the roots.

Biotic integrity: Capacity of a site to support characteristic functional and structural communities in the context of normal variability, to resist loss of this function and structure due to a disturbance, and to recover following such disturbance. (One of the three attributes of rangeland health.)

Blowout: An excavation in areas of loose soil, usually sand, produced by wind; a breakthrough or rupture of a soil surface attributable to hydraulic pressure, usually associated with sand boils (SRM 1999).

Bunch grass: A grass having the characteristic growth habit of forming a bunch; lacking stolons or rhizomes (SRM 1999).

Canopy Cover: The percentage of the ground covered by a vertical projection of the outermost perimeter of the natural spread of foliage of plants. Small openings within the canopy are included. *Synonym:* crown cover (USDA 1997).

Chemical soil crust: A soil-surface layer, ranging in thickness from a few millimeters to a few centimeters, that is formed when chemical compounds become concentrated on the soil surface. They can reduce infiltration and increase overland water flow similar to physical crusts. They are usually identified by a white color on the soil surface.

Climate: The average or prevailing weather conditions of a place over a period of years (SRM 1999).

Climax plant community (climax): The final or stable biotic community in a successional series; it is self-perpetuating and in equilibrium with the physical habitat (SRM 1999).

Community pathway: Shifts in plant species compositions among biological communities within a single state.

Compaction layer: A near surface layer of dense soil caused by the repeated impact on or disturbance of the soil surface. When soil is compacted, soil grains are rearranged to decrease the void space and bring them into closer contact with one another, thereby increasing the bulk density (SSSA 1997).

Composition: The proportions of various plant species in relation to the total on a given area; it may be expressed in terms of cover, density, weight, etc. *Synonym:* Species composition (SRM 1999).

Cool-season plant: A plant which generally makes the major portion of its growth during the late fall, winter, and early spring. Cool season grasses generally exhibit the C-3 photosynthetic pathway. cf. warm-season plants (SRM 1999).

Cover: Percentage of material, other than bare ground, covering the land surface. It may include live and standing dead vegetation, litter, biological crust, cobble, gravel, stones, and bedrock. Ground cover plus bare ground would total 100 percent. *Synonym:* ground cover.

Decomposition: The biochemical breakdown of organic matter into its original compounds and nutrients.

Deposition area: An area offsite from where the original soil erosion occurred that now has the soil deposits from the original soil erosion area.

Descriptor: The narrative that describes the indicator characteristics under each of the five rating categories (Extreme to Total, Moderate to Extreme, Moderate, Slight to Moderate, and None to Slight) in the Rangeland Health Indicator Evaluation Matrix. The “default descriptor” is printed in the Matrix, while the “revised descriptor” is completed by the evaluators if the default descriptor does not fit the characteristics of a particular indicator for a particular ecological site.

Desired plant community: Of the several plant communities that may occupy a site, the one that has been identified through a management plan to best meet the plan's objectives for the site. It must protect the site as a minimum (SRM 1999).

Dominant species: Plant species or species groups, which by means of their number, coverage, or size, have considerable influence or control upon the conditions of existence of associated species (SRM 1999). Daubenmire (1968) defines dominant species as "those species whose removal would bring about the greatest readjustments in the edaphic, aerial, and biotic character of their ecosystem. They are often the tallest plants" and "where there is little difference in size, dominance is determined primarily by numbers of individuals." For purposes of this document, *Interpreting Indicators of Rangeland Health*, dominant plants are those of the greatest size per unit area as measured by biomass, production, or cover.

Ecological processes: Ecological processes include the water cycle (the capture, storage, and redistribution of precipitation), energy flow (conversion of sunlight to plant and animal matter), and nutrient cycle (the cycle of nutrients such as nitrogen and phosphorus through the physical and biotic components of the environment). Ecological processes functioning within a normal range of variation will support specific plant and animal communities.

Ecological reference area: An area representing a single ecological site in which ecological processes are functioning within a normal range of variability and the plant community has adequate resistance to and resistance from most disturbances. These areas do not need to be pristine, historically unused lands (e.g., climax plant communities or relict areas).

Ecological site: A kind of land with specific physical characteristics which differs from other kinds of land in its ability to produce distinctive kinds and amounts of vegetation and in its response to management. Apparently synonymous with ecological type used by USDA Forest Service. Synonym: Rangeland Ecological Site (SRM 1999).

Ecological site description: Description of the soils, uses, and potential of a kind of land with specific physical characteristics to produce distinctive kinds and amounts of vegetation.

Ecosystem: Organisms together with their abiotic environment, forming an interacting system, inhabiting an identifiable space (SRM 1999).

Energy flow: Conversion of sunlight to plant and animal matter; one of the ecological processes.

Erosion: Detachment and movement of soil or rock fragments by water, wind, ice, gravity; the land surface worn away by running water, wind, ice, or other geological agents, including such processes as gravitational creep (SRM 1999).

Evaluation area: The area (generally 1/2 to 1 acre in size) where the evaluation of rangeland health attributes takes place.

Evaluator(s): The person or persons conducting the evaluation of rangeland health on an evaluation area.

Exclosure: An area fenced to exclude animals (SRM 1999).

Exotic plant: A plant growing on or occurring in an ecosystem beyond its natural range of existence or natural zone of potential dispersal.

Flow pattern: The path that water takes (i.e., accumulates) as it moves across the soil surface during overland flow.

Foliar Cover: The percentage of ground covered by the vertical projection of the aerial portion of plants. Small openings in the canopy and intraspecific overlap are excluded. Foliar cover is always less than canopy cover; either may exceed 100 percent (USDA 1997).

Forb: Any broad-leafed, herbaceous plant other than those in the Poaceae, Cyperaceae, and Juncaceae families (SRM 1999).

Functional/structural groups: A suite or group of species that because of similar shoot or root structure, photosynthetic pathways, nitrogen fixing ability, life cycle, etc., are grouped together on an ecological site basis.

Functioning: (1) Refers to the rangeland health attributes where the majority (see definition of "preponderance of evidence") of the associated indicators are rated as having little or no deviation from that described in the Reference Sheet (Appendix 2) for the ecological site; (2) Refers to the presence and integrity of ecological processes (energy flow, water cycling, and nutrient cycling) being within the range of expectations for the ecological site.

Geomorphology: The science that studies the evolution of the earth's surface. The science of landforms (SSSA 1997).

Grass: Members of the plant family Poaceae (SRM 1999).

Ground cover: Percentage of material, other than bare ground, covering the land surface. It may include live and standing dead vegetation, litter, biological crust, cobble, gravel, stones, and bedrock. Ground cover plus bare ground would total 100 percent.

Ground cover (as used in this document): Percentage of material, other than bare ground, covering the land surface. It may include live and standing dead vegetation, ***biological soil crusts***, litter, cobble, gravel, stones, and bedrock. Ground cover plus bare ground would total 100 percent.

Gully: A furrow, channel, or miniature valley, usually with steep sides through which water commonly flows during and immediately after rains or snowmelt (SRM 1999). Small channels eroded by concentrated water flow.

Headcut: Abrupt elevation drops in the channel of a gully that accelerates erosion as it undercuts the gully floor and migrates upstream.

Half-shrub: A perennial plant with a woody base whose annually produced stems die each year (SRM 1999).

Healthy rangelands: The degree to which the integrity of the soil, vegetation, water, and air, as well as the ecological processes of the rangeland ecosystem, are balanced and sustained. Integrity is defined as maintenance of the structure and functional attributes characteristic of a locale, including normal variability (SRM 1999). *Synonym:* rangeland health.

Historic climax plant community: The plant community that was best adapted to the unique combination of factors associated with the ecological site. It was in a natural dynamic equilibrium with the historic biotic, abiotic, climatic factors on its ecological site in North America at the time of European immigration and settlement (USDA 1997).

Hydrologic function: The capacity of the site to capture, store, and safely release water from rainfall,

run-on, and snowmelt (where relevant), to resist a reduction in this capacity, and to recover this capacity following degradation (one of the three attributes of rangeland health).

Increaser: For a given plant community, those species that increase in amount as a result of a specific abiotic/biotic influence or management practice (SRM 1999).

Indicator: Components of a system whose characteristics (e.g., presence or absence, quantity, distribution) are used as an index of an attribute (e.g., rangeland health) that are too difficult, inconvenient, or expensive to measure.

Infiltration: The entry of water into the soil (SSSA 1997).

Interrill erosion: The removal of a fairly uniform layer of soil on a multitude of relatively small areas by splash due to raindrop impact and by sheet flow (SSSA 1997).

Invader: Plant species that were absent in undisturbed portions of the original vegetation of a specific range site and will invade or increase following disturbance or continued heavy grazing (SRM 1999).

Invasive plants: Plants that are not part of (if exotic), or are a minor component of (if native), the original plant community or communities that have the potential to become a dominant or co-dominant species on the 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.

Inventory (rangeland inventory): (1) The systematic acquisition and analysis of resource information needed for planning and management of rangeland; (2) the information acquired through rangeland inventory. (SRM 1999).

Life form: Characteristic form or appearance of a species at maturity (e.g., tree, shrub, herb) (SRM 1999).

Litter: The uppermost layer of organic debris on the soil surface, essentially the freshly fallen or slightly decomposed vegetal material (SRM 1999). In this document, it includes persistent and non-persistent organic matter that is in contact with the soil surface.

Major plant species: are those species that based on soil and climatic conditions should be high in frequency on that site due to favored conditions over other species within that site. 4

Microsite: A spatial unit that contains only a few biological individuals that has a distinct climate or soil from the surrounding units (e.g., the spaces between plants relative to the spaces under plants).

Monitoring: The orderly collection, analysis, and interpretation of resource data to evaluate progress toward meeting management objectives. The process must be conducted over time in order to determine whether or not management objectives are being met (SRM 1999).

Native invasive: A native plant that has migrated to a site where it was not a part of the original plant community, or a native plant that because of management or other changes is now increasing beyond its original composition on the site.

Natural disturbance regime: The frequency and intensity of events that occur because of climate or animals (e.g., flood, fire, frost heave, drought, animal burrowing, or defoliation) that alter the structure of ecological systems or the processes that maintain ecological systems.

Nitrogen fixation (fixers): The biological reduction of molecular nitrogen to chemical forms that can be used by organisms in the synthesis of organic molecules.

Normal variability or normal range of variability: The deviation of characteristics of biotic communities and their environment that can be expected given natural variability in climate and disturbance regimes.

Noxious weed: Any plant designated by a Federal, State, or county government to be injurious to public health, agriculture, recreation, wildlife, or any public or private property (Sheley et al. 1999).

Nutrient cycle: The cycle of nutrients, such as nitrogen and phosphorus, through the physical and biotic components of the environment; one of the ecological processes.

Organic matter: Living plant tissue and decomposed or partially decomposed material from living organisms.

Oxidation: The loss of one or more electrons by an ion or molecule (SSSA 1997). Oxidation is a chemical process of decomposition whereby nutrients are released into the atmosphere instead of into the soil. Oxidation commonly increases as aridity increases.

Pedestal (erosional): Plants or rocks that appear elevated as a result of soil loss by wind or water erosion (does not include plant or rock elevation as a result of non-erosional processes such as frost heaving).

Perennial plant: A plant that has a life span of three or more years (USDA 1997).

Physical crust: Thin surface layers induced by impact of raindrops on bare soil causing the soil surface to seal and absorb less water.

Plant decadence: In a plant community, decadence refers to an overabundance of dead or dying plants relative to what is expected for a site given the natural range of variability in disease, climate, and management influences.

Plant mortality: The death of a plant, or in a plant community, the death of a number of plants in the community.

Potential natural community (PNC): The biotic community that would become established on an ecological site if all successional sequences were completed without interferences by man under present environmental conditions. Natural disturbances are inherent in its development. The PNC may include acclimatized or naturalized nonnative species (USDA 1997).

Potential natural vegetation: A historical term originally defined by A.W. Kuchler as the stable vegetation community which could occupy a site under current climatic conditions without further influence by people. Often used interchangeably with “potential natural community” (SRM 1999).

Preponderance of evidence: The rating of an attribute of rangeland health by observing where the distribution of indicators is in respect to the five categories used to rate each indicator associated with that attribute.

Qualitative data: Observational data derived from visual observations and recorded descriptively but not measured (e.g., descriptive or non-numerical data).

Qualitative rangeland health assessment: The determination of the functional status of attributes through non-numerical observations of indicators. Qualitative assessments have an element of subjectivity.

Quantitative data: Data derived from measurements, such as counts, dimensions, weights, etc., and recorded numerically; may include ratios or other values. Qualitative numerical estimates, such as ocular cover and production estimates, are often referred to as "semi-quantitative."

Quantitative rangeland health assessment: The determination of the functional status of an attribute(s) through measurement of vegetation, soil, or landscape characteristics that are indicators or can be used to derive indicators. Quantitative assessments have a known level of precision and accuracy, and require a quantitative reference.

Range condition: The present status of vegetation of a range site in relation to the climax (natural potential) plant community for that site. It is an expression of the relative degree to which the kinds, proportions, and amounts of plants in a plant community resemble that of the climax plant community for the site (SRM 1999).

Rangeland: Land on which the indigenous vegetation (climax or natural potential) is predominantly grasses, grass-like plants, forbs, or shrubs and is managed as a natural ecosystem. If plants are introduced, they are managed similarly. Rangelands include natural grasslands, savannas, shrublands, many deserts, tundra, alpine communities, marshes, and wet meadows (SRM 1999). The authors of this document also include oak and pinyon-juniper woodlands in this definition.

Rangeland health: The degree to which the integrity of the soil, vegetation, water, and air, as well as the ecological processes of the rangeland ecosystem, are balanced and sustained. Integrity is defined as maintenance of the structure and functional attributes characteristic of a locale, including normal variability (SRM 1999).

Recruitment: The successful entry of new individuals into the breeding population.

Reference state: The reference state is the state where the functional capacities represented by soil/site stability, hydrologic function, and biotic integrity are performing at an optimum level under the natural disturbance regime. This state usually includes, but is not limited to, what is often referred to as the potential natural plant community (PNC). See definition of "State" in Concepts section and Figure 2.

Relative dominance (composition): The percent of cover or production represented by a species or lifeform expressed relative to the total cover or production. It can also be based on biomass.

Relict (area): A remnant or fragment of the climax plant community that remains from a former period when it was more widely distributed. *Synonym:* pristine (SRM 1999).

Resilience: The capacity of ecological processes to recover following a disturbance. Resilience can be defined in terms of the rate of recovery, the extent of recovery during a particular period of time, or both.

Resistance: The capacity of ecological processes to continue to function without change following a disturbance.

Rhizomatous plant: A plant that develops clonal shoots by producing rhizomes. Rhizomes are horizontal underground stems that usually produce roots and shoots from nodes (SRM 1999).

Rill: A small, intermittent water course with steep sides, usually only several centimeters deep (SSSA 1997). Rills generally are linear erosion features.

Runoff: The portion of precipitation or irrigation on an area which does not infiltrate, but instead is discharged by the area (SSSA 1997).

Saltation: A particular type of momentum-dependent transport involving the rolling, bouncing, or jumping action of soil particles 0.1 to 0.5 mm in diameter by wind, usually at a height of <15 cm above the soil surface, for relatively short distances; the rolling, bouncing or jumping action of mineral grains, gravel, stones, or soil aggregates affected by the energy of following water; the bouncing or jumping movement of material downslope in response to gravity (SSSA 1997).

Shrub: A plant that has persistent, woody stems and a relatively low growth habit, and that generally produces several basal shoots instead of a single bole. It differs from a tree by its low stature (generally less than 5 meters, or 16 feet) and non-arborescent form (SRM 1999).

Similarity index (rangeland): The present state of vegetation and soil protection on an ecological site in relation to the historic climax plant community. *Synonym:* range condition. (SRM 1999).

Soil aggregates: A group of primary soil particles that cohere to each other more strongly than to other surrounding particles (SSSA 1997).

Soil association: A kind of map unit used in soil surveys comprised of delineations, each of which shows the size, shape, and location of a landscape unit composed of two or more kinds of component soils or component soils and miscellaneous areas, plus allowable inclusions in either case. The individual bodies of component soils and miscellaneous areas are large enough to be delineated at the scale of 1:24,000. Several bodies of each kind of component soil or miscellaneous area are apt to occur in each delineation, and they occur in a fairly repetitive and describable pattern (SSSA 1997).

Soil classification: The systematic arrangement of soil units into groups or categories on the basis of their characteristics. Broad groupings are made on the basis of general characteristics and subdivisions on the basis of more detailed differences in specific properties (SSSA 1997).

Soil complex: A kind of map unit used in soil surveys comprised of delineations, each of which shows the size, shape, and location of a landscape unit composed of two or more kinds of component soils or component soils and a miscellaneous area, plus allowable inclusions in either case. The individual bodies of component soils and miscellaneous areas are too small to be delineated at the scale of 1:24,000. Several to numerous bodies of each kind of component soil or miscellaneous area are apt to occur in each delineation (SSSA 1997).

Soil inclusions: One or more polypedons or parts of polypedons within a delineation of a map unit, not identified by the map unit name (i.e., is not one of the named component soils or named miscellaneous area components). Such soils or areas are either too small to be delineated separately without creating excessive map or legend detail, occur too erratically to be considered a component, or are not identified by practical mapping methods (SSSA 1997).

Soil/site stability: The capacity of a site to limit redistribution and loss of soil resources (including nutrients and organic matter) by wind and water (one of the three attributes of rangeland health).

Soil structure: The combination or arrangement of primary soil particles into secondary units or peds. The secondary units are characterized on the basis of size, shape, and grade (degree of distinctiveness) (SSSA 1997).

Soil survey: The systematic examination, description, classification, and mapping of soils in an area. Soil surveys are classified according to the kind and intensity of field examination (SSSA 1997).

Soil texture: The relative proportions of the various soil separates (sand, silt, and clay) in a soil (SSSA 1997).

Species composition: The proportions of various plant species in relation to the total on a given area. It may be expressed in terms of cover, density, weight, etc. (SRM 1999).

Standing dead vegetation: The total amount of dead plant material, in aboveground parts, per unit of space, at a given time. (USDA 1997). This component includes all standing dead vegetation produced in the previous (not the current) growing season that is not detached from the plant and is still standing.

State: A state is comprised of an integrated soil and vegetation unit having one or more biological communities that occur on a particular ecological site and that are functionally similar with respect to the three attributes (soil/site stability, hydrologic function, and biotic integrity) under natural disturbance regimes. See Concepts section.

Structure (soils): The combination or arrangement of primary soil particles into secondary units or peds. The secondary units are characterized on the basis of size, shape, and grade (degree of distinctiveness) (SSSA 1997).

Structure (vegetation): The height and area occupied by different plants or life forms in a community.

Subdominant (subordinate) species: Daubenmire (1968) defines subordinate species as “those species, which if removed singly, would not occasion much rearrangement with their ecosystem.” For the purposes of this document, *Interpreting Indicators of Rangeland Health*, subdominant plants are those within a community with less size-per-unit area as measured by biomass, production, or cover.

Succulent: Generally a type of cactus.

Terracette: “Benches” of soil deposition behind obstacles caused by water erosion.

Threshold: A transition boundary that an ecosystem crosses resulting in a new stable state that is not easily reversed without significant inputs of resources.

Tiller: A plant shoot that arises from the root or base of a plant.

Transition: A shift between two states. Transitions are not reversible by simply altering the intensity or direction of factors that produced the change. Instead, they require new inputs such as revegetation or shrub removal. Practices, such as these, that accelerate succession (USDA 1997) are often expensive to apply.

Tree: A woody, usually single-stemmed, perennial plant that has a definite crown shape and reaches a mature height of at least 4 meters. The distinction between woody plants, known as trees, and those called shrubs is gradual. Some plants, such as oaks (*Quercus* spp.), may grow as either trees or shrubs (SRM 1999).

Trend: The direction of change in ecological status or resource value rating observed over time (SRM 1999).

Unhealthy rangelands: Rangelands on which degradation has resulted in the loss of ecological processes that function properly, and the capacity to provide values and commodities to a degree that external inputs are required to restore the health of the land (NRC 1994).

Vascular plants: Higher plants with vessels that conduct sap throughout the plant.

Vesicular crust: A type of physical crust that contains numerous small air pockets or spaces similar to a sponge causing a reduction in infiltration.

Viable seed: Wildland plant seed that is capable of germination given appropriate environmental conditions.

Warm season plant: A plant which makes most or all its growth during the spring, summer, and fall, and is usually dormant in winter; a plant that exhibits the C-4 photosynthetic pathway (SRM 1999).

Water cycle: The capture, storage, and redistribution of precipitation. *Synonym:* hydrologic cycle.

Weather: The current state of the atmosphere with regard to wind, temperature, cloudiness, moisture, pressure, etc.

Well-managed rangelands: Rangelands that have properly functioning ecological processes, biotic integrity, and soil stability associated with human uses of the land.

Wind-scoured area: Areas, generally in interspaces, where the finer soil particles have blown away sometimes leaving residual gravel, rock, or exposed roots on the soil

Appendix 1 – Soil Descriptions

EVC Eaglecone Vickton – Soils supporting this site are moderately deep to very deep, well drained, with moderately slow permeability above the bedrock. Runoff is low to medium. The erosion hazard is slight to high by water, and slight to high by wind. The available holding water capacity (AWC) is medium to high. These soils are usually 20 inches to greater than 60 inches deep to basalt bedrock. The dark colored surface texture is generally loam or silt loam with few or no surface stones. The subsoil's are usually moderately will to well developed with clay ranging from 20 to 35 percent. These soils are characterized by dark colored surfaces with lime leached to 15 inches or more. A few gravels or stones may be present but do not affect production. These soils have a xeric moisture regime and a frigid soil temperature regime.

GAA Grassyridg-Bedrock Bllb-4-ID - Soils are lightly textured loamy fine sand to very fine sandy loams usually over 20 inches deep. Organic matter content is low. Permeability is rapid with low available water capacity per foot of effective depth. Erosion hazard by wind is severe when plant cover is scarce or lacking.

EMC – Soils are loams and silt loams over 20 inches deep. Any lime is leached to 15 inches or more. The surface is brown colored. Gravels or stones may be present but do not affect the production.

LMC Lostine-Marotz-Marystown – These soils are light textured loamy fine sand to very fine sandy loams usually over 20 inches deep. Organic matter content is low. Permeability is rapid with low available water capacity per foot of effective depth. Erosion hazard by wind is severe when plant cover is scarce or lacking.

LAC Latigo – Soils are dark colored, medium textured, moderately deep to deep silt loams, silty clay loams and clay loams, moderately high in organic matter with medium to high permeability. These soils have good available water capacity. Coarse fragments may be present but do not significantly affect vegetation. Erosion hazard ranges from slight to severe, depending upon slope and ground cover.

R013XY020ID - Soils of this site are deep, well drained, loam and silt loam and have thick dark colored surface layers. They are underlain by medium textured layers that may contain gravel and cobble. Some soils may have lime horizons below 50 inches, but the overlying soil is usually non-calcareous. Intake rate is moderate and water movement through the soil is moderate. Roots penetrate the soil readily. These soils have a high water holding capacity. Rock fragments are variable throughout the profile, but are less than 35 percent by volume. Stone or cobble may occur on the surface but less than 15 percent. Under proper management, these soils have little surface runoff and slight or no erosion.

Appendix 2 – Ecological Site Descriptions

R011BY010ID - This site occurs on nearly level lava plains, terraces, and benchlands, and on rolling and somewhat broken foothills. Slopes range from 1 to 30 percent. Small lava rock outcrop areas may be scattered throughout the site. Elevations range from 4000 to 5500 feet (1200-1680 meters). It occurs on all aspects.

R011BY005ID - This site occurs on nearly level areas between outcrops of lava flows or pressure ridges which are highly fractured and have vegetation growing where soil material has accumulated. Slopes range from 0-30 percent. It occurs on all aspects and elevations range from 4800-5600 ft (1450-1700 meters).

B11b-4-I – This site usually occurs on alluvial fans, terraces and low rolling hills. Slopes are predominantly 5-25 percent. Elevations ranges from 4000 -5500 feet.

B11b-11-ID. – This site occurs on nearly level flats and benchlands to rolling and somewhat broken foothills. Slopes predominantly range from 3-25 percent, occasionally to 35 percent. Small lava rock outcrop areas may be scattered throughout the site. Elevation ranges from 4000-5500 feet. This site seems to occupy areas which are slight depressions and may accumulate snow.

B13-29-ID – This site occurs on gently undulating to somewhat rolling and broken foothills. Slopes predominantly range from 8-20 percent, occasionally to 35 percent. Elevation ranges from 4800-7000 feet.

B13-31-ID – This site generally occurs on all aspects on the steep upper portion of mountain ridges with slopes of 20-60 percent. Elevations range 6000-9000 feet.

B13-23-I – This site generally occurs on nearly level to gently sloping mountain slopes and plateaus. Elevations range from 5000-6000 feet.

R013XY020ID – This site occur on gently to steep, concave mountain slopes. Slopes vary from 10 to 70 percent, but are mostly 20 to 60 percent. It occurs on all exposures, but predominantly north and east. Elevation ranges from 5000 to 7500 feet.

Section II-E-8 – This range site occurs on nearly level bottom land and uplands having a beneficial perched water table within 36 to 60 inches of the surface during most of the growing season. It often is associated with Wet Land and Overflow range sites.

Sandy, Silty, Clayey 20" plus P.Z. – These upland range sites occur mostly as parks in the forest. The soils are moderately deep-to-deep and they occur on nearly level to steep slopes.

Subirrigated, 20" plus P.Z. – The range site occurs in the higher mountain areas that have a perched water table above the surface during only a part of the growing season. It is not so wet that it supports common reed, cattails, or true aquatics.