APPENDIX L.
DESIRED FUTURE CONDITION FOR VEGETATION

L.1 INTRODUCTION

The purpose of this report is to provide a description of desired vegetative conditions on the landscape over the life of the Moab RMP. This process is referred to as determining the Desired Future Condition (DFC). The determination of the DFC takes a number of factors into consideration such as:

- Current vegetation communities and conditions on the landscape;
- Landscape setting;
- Current uses of vegetative resources;
- Desired management direction for specific uses across the landscape;
- Vegetative treatment/manipulation potentials and methods;
- Current and projected climatic conditions; and
- Soil conditions and availability.

The DFC provides general landscape level guidelines, not site specific prescriptions for project or activity level work within the Moab area. When initiating "on the ground activities", either in response to management related disturbance (vegetative manipulations, damaged land restoration, fuel reductions, etc.) or natural disturbance (flooding, fire, drought, etc.), area specific guidelines would be utilized that are provided in corresponding Natural Resource Conservation Service (NRCS) Ecological Site Inventories and State and Transition model data (as these models are developed). The types of data found in these documents would allow the development of detailed prescriptions for specific vegetative type's, recommended percentages by species, distribution, etc., based on the particular elevational, climatic, soil, and landform features present at that site.

The distribution of vegetative communities across a landscape are primarily influenced by soil type, elevation, precipitation, topography, and to varying degrees by land management activities such as livestock and wildlife grazing, road and mineral development, and OHV use. These vegetative communities subsequently form a mosaic across the landscape, sometimes occurring in relatively homogenous individual species stands, more often however, occurring in various species combinations and associations dependent on the abiotic factors listed above.

Of more recent influence however, are changes in types and distribution of vegetation communities as a result of extended regional drought across southeastern Utah during the last 5-6 years. This has resulted in severe stress and in some cases loss of significant portions of vegetative communities in the region, in particular pinyon pine, sagebrush and salt desert shrub species. We have also seen an increase in the distribution of invasive species, particularly halogeton and cheatgrass. And perhaps more alarming and potentially impacting than below normal precipitation patterns over the region, is the increasing temperatures recorded over the past century. This temperature increase could have a variety of long-term effects including: plants entering spring green up earlier and going into dormancy later, altered snowmelt patterns and subsequent water availability, evapotranspiration dynamics and increased losses for soil infiltration, in addition to affecting growth of some plants as a result of decreased nutrient uptake.

The uncertainty associated with future climatic conditions makes the identification of DFC's uncertain to some extent. The DFC's developed herein are based on some level of return to regional climatic conditions over the past 20 to 30 years. If the current ongoing regional dry trend continues, and temperatures continue to rise, these DFC's could be difficult to obtain, and any treatment efforts undertaken to help achieve these DFC's could be subject to failure.

L.2 PROCESS

The primary data source for development of the DFC for the Moab Field Office is the Southwest ReGAP (SW ReGAP) terrestrial ecological classification system. The SW ReGAP is an update of the GAP Analysis Program's mapping and assessment of regional biodiversity for a five state region (NM, AZ, CO, UT, and NV) completed in 1995. Both endeavors were multi-institutional cooperative efforts coordinated by the U.S. Geological Survey GAP Analysis Program. The classification was conducted using Landsat-7 satellite imagery, field data, digital elevation models, and other spatial data. The remote imagery utilized and the subsequent processing of this data provides a spatial resolution of 5 hectares.

Although GAP analysis was never intended to provide fine scale resolution, stand alone vegetation maps, the outcome of the terrestrial ecological system classification process provides a useful set of "proxy" vegetation association maps. The classification methodology used specifically group's terrestrial ecological systems as plant community types (associations) that co-occur within landscapes with similar ecological processes, substrates, and/or environmental gradients. The systems approach complements the National Vegetation Classification system (NVCS), whose finer-scale units provide a basis for interpreting larger-scale ecological system patterns and concepts.

Three methodological improvements were utilized in the ReGAP program to increase the accuracy and utility of the vegetation map: 1) a universal standard for the identification of plant communities, the NVCS, 2) the use of a single methodology for constructing predictive models of plant community distribution, classification and regression trees (CART), and 3) the subdivision of the 5-state regions into map zones, or provinces of homogeneous geology, climate and phenology, to reduce the complexity of predictive landcover models.

Plant community types utilized in SW ReGAP are derived from a vegetation classification unit at the association or alliance level, where these are available in the NVCS (Grossman et al. 1998, Jennings et al. 2003, NatureServe 2003), or, if these are not available, other comparable vegetation units. NVCS associations are used wherever possible to describe the component biotic communities of each terrestrial system. The NVCS provides a multi-tiered, nested hierarchy for classifying vegetation types.

The SW ReGAP is intended to provide classification at a "meso-scale," both spatially and temporally, and the specific spatial and temporal scales are further refined by the biotic and ecological distinctiveness of the systems identified. A given system will typically manifest itself in a landscape at intermediate geographic scales of tens to thousands of hectares and will persist for 50 or more years. This temporal scale allows typical successional dynamics to be integrated into the concept of each classified unit. Mapping at this scale is spatially comparable to the scale of analysis for most RMPs.

The DFC recommendations for the current revision of the Moab RMP are based on grouping the various vegetative land cover classifications identified in the SW ReGAP program for the Moab area. Analysis of the SW ReGAP data identified 43 vegetative classifications within the overall boundaries of the Moab Field office. We subsequently grouped these 43 units into 12 broader categories for the Moab RMP DFC. These groups were determined primarily by the dominant vegetation type present. These DFC groupings also correspond with vegetation groupings in the draft Utah Fire Management Plan. These groupings are shown on the Table at the end of this Appendix.

The following discussion of each vegetative group is taken primarily from information presented for each classification unit identified in SW ReGAP. The information presented includes a description of the physical environment the vegetation association occurs in, the dynamics of that system, and the vegetation types present. <u>It should be emphasized that these descriptions describe current conditions and dynamics.</u> At the end of each section is the DFC for that vegetation grouping. In many instances the DFC will reflect a continuation of the current systems described, with some exceptions, particularly for invasive or exotic species. The DFC will also describe what types of treatment actions would work best in that system in the event of management or natural disturbances requiring rehabilitation or restoration.

Again it will be emphasized that this DFC is a landscape level analysis, and is intended to provide general descriptions of what the desired conditions should include in any given broad vegetation community. Any details that would be required to conduct restoration or rehabilitation projects would use this only as general guidance and would refer to NRCS Ecological Site Inventories, soil surveys and other site specific data that may be available specific details for that system. The Figure illustrating the Desired Future Condition of vegetation in the Moab Field Office is shown at the end of this Appendix.

L.3 Dominant Vegetation Communities and Desired Future Conditions For The Moab Field Office RMP

L.3.1 Grasslands

<u>Corresponding SW ReGAP Landcover Classification</u>:

- S090 Inter-mountain Basins Semi-desert Grassland

<u>Environment:</u> Low-elevation grasslands in the region occur in semi-arid to arid climates at approximately 4,750-7,610 feet in elevation. Grasslands within this system are typically characterized by a sparse to moderately dense herbaceous layer dominated by medium-tall and short bunch grasses, often in a sod-forming growth. These grasslands occur in lowland and upland areas and may occupy swales, playas, mesa tops, plateau parks, alluvial flats, and plains. These grasslands typically occur on xeric sites. This system experiences cold temperate conditions. Hot summers and cold winters with freezing temperatures and snow are common. Annual precipitation is usually from 7.9-15.7 inches. A significant portion of the precipitation falls in July through October during the summer monsoon storms, with the rest falling as snow during the winter and early spring months. These grasslands occur on a variety of aspects and slopes. Sites may range from flat to moderately steep. Soils supporting this system also vary from deep to shallow, and from sandy to finer-textured. The substrate is typically sand or shale-derived. Some sandy soil occurrences have a high cover of cryptogams on the soil. These cryptogamic species would tend to increase the stability of the highly erodible sandy soils of these grasslands during torrential summer rains and heavy wind storms (Kleiner and Harper 1977).

Vegetation: These grasslands are typically dominated or codominated by *Achnatherum hymenoides, Aristida* spp., *Bouteloua gracilis, Hesperostipa comata, Muhlenbergia pungens,* or *Pleuraphis jamesii*, and may include scattered shrubs and dwarf-shrubs of species of *Artemisia, Atriplex, Coleogyne, Ephedra, or Gutierrezia.* The dominant perennial bunch grasses and shrubs within this system are all very drought-resistant plants.

Dynamics: This system is maintained by frequent fires and sometimes associated with specific soils, often well drained clay soils. A combination of precipitation, temperature, and soils limits this system to the lower elevations within the region. The dominant perennial bunch grasses and shrubs are all very drought resistant plants. Grasses that dominate semi-arid grasslands develop a dense network of roots concentrated in the upper parts of the soil where rainfall penetrates most frequently (Blydenstein 1966, Cable 1969, Sala and Lauenroth 1985, as cited by McClaran and Van Devender 1995). *Bouteloua gracilis* is also very grazing-tolerant and generally forms a short sod. *Pleuraphis jamesii* is only moderately palatable to livestock, but decreases when heavily grazed during drought and in the more arid portions of its range where it is the dominant grass (West 1972). This grass reproduces extensively from scaly rhizomes making the plant resistant to trampling by livestock and providing good soil-binding properties (Weaver and Albertson 1956, West 1972). *Achnatherum hymenoides* is one of the most drought-tolerant grasses in the western U.S. (USDA 1937). It is also a valuable forage grass in arid and semiarid regions. Improperly managed livestock grazing could increase soil erosion, decrease cover of this palatable plant species and increase weedy species (USDA 1937). *Muhlenbergia asperifolia*, along with the flooding regime and high evaporation rate in its preferred habitat, causes accumulations of soluble salts in the soil. Total vegetation cover (density and height), species composition and soil salinity depend on the amount and timing of precipitation and flooding. Growth-inhibiting salt concentrations are diluted when the soil is saturated allowing the growth of less salt-tolerant species. As the saturated soils dry, the salt concentrates until it precipitates out on the soil surface (Dodd and Coupland 1966, Ungar 1968).

Desired Future Condition: Where native grasslands occurred historically the DFC is native grass and forb communities. In many instances native grasslands have been lost to pinyon and juniper encroachment, cheatgrass/halogeton invasion and non-native plant seedings (e.g., crested wheatgrass, perennial ryegrass, etc.). Where non-native grasslands occur the DFC may be the restoration of the native grassland or shrub community. Treatments of these native grasslands with fire, mechanical, or chemical treatments to reduce encroaching trees (mainly juniper), shrubs and invasive plants results in the potential for cheatgrass/halogeton invasion (areas below 7,000 feet that have adjacent cheatgrass/halogeton populations) (Pellant 2002). Following disturbance, these grasslands should be aggressively seeded to reduce potential for cheatgrass/halogeton and other invasive weeds.

L.3.2 SALT DESERT SHRUB

This vegetation grouping for Moab is a combination of 5 SW ReGAP vegetative cover types that occur within the boundaries of the Moab Field Office. These groupings are similar enough in characteristics to serve the purposes of broad vegetation groupings for this DFC.

Corresponding SW ReGAP Landcover Classification:

- S011 - Inter-mountain Basins Shale Badland
- S045 - Inter-mountain Basins Mat Saltbush Shrubland
- S065 - Inter-mountain Basins Mixed Salt Desert Scrub
- S079 - Inter-mountain Basins Semi-Desert Shrub Steppe
- S096 - Inter-mountain Basins Greasewood Flat

Environment: Vegetative communities within this broad area receive relatively low annual precipitation (5 to 10 inches) and infiltration rates are typically low, which translates into very little soil moisture available for plant growth. Elevation ranges from 4,000 to 5,400 feet. Regionally, thirty-three plant communities have been recognized in this zone, indicated by the dominant species: shadscale, greasewood, blackbrush, salt cedar, fourwing saltbush, nuttall saltbush, mat saltbush, buckwheat, spiny hopsage, salina wildrye, and other perennial grasses. Soils are often very saline or alkaline and vary in moisture availability from drier, well-drained sites to areas where the water table is near the surface (MacMahon 1988).

The shale-badland portions of this community are primarily composed of barren and sparsely vegetated substrates (<10% plant cover) typically derived from marine shales, but also including substrates derived from siltstones and mudstones (clay). Landforms are typically rounded hills and plains that form a rolling topography. The harsh soil properties and high rate of erosion and deposition are driving environmental variables supporting sparse dwarf-shrubs and herbaceous vegetation.

The mat saltbush shrubland areas occur on gentle slopes and rolling plains primarily associated with the Mancos Shale badlands in the Moab area. Substrates are shallow, typically saline, alkaline, fine-textured soils developed from shale or alluvium. Infiltration rate is typically low. These landscapes that typically support dwarf shrublands composed of relatively pure stands of *Atriplex* spp. The herbaceous layer is typically sparse. Scattered perennial forbs occur and the perennial grasses may dominate the herbaceous layer. In less saline areas, there may be inclusion grasslands. Annuals are seasonally present in some areas.

The mixed salt desert scrub communities consist of open-canopied shrublands of typically saline basins, alluvial slopes and plains. Substrates are often saline and calcareous, medium- to fine-textured alkaline soils, but include some coarser-textured soils. The vegetation is characterized by a typically open to moderately dense shrubland composed of one or more *Atriplex* species. Other shrubs present may also codominate. The herbaceous layer varies from sparse to moderately dense and is dominated by perennial graminoids. Various forbs are also present.

The semi-desert shrub steppe component typically occurs at lower elevations on alluvial fans and flats with moderate to deep soils. This semi-arid shrub-steppe is typically dominated by graminoids (>25% cover) with an open shrub layer, but includes sparse mixed shrublands without a strong graminoid layer. The woody layer is often a mixture of shrubs and dwarf-shrubs. Scattered *Artemisia tridentata* may be present but does not dominate. The general aspect of occurrences may be either open shrubland with patchy grasses or patchy open herbaceous layer. Disturbance may be important in maintaining the woody component. Microphytic crust is very important in some occurrences.

The greasewood flat component of this group typically occurs near drainages on stream terraces and flats or may form rings around playas. Sites typically have saline soils, a shallow water table and flood intermittently, but remain dry for most growing seasons. This system usually occurs as a mosaic of multiple communities, with open to moderately dense shrublands dominant or codominant. Occurrences are often surrounded by mixed salt desert scrub. The herbaceous layer, if present, is usually dominated by graminoids. There may be inclusions of herbaceous types.

Vegetation: Occurrences of these grouped ecological systems varies from almost pure occurrences of single species to fairly complex mixtures. The characteristic mix of low shrubs and grasses is sparse, with large open spaces between the plants (Blaisdell and Holmgren 1984). Occurrences have a sparse to moderately dense cover of woody species that is dominated by *Atriplex canescens* (may codominate with *Artemisia tridentata*), *Atriplex confertifolia* (may codominate with *Lycium andersonii*), *Atriplex obovata, Picrothamnus desertorum*, or *Krascheninnikovia lanata*. Other shrubs that may occur within these occurrences include *Purshia stansburiana, Psorothamnus polydenius, Ephedra* spp., *Acacia greggii, Encelia frutescens, Tiquilia latior, Atriplex polycarpa, Atriplex lentiformis, Picrothamnus desertorum* (= *Artemisia spinescens*), *Artemisia frigida, Chrysothamnus* spp., *Lycium* ssp., *Suaeda* spp., *Yucca glauca*, and *Tetradymia spinosa*.

Dwarf-shrubs include *Gutierrezia sarothrae* and *Eriogonum* spp. Warm-season medium-tall and short perennial grasses dominate in the sparse to moderately dense graminoid layer. The species present depend on the geographic range of the grasses, alkalinity/salinity and past land use. Species may include *Pleuraphis jamesii, Bouteloua gracilis, Sporobolus airoides, Sporobolus cryptandrus, Achnatherum hymenoides, Elymus elymoides, Distichlis spicata, Leymus salinus, Pascopyrum smithii, Hesperostipa comata, Pseudoroegneria spicata, Poa secunda, Leymus ambiguus*, and *Muhlenbergia torreyi*. A number of annual species may also grow in association with the shrubs and grasses of this system, although they are usually rare and confined to areas of recent disturbance (Blaisdell and Holmgren 1984). Forb cover is generally sparse. Perennial forbs that might occur include *Sphaeralcea coccinea, Chaetopappa ericoides, Xylorhiza venusta, Descurainia sophia*, and *Mentzelia* species. Annual natives include *Plantago* spp., *Vulpia* *octoflora*, or *Monolepis nuttalliana*. Associated halophytic annuals include *Salicornia rubra*, *Salicornia bigelovii*, and *Suaeda* species. Exotic annuals that may occur include *Salsola kali* and *Bromus tectorum*. Cacti like *Opuntia* spp. and *Echinocereus* spp. may be present in some occurrences. Trees are not usually present but some scattered *Juniperus* spp. may be found.

Dynamics: West (1982) stated that "salt desert shrub vegetation occurs mostly in two kinds of situations that promote soil salinity, alkalinity, or both. These are either at the bottom of drainages in enclosed basins or where marine shales outcrop." However, salt-desert shrub vegetation may be an indication of climatically dry as well as physiologically dry soils (Blaisdell and Holmgren 1984). Not all salt-desert shrub soils are salty, and their hydrologic characteristics may often be responsible for the associated vegetation (Naphan 1966). Species of the salt-desert shrub complex have different degrees of tolerance to salinity and aridity, and they tend to sort themselves out along a moisture/salinity gradient (West 1982). Species and communities are apparently sorted out along physical, chemical, moisture, and topographic gradients through complex relations that are not understood and are in need of further study (Blaisdell and Holmgren 1984). The winter months within this system are a good time for soil moisture accumulation and storage. There is generally at least one good snow storm per season that will provide sufficient moisture to the vegetation. The winter moisture accumulation amounts will affect spring plant growth. Plants may grow as little as a few inches to 1 m. Unless more rains come in the spring, the soil moisture will be depleted in a few weeks, growth will slow and ultimately cease, and the perennial plants will assume their various forms of dormancy (Blaisdell and Holmgren 1984). If effective rain comes later in the warm season, some of the species will renew their growth from the stage at which it had stopped. Others, having died back, will start over as if emerging from winter dormancy (Blaisdell and Holmgren 1984). *Atriplex confertifolia* shrubs often develop large leaves in the spring, which increase the rate of photosynthesis. As soil moisture decreases, the leaves are lost, and the plant takes on a dead appearance. During late fall, very small overwintering leaves appear which provide some photosynthetic capability through the remainder of the year (IVC 1999). Other communities are maintained by intra- or inter-annual cycles of flooding followed by extended drought, which favor accumulation of transported salts. The moisture supporting these intermittently flooded wetlands is usually derived off-site, and they are dependent upon natural watershed function for persistence (Reid et al. 1999).

In summary, desert communities of perennial plants are dynamic and changing. The composition within this system may change dramatically and may be both cyclic and unidirectional. Superimposed on the compositional change is great variation from year to year in growth of all the vegetation – the sum of varying growth responses of individual species to specific conditions of different years (Blaisdell and Holmgren 1984). Desert plants grow when temperature is satisfactory, but only if soil moisture is available at the same time. Because amount of moisture is variable from year to year and because different species flourish under different seasons of soil moisture, seldom do all components of the vegetation thrive in the same year (Blaisdell and Holmgren 1984).

Desired Future Condition: The DFC for this vegetation community consists of native, open salt desert scrub vegetation with little to no cheatgrass or halogeton cover, and scattered pockets and patches of herbaceous material and forbs, primarily in the lower areas of the terrain. These communities should exhibit the types of dynamic interactions identified above.

Soils that these communities often occur on are generally highly sensitive to erosion under most types of disturbance, and are usually the first soils to show evidence of stress and/or failure during long sustained periods of drought. As indicted, most of the plant species present have developed a natural level of drought resistance based on the minimal amounts of precipitation they receive even during good climatic cycles; however extended periods of low precipitation can cross critical precipitation required thresholds for the plants. Salt desert shrub communities are often susceptible to severe drought and may require partial or total removal of livestock during prolonged drought (USDA, SCS, Grand County Soil Survey, Central Part, 1989). The best management practices in trying to achieve the DFC during extended drought conditions are to avoid unnecessary disturbance.

Treatments on salt desert scrub types can consist of a combination of mechanical, chemical, seeding and biological treatments to reduce cheatgrass and halogeton cover and restore native communities. However, restoration potentials for salt desert shrub communities are often limited due to high salt contents within the soil and degree of aridity which limit vegetative response (USDA, SCS, Grand County Soil Survey, Central Part, 1989). Surface disturbing treatments should not be attempted during drought conditions however. Prescribed fire may be used in conjunction with seeding when part of a cheatgrass/halogeton control objective (Pellant 2002). However, fire within these communities often results in high densities of exotic annual grasses (*Eremopyrum triticeum*, MFO). Due to the high incidence of cheatgrass and halogeton in this vegetation type, consider seeding following any surface disturbing activity.

L.3.3 BLACKBRUSH

Corresponding SW ReGAP Landcover Classification:

- 059 Colorado Plateau Blackbrush-Mormon Tea Shrubland

Environment: This ecological system typically occurs on gentle benchlands, colluvial slopes, pediments or bajadas, and steep or rocky slopes of mountains, canyons, and mesas with varying aspects. This system is an evergreen, microphyllous desert scrub with succulents, half-shrubs, and scattered deciduous shrubs typically found at elevations ranging from 1,900-5,250 feet. This shrubland system occurs in an arid to semi-arid climate with annual precipitation in the form of summer monsoons and winter storms averaging approximately 8 in. Soils are highly variable and parent materials may include shale, sandstone, limestone, quartzites, and igneous rocks. Soils are generally coarse-textured, calcareous, non-saline and gravelly, often rocky, shallow and well-drained. Substrates are shallow, typically sandy soils over sandstone alluvium or caliche. It also occurs in deeper soils on sandy plains where it may have invaded desert grasslands. Effective soil moisture appears to be primarily controlled by regolith depth and position in relation to the water table. This brushland system occupies most sites where regolith is uniformly shallow. In association with blackbrush (*Coleogyne ramosissima*) sites, the soil moisture is concentrated on top of impermeable bedrock at a shallow depth. This perching effect allows for gradual uptake of moisture by the plants roots (Loope and West 1979). This permits growth of plants with more mesic habitat requirements (Warren et al. 1982). On sites with deep soil, blackbrush may occur in almost pure occurrences with only a few associated species (Warren et al. 1982). Dark-colored cryptogamic soil crusts composed of lichens, mosses, fungi, and algae, are often present in this system in fairly undisturbed areas. Sandy soils may have more cryptogamic crusts than clayish or silty soil surfaces.

Vegetation: The vegetation within this ecological system is characterized by extensive open shrublands dominated by *Coleogyne ramosissima* often with *Ephedra viridis, Ephedra torreyana*, or *Grayia spinosa*. Sandy portions may include *Artemisia filifolia* as codominant. Within a blackbrush shrubland disturbed patches are dominated by shrubs such as *Chrysothamnus viscidiflorus, Ericameria* spp.*, Ephedra* spp.*, Grayia spinosa, Poliomintha incana* or exotic annual grasses. There is usually a sparse herbaceous layer with some perennial grasses and forbs such as *Achnatherum hymenoides, Pleuraphis jamesii*, or *Sporobolus cryptandrus*. Annual grasses and forbs are present seasonally. Some characteristic species associated with this system include the shrubs *Gutierrezia sarothrae, Chrysothamnus viscidiflorus, Yucca baccata*, and succulents such as *Opuntia* spp., *Echinocereus* spp., *and Echinocactus* spp., the graminoid *Pleuraphis rigida*, and perennial forbs such as *Machaeranthera pinnatifida* and *Sphaeralcea ambigua*. Adjacent vegetation often includes *Atriplex* dominated shrubland communities and upland areas of pinyon-juniper woodlands. Grasslands dominated by *Pleuraphis jamesii, Hesperostipa comata*, and *Achnatherum hymenoides* also occur.

Dynamics: Fire does not appear to play a role in maintenance of shrublands within this system. Topographic breaks dissect the landscape, and isolated pockets of vegetation are separated by rock walls or steep canyons. Blackbrush is fire-intolerant (Loope and West 1979). Following fires, these communities are often colonized by non-native grasses, which serve to encourage recurrent fires and delay shrub regeneration (IVC 1999). In shallow regolith situations, secondary succession, in the sense of site preparation by seral plants, may not occur at all (Loope and West 1979).

Desired Future Condition: The DFC recommends a vegetative composition of dense-to-scattered shrubs and dense-to-open native grasses. Disturbances should be avoided whenever possible in blackbrush communities due to invasive species concerns and extremely poor regeneration of blackbrush following disturbance.

Following surface disturbing activities, aggressively seed to reduce potential for invasion of cheatgrass/halogeton and noxious weeds.

L.3.4 SAGEBRUSH

This vegetation grouping for Moab is a combination of 3 SW ReGAP vegetative cover types that occur within the boundaries of the Moab Field Office. These groupings are similar enough in characteristics to serve the purposes of broad vegetation groupings for this DFC. The groupings range from relatively pure stands of big sage to mixed stands to montane steppe environments.

Corresponding SW ReGAP Landcover Classification:

- 054 - Inter-Mountain Basins Big Sagebrush Shrubland
- 056 - Colorado Plateau Mixed Low Sagebrush Shrubland
- 071 - Inter-Mountain Basins Montane Sagebrush Steppe

Environment: The predominant community in the Moab Field Office area is the Colorado Plateau mixed low sagebrush shrubland. This ecological system occurs in canyons, gravelly draws, hilltops, and dry flats at elevations generally below 5,900 feet. Soils are often rocky, shallow, and alkaline. It includes open shrublands and steppe. Semi-arid grasses are often present and may form a graminoid layer with over 25% cover.

The climate regime is cool, semi-arid to subhumid, with yearly precipitation ranging from 10 to 35 in/year. Much of this precipitation falls as snow. Temperatures are continental with large annual and diurnal variation. In general this system shows an affinity for mild topography, fine soils, and some source of subsurface moisture. Soils generally are moderately deep to deep, well-drained, and of loam, sandy loam, clay loam, or gravelly loam textural classes; soils often have a substantial volume of coarse fragments, and are derived from a variety of parent materials. This system primarily occurs on deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. All aspects are represented, but the higher elevation occurrences may be restricted to south- or west-facing slopes.

The environment for the big sagebrush shrubland system is typically broad basins between mountain ranges, plains and foothills between 4,900-7,500 feet elevation. Soils are typically deep, well drained and non-saline. These shrublands are dominated by *Artemisia tridentata ssp. tridentata* and/or *Artemisia tridentata ssp. wyomingensis*. Scattered Juniper may be present in some stands. *Ericameria nauseosa, Chrysothamnus viscidiflorus, Purshia tridentata,* or *Symphoricarpos oreophilus* may codominate disturbed stands. Perennial herbaceous components typically contribute less than 25% vegetative cover. Common graminoid species include *Achnatherum hymenoides, Bouteloua gracilis, Elymus lanceolatus, Hesperostipa comata, Leymus cinereus, Pleuraphis jamesii, Pascopyrum smithii, Poa secunda*, or *Pseudoroegneria spicata*.

The environment of the montane sagebrush steppe includes sagebrush communities occurring at montane and subalpine elevations from 3,200 feet to over 9,800 feet. Climate is cool, semi-arid to subhumid. This system primarily occurs on deep-soiled to stony flats, ridges, nearly flat ridgetops, and mountain slopes. It is composed primarily of mountain sagebrush and related taxa such as *Artemisia tridentata ssp*, non-riparian *Artemisia cana ssp. viscidula*, and *Artemisia arbuscula ssp. arbuscula*. *Purshia tridentata* may codominate or even dominate some stands. Other common shrubs include *Symphoricarpos* spp., *Amelanchier* spp., *Ericameria nauseosa, Peraphyllum ramosissimum*, *Ribes cereum*, and *Chrysothamnus viscidiflorus*. Most stands have an abundant perennial herbaceous layer (over 25% cover), but this system also includes *Artemisia tridentata ssp. vaseyana* shrublands. Common graminoids include *Hesperostipa comata, Poa fendleriana, Elymus trachycaulus, Bromus carinatus, Poa secunda, Leucopoa kingii, Deschampsia caespitosa*, and *Pseudoroegneria spicata*. Frequent wildfire maintains an open herbaceous-rich steppe condition.

Vegetation: Vegetation types within these ecological systems are dominated by *Artemisia tridentata ssp. vaseyana, Artemisia cana ssp. viscidula*, or *Artemisia tridentata ssp. spiciformis*. A variety of other shrubs can be found in some occurrences, but these are seldom dominant. They include *Artemisia frigida, Artemisia arbuscula, Ericameria nauseosa, Chrysothamnus viscidiflorus, Symphoricarpos oreophilus, Purshia tridentata, Peraphyllum ramosissimum, Ribes cereum, Rosa woodsii, Ceanothus velutinus*, and *Amelanchier alnifolia*. The canopy cover is usually between 20-80%. The herbaceous layer is usually well represented, but bare ground may be common in particularly arid or disturbed occurrences. Graminoids that can be abundant include *Festuca idahoensis, Festuca thurberi, Festuca ovina, Elymus elymoides, Stipa* spp., *Pascopyrum smithii, Bromus carinatus, Elymus trachycaulus, Pseudoroegneria spicata, Poa fendleriana*, or *Poa secunda*, and *Carex* spp. Forbs are often numerous and an important indicator of health. Forb species may include *Castilleja, Potentilla, Erigeron, Phlox, Astragalus, Geum, Lupinus*, and *Eriogonum, Balsamorhiza sagittata, Achillea millefolium, Antennaria rosea*, and *Eriogonum umbellatum, Fragaria virginiana, Artemisia ludoviciana, Hymenoxys hoopesii (= Helenium hoopesii)*, etc.

Dynamics: Healthy sagebrush shrublands are very productive, are often grazed by domestic livestock, and are strongly preferred during the growing season (Padgett et al. 1989). Prolonged livestock use can cause a decrease in the abundance of native bunch grasses and increase in the cover of shrubs and non-native grass species, such as *Poa pratensis*. Research suggests that stand-replacement fires burned every 10–100 years depending on the particular sagebrush species and its associated habitat (Miller 2002, Brown 2000). *Artemisia cana* resprouts vigorously following spring fire, and prescribed burning may increase shrub cover. Conversely, fire in the fall may decrease shrub abundance (Hansen et al. 1995). *Artemisia tridentata* is generally killed by fires and may take over ten years to form occurrences of some 20% cover or more. The condition of most sagebrush steppe has been degraded due to fire suppression and heavy livestock grazing. It is unclear how long restoration will take to restore degraded occurrences.

Desired Future Condition: The DFC for this vegetative community is healthy sagebrush defined as diverse age classes with an understory of native grasses and forbs (Paige and Ritter 1999).

Treatments for dense sagebrush (>30%) (Winward 1991) with fire, mechanical or chemical treatments would be to reduce sagebrush canopy cover and improve native grass and forb density and cover; an additional objective in treating sagebrush is to remove encroaching pinyon and juniper trees (Miller and Tausch 2001).

Following wildfire, areas should be aggressively re-seeded to promote native understory grasses and forbs and reduce invasion of cheatgrass/halogeton and noxious weeds. Consider including sagebrush in seeding mixes or planting sagebrush seedlings in high-value wildlife areas following large, high-severity wildfires when natural seed sources would be lacking.

L.3.5 PINYON-JUNIPER

This vegetation grouping for Moab is a combination of 3 SW ReGAP vegetative cover types that occur within the boundaries of the Moab Field Office. These groupings are similar enough in characteristics to serve the purposes of broad vegetation groupings for this DFC.

Corresponding SW ReGAP Landcover Classification:

- S039 - Colorado Plateau Pinyon-Juniper Woodland
- S052 - Colorado Plateau Pinyon-Juniper Shrubland
- S010 - Colorado Plateau Mixed Bedrock Canyon and Tableland

Environment: The woodlands portion of this ecological system occurs on dry mountains and foothills in the Moab region. It is typically found at lower elevations ranging from 4,900-8,000 feet. These woodlands occur on warm, dry sites on mountain slopes, mesas, plateaus, and ridges. Severe climatic events occurring during the growing season, such as frosts and drought, are thought to limit the distribution of pinyon-juniper woodlands to relatively narrow altitudinal belts on mountainsides. Soils supporting this system vary in texture ranging from stony, cobbly, gravelly sandy loams to clay loam or clay.

The shrubland component of this system is typically found on rocky mesa tops and slopes, but these stunted tree shrublands may extend further upslope along the low elevation margins of taller pinyon-juniper woodlands. Sites are drier than Colorado Plateau Pinyon-Juniper Woodland. Substrates are shallow/rocky and shaley soils at lower elevations (3,900-6,500 feet). Sparse examples of the system grade into Colorado Plateau Mixed Bedrock Canyon and Tableland. The vegetation is dominated by dwarfed (usually <3 m tall) *Pinus edulis* and/or *Juniperus osteosperma* trees forming extensive tall shrublands in the region along low-elevation margins of pinyon-juniper woodlands. Other shrubs, if present, may include *Artemisia nova*, *Artemisia tridentata ssp. wyomingensis*, *Chrysothamnus viscidiflorus*, or *Coleogyne ramosissima*. Herbaceous layers are sparse to moderately dense and typically composed of xeric graminoids

The mixed bedrock canyon and tableland component of this larger ecological system is found from foothill to subalpine elevations and includes barren and sparsely vegetated landscapes (generally <10% plant cover) of steep cliff faces, narrow canyons, and smaller rock outcrops of various igneous, sedimentary, and metamorphic bedrock types. Also included are unstable scree and talus slopes that typically occur below cliff faces. Widely scattered trees and shrubs may include *Abies concolor*, *Pinus edulis*, *Pinus flexilis*, *Juniperus* spp., *Artemisia tridentata*, *Purshia tridentata*, *Cercocarpus ledifolius*, *Ephedra* spp., *Holodiscus discolor*, and other species often common in adjacent plant communities.

Vegetation: *Pinus edulis* and/or *Juniperus osteosperma* dominate the tree canopy. *Juniperus scopulorum* may codominate or replace *Juniperus osteosperma* at higher elevations. Understory layers are variable and may be dominated by shrubs, graminoids, or be absent. Associated species include *Arctostaphylos patula*, *Artemisia tridentata*, *Cercocarpus intricatus*, *Cercocarpus montanus, Coleogyne ramosissima, Purshia stansburiana, Purshia tridentata, Quercus gambelii, Bouteloua gracilis, Pleuraphis jamesii*, or *Poa fendleriana*.

Dynamics: Evidence indicates many pinyon-juniper stands have encroached on native grasslands and shrubland over the past 100 years (Miller and Wigand 1994). The exact mechanics of this encroachment are not fully understood, but is likely driven by a combination of fire exclusion, grazing and the relatively wet climate of the 20th century. The historical role of fire (estimated 15–50 years) prevented encroachment of pinyon and juniper into other vegetation communities (Heyerdahl et al. 2004, Miller and Tausch 2001, Bradley et al. 1992, Romme et al. 2002).

Pinyon dominate at higher elevations, and tend to form more closed-canopied stands that exhibit forest like dynamics and species composition, commonly including a significant shrub component of oaks and alder leaf, mountain mahogany and limited grasses. Juniper tends to grow at lower elevations and in more arid areas as its scaled foliage allows it to conserve water more effectively than pinyon pine. Juniper dominated woodlands tend to include open savannas of scattered trees without a significant shrub component, except in areas where big sagebrush has become dominant as a consequence of overgrazing.

Over the past 50 years, anecdotal evidence suggests tree densities and canopy cover have increased, and junipers and pinyon pines have expanded upslope into ponderosa pine forests and downslope into grass and shrub communities. Densities have increased in some areas to the point that larger proportions of pinyon-juniper woodland can now support crown fires. Additionally, pinyon is very susceptible to large scale die-offs from engraver beetles during drought induced stress. Over the past 5 to 6 years millions of acres of pinyon have been lost to this insect across the entire southwest US, including some pinyon stands in the Moab area.

Historical occurrence of pinyon and juniper is difficult to map, but pre-settlement trees are generally located in shallow, rocky soils and tend to have a unique growth form characterized by rounded, spreading canopies; large basal branches; large irregular trunks; and furrowed fibrous bark (Miller and Rose 1999). Historic fire return intervals in these protected sites are greater than 100 years (Romme et al. 2002).

Desired Future Condition: Where pinyon and juniper occur historically the DFC are open stands of pinyon and juniper with native grass and shrub understory (Miller and Wigand 1994, FEIS 2004). Where pinyon and juniper did not occur historically, the DFC is the native shrub, grass and forest communities that the pinyon and juniper have invaded.

Follow disturbance or treatments in these communities with seeding in stands which lack native understory vegetation. Seeding will help discourage the establishment of invasive annual grasses.

L.3.6 PONDEROSA PINE

Corresponding SW ReGAP Landcover Classification:

- S036 - Rocky Mountain Ponderosa Pine Woodland

Environment: This ecological system within the region occurs at the lower treeline/ecotone between grassland or shrubland and more mesic coniferous forests typically in warm, dry, exposed sites at elevations ranging from 6,500-8,500 feet. It can occur on all slopes and aspects; however, it commonly occurs on moderately steep to very steep slopes or ridgetops. This ecological system generally occurs on igneous, metamorphic, and sedimentary material derived soils (Youngblood and Mauk 1985). Characteristic soil features include good aeration and drainage, coarse textures, circumneutral to slightly acid pH, an abundance of mineral material, and periods of drought during the growing season. Some occurrences may occur as edaphic climax communities on very skeletal, infertile, and/or excessively drained soils, such as pumice, cinder or lava fields, and scree slopes. Surface textures are highly variable in this ecological system ranging from sand to loam and silt loam. Exposed rock and bare soil consistently occur to some degree in all the associations. Precipitation generally contributes 10-23 in annually to this system, mostly through winter storms and some monsoonal summer rains. Typically a seasonal drought period occurs throughout this system as well. Fire plays an important role in maintaining the characteristics of these open canopy woodlands. However, soil infertility and drought may contribute significantly in some areas as well.

Vegetation: *Pinus ponderosa* is the predominant conifer; *Pseudotsuga menziesii*, *Pinus edulis*, and *Juniperus* spp. may be present in the tree canopy. The understory is usually shrubby; with *Artemisia nova*, *Artemisia tridentata*, *Arctostaphylos patula*, *Arctostaphylos uva-ursi*, *Cercocarpus montanus*, *Cercocarpus ledifolius*, *Purshia stansburiana*, *Purshia tridentata*, *Quercus gambelii*, *Symphoricarpos oreophilus*, *Prunus virginiana*, *Amelanchier alnifolia*, and *Rosa* spp. are common species. *Pseudoroegneria* spicata and species of *Hesperostipa*, *Achnatherum*, *Festuca*, *Muhlenbergia*, and *Bouteloua* are some of the common grasses.

Dynamics: *Pinus ponderosa* is a drought-resistant, shade-intolerant conifer which usually occurs at lower treeline in the major ranges of the western United States. Historically, ground fires and drought were influential in maintaining open-canopy conditions in these woodlands. With settlement and subsequent fire suppression, occurrences have become denser. Presently, many occurrences contain understories of more shade-tolerant species, such as *Pseudotsuga menziesii* and/or *Abies* spp., as well as younger cohorts of Pinus ponderosa. These altered occurrence structures have affected fuel loads and alter fire regimes. Presettlement fire regimes were primarily frequent (5-15 year return intervals), low-intensity ground fires triggered by lightning strikes or deliberately set fires by Native Americans. With fire suppression and increased fuel loads, fire regimes are now less frequent and often become intense crown fires, which can kill mature *Pinus ponderosa* (Reid et al. 1999). Establishment is erratic and believed to be linked to periods of adequate soil moisture and good seed crops as well as fire frequencies, which allow seedlings to reach sapling size. Longer fire-return intervals have resulted in many occurrences having dense subcanopies of overstocked and unhealthy young *Pinus ponderosa* (Reid et al. 1999). Mehl (1992) states the following: "Where fire has been present, occurrences will be climax and contain groups of large, old trees with little understory vegetation or down woody material and few occurring dead trees. The age difference of the groups of trees would be large. Where fire is less frequent there will also be smaller size trees in the understory giving the occurrence some structure with various canopy layers. Dead, down material will be present in varying amounts along with some occurring dead trees. In both cases the large old trees will have irregular open, large branched crowns. The bark will be lighter in color, almost yellow, thick and some will like have basal fire scars." Grace's warbler, Pygmy nuthatch, and flammulated owl are indicators of healthy ponderosa pine woodlands. All of these birds prefer mature trees in an open woodland setting (Winn 1998, Jones 1998, Levad 1998 as cited in Rondeau 2001).

Desired Future Condition: The DFC for Ponderosa pine communities consists of open stands with a native grass and forb understory. Consider mechanical treatments in dense stands. Reduce juniper encroachment through fire (preferred when fuels conditions allow) or mechanical treatments. Following wildfires or other disturbance, consider seeding to reduce invasive weeds and planting ponderosa pine seedlings for forest restoration and rehabilitation.

L.3.7 Mountain Shrub

Corresponding SW ReGAP Landcover Classification:

- S046 - Rocky Mountain Gambrel Oak-Mixed Montane Shrubland
- S047 - Rocky Mountain Lower Montane-Foothill Shrubland

Environment: The gambrel oak-mixed montane shrubland ecological system occurs in the mountains, plateaus and foothills. These shrublands are most commonly found along dry foothills, lower mountain slopes, from approximately 6,500 to 9,500 feet elevation, and are often situated above pinyon-juniper woodlands. Substrates are variable typically poorly developed and include soil types ranging from calcareous, heavy, fine-grained loams to sandy loams, gravelly loams, clay loams, deep alluvial sand, or coarse gravel. Climate is semi-arid and characterized by mostly hot-dry summers with mild to cold winters and annual precipitation of 10 to 27 inches. Precipitation mostly occurs as winter snows but may also consist of some late summer rains. Although this is a shrub-dominated system, some trees may be present. In older occurrences, or occurrences on mesic sites, some of the shrubs may acquire tree-like sizes. Adjacent communities often include woodlands or forests at higher elevations, and *Pinus edulis* and *Juniperus osteosperma* on the lower and adjacent elevations. Shrublands of *Artemisia tridentata* or grasslands of *Festuca* sp., *Stipa* sp., or *Pseudoroegneria* sp. may also be present at the lower elevations.

The lower montane-foothill scrubland ecological system is found in the foothills, canyon slopes and lower mountain slopes on outcrops and canyon slopes. These shrublands occur between 4,900-9,500 feet elevations and are usually associated with exposed sites, rocky substrates, and dry conditions, which limit tree growth. It is common where *Quercus gambelii* is absent and in drier foothills and prairie hills. Scattered trees or inclusions of grassland patches or steppe may be present, but the vegetation is typically dominated by a variety of shrubs. Grasses are represented as species of *Muhlenbergia*, *Bouteloua*, *Hesperostipa*, and *Pseudoroegneria spicata*. Fires play an important role in this system as the dominant shrubs usually have a severe die-back, although some plants will stump sprout. *Cercocarpus montanus* requires a disturbance such as fire to reproduce, either by seed sprout or root crown sprouting. Fire suppression may have allowed an invasion of trees into some of these shrublands, but in many cases sites are too xeric for tree growth.

Vegetation: Vegetation types in this system may occur as sparse to dense shrublands composed of moderate to tall shrubs. Occurrences may be multi-layered, with some short shrubby species occurring in the understory of the dominant overstory species. In many occurrences of this system, the canopy is dominated by the broad-leaved deciduous shrub *Quercus gambelii*, which occasionally reaches small tree size. Occurrences can range from dense thickets with little understory to relatively mesic mixed-shrublands with a rich understory of shrubs, grasses and forbs. These shrubs often have a patchy distribution with grass growing in between. Scattered trees are occasionally present in stands and typically include species of *Pinus* or *Juniperus*. Characteristic shrubs that may co-occur, or be singularly dominant, include *Amelanchier alnifolia*, *Amelanchier utahensis*, *Arctostaphylos patula*, *Artemisia tridentata*, *Cercocarpus montanus*, *Prunus virginiana*, *Purshia stansburiana*, *Rosa* spp., *Symphoricarpos oreophilus*, and *Symphoricarpos rotundifolius*. The herbaceous layer is sparse to moderately dense, ranging from 1-40% cover. Perennial graminoids are the most abundant species, particularly *Bouteloua curtipendula*, *Bouteloua gracilis*, *Aristida* spp., *Carex geyeri*, *Festuca* spp., *Muhlenbergia* spp., and *Stipa* spp. Many forbs and fern species can occur, but none have much cover. Commonly present forbs include *Achillea millefolium*, *Artemisia* spp., *Geranium* spp., *Thalictrum fendleri*, and *Vicia americana*. Ferns include species of *Cheilanthes* and *Woodsia*. Annual grasses and forbs are seasonally present, and weedy annuals are often present, at least seasonally.

Dynamics: Fire typically plays an important role in this system, causing die-back of the dominant shrub species in some areas, promoting stump sprouting of the dominant shrubs in other areas, and controlling the invasion of trees into the shrubland system. Natural fires typically result in a system with a mosaic of dense shrub clusters and openings dominated by herbaceous species. In some instances these associations may be seral to the adjacent *Pinus ponderosa*, *Abies concolor*, and *Pseudotsuga menziesii* woodlands and forests. Ream (1964) noted that on many sites in Utah, Gambel oak may be successional and replaced by bigtooth maple (*Acer grandidentatum*).

Desired Future Condition: The DFC for these vegetation communities consists of stands with patches of differing age classes and densities. In fuel hazard situations the DFC is greatly reduced vegetation density or a conversion to less-flammable vegetation. When possible, allow fire to play its natural role in a historical fire-return.

Treat large expanses of even-aged, dense, homogenous stands to result in patches of diverse age classes [see Rondeau (2001) for patch size guidance]. To achieve greater habitat diversity and decreased potential for large-scale high-severity fire, reduce invasion of pinyon and juniper and reduce the average age of stands through fire, mechanical or biological (i.e., grazing goats) treatments. Since most of these species sprout following wildfire, consider seeding only to reduce potential for invasive weeds.

L.3.8 Douglas Fir - Mixed Conifer

This vegetation grouping for Moab is a combination of 6 SW ReGAP vegetative cover types that occur within the boundaries of the Moab Field Office. These groupings are similar enough in characteristics to serve the purposes of broad vegetation groupings for this DFC. In addition, most of the spruce, fir and aspen woodlands on BLM lands within the Moab Field Office boundary occur in the rugged and remote terrain of the Book Cliffs, where these vegetation types occur in a mixed mosaic across a significant elevational gradient. Vegetation and dynamics of these systems are not all described in detail, with some of this information presented under the environment heading.

Corresponding SW ReGAP Landcover Classification:

- S023 - Rocky Mountain Aspen Forest and Woodland
- S028 - Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland
- S030 - Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland
- S032 - Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland
- S034 - Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland
- S042 - Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland

Environment: Climate within these systems is temperate with a relatively long growing season, typically cold winters and deep snow. Mean annual precipitation is greater than 15 inches and typically greater than 20 inches, except in semi-arid environments where occurrences are restricted to mesic microsites such as seeps or large snow drifts. Occurrences at high elevations are restricted by cold temperatures and are found on warmer southern aspects. At lower elevations occurrences are restricted by lack of moisture and are found on cooler north aspects and mesic microsites. The soils are typically deep and well developed with rock often absent from the soil. Soil texture ranges from sandy loam to clay loams.

The aspen forest and woodland ecological system occurs primarily in the montane and subalpine zones. Elevations generally range from 5,000-10,000 feet, but occurrences can be found at lower elevations in some regions. Topography is variable, sites range from level to steep slopes. Distribution of this ecological system is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand, and secondarily is limited by the length of the growing season or low temperatures. Occurrences of this system originate and are maintained by stand-replacing disturbances such as avalanches, crown fire, insect outbreak, disease and windthrow, or clearcutting by man or beaver, within the matrix of conifer forests.

The subalpine dry-mesic spruce-fir forest and woodland consists primarily of Engelmann spruce and subalpine fir forests. Elevations range from 5,000-11,000 feet. Sites within this system are cold year-round, and precipitation is predominantly in the form of snow, which may persist until late summer. Snowpacks are deep and late-lying, and summers are cool. Frost is possible almost all summer and may be common in restricted topographic basins and benches. Despite their wide distribution, the tree canopy characteristics are remarkably similar, with *Picea engelmannii* and *Abies lasiocarpa* dominating either mixed or alone. *Pinus contorta* is common in many occurrences and patches of pure *Pinus contorta* are not uncommon, as well as mixed conifer/*Populus tremuloides* stands. Disturbance includes occasional blow-down, insect outbreaks and stand-replacing fire.

The subalpine mesic spruce-fir forest and woodland is a high-elevation system of the Rocky Mountains, dominated by *Picea engelmannii* and *Abies lasiocarpa*. Occurrences are typically found in locations with cold-air drainage or ponding, or where snowpacks linger late into the summer, such as north-facing slopes and high-elevation ravines. They can extend down in elevation below the subalpine zone in places where cold-air ponding occurs; northerly and easterly aspects predominate. These forests are found on gentle to very steep mountain slopes, high-elevation ridgetops and upper slopes, plateaulike surfaces, basins, alluvial terraces, well-drained benches, and inactive stream terraces. Disturbances include occasional blow-down, insect outbreaks and stand-replacing fire.

The montane dry-mesic mixed conifer forest and woodland is a highly variable ecological system of the montane zone of the Rocky Mountains. These are mixed-conifer forests occurring on all aspects at elevations ranging from 4,000 to 10,500 feet. Rainfall averages less than 30 in per year with summer "monsoons" during the growing season contributing substantial moisture. The composition and structure of overstory is dependent upon the temperature and moisture relationships of the site, and the successional status of the occurrence. This system was undoubtedly characterized by a mixed severity fire regime in its "natural condition", characterized by a high degree of variability in lethality and return interval.

The rocky mountain montane mesic mixed conifer forest and woodlands are mixed-conifer forests, occurring predominantly in cool ravines and on north-facing slopes. Elevations range from 4,000 to 10,500 feet. Occurrences of this system are found on cooler and more mesic sites than Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland. Such sites include lower and middle slopes of ravines, along stream terraces, moist, concave topographic positions and north- and east-facing slopes which burn somewhat infrequently. Naturally occurring fires are of variable return intervals, and mostly light, erratic, and infrequent due to the cool, moist conditions.

The inter-mountain basins aspen-mixed conifer forest and woodland ecological system occurs on montane slopes and plateaus at elevations ranging from 5,500 to 9,000 feet. Occurrences are typically on gentle to steep slopes on any aspect, but are often found on clay-rich soils in intermontane valleys. Soils are derived from alluvium, colluvium and residuum from a variety of parent materials, but most typically occur on sedimentary rocks. Distribution of this ecological system is primarily limited by adequate soil moisture required to meet its high evapotranspiration demand (Mueggler 1988). Secondarily, its range is limited by the length of the growing season; or low temperatures (Mueggler 1988). At lower elevations aspen is restricted by lack of moisture and is found on cooler north aspects and mesic microsites. The soils are typically deep and well-developed with rock often absent from the soil. Soil texture ranges from sandy loam to clay loams. Parent materials are variable and may include sedimentary, metamorphic or igneous rocks, but it appears to grow best on limestone, basalt, and calcareous or neutral shales (Mueggler 1988). Most occurrences at present represent a late-seral stage of aspen changing to a pure conifer occurrence. Nearly a hundred years of fire suppression and livestock grazing have converted much of the pure aspen occurrences to the present-day aspen-conifer forest and woodland ecological system.

Vegetation: Vegetation in the aspen forest and woodland have a somewhat closed canopy of trees of 15-65 feet tall dominated by the cold deciduous, broad-leaved tree *Populus tremuloides*. Conifers that may be present but never codominant include *Abies concolor*, *Abies lasiocarpa*, *Picea engelmannii*, *Picea pungens*, *Pinus ponderosa*, and *Pseudotsuga menziesii*. Conifer species may contribute up to 15% of the tree canopy before the occurrence is reclassified as a mixed occurrence. Because of the open growth form of *Populus tremuloides*, enough light can penetrate for lush understory development. Depending on available soil moisture and other factors like disturbance, the understory structure may be complex with multiple shrub and herbaceous layers, or simple with just an herbaceous layer. The herbaceous layer may be dense or sparse, dominated by graminoids or forbs. Common shrubs include *Acer glabrum, Amelanchier alnifolia, Artemisia tridentata, Juniperus communis, Prunus virginiana, Rosa woodsii, Shepherdia canadensis, Symphoricarpos oreophilus*, and the dwarf-shrubs *Mahonia repens* and *Vaccinium* spp. The herbaceous layers may be lush and diverse. Common graminoids may include *Bromus carinatus, Calamagrostis rubescens, Carex siccata (= Carex foenea), Carex geyeri, Carex rossii, Elymus glaucus, Elymus trachycaulus, Festuca thurberi*, and *Hesperostipa comata*. Associated forbs may include *Achillea millefolium, Eucephalus engelmannii (= Aster engelmannii), Delphinium* spp., *Geranium viscosissimum, Heracleum sphondylium, Ligusticum filicinum, Lupinus argenteus, Osmorhiza berteroi (= Osmorhiza chilensis), Pteridium aquilinum, Rudbeckia occidentalis, Thalictrum fendleri, Valeriana occidentalis, Wyethia amplexicaulis*, and many others. Exotic grasses such as the perennials *Poa pratensis* and *Bromus inermis* and the annual *Bromus tectorum* are often common in occurrences disturbed by grazing.

Vegetation in the montane dry-mesic mixed conifer forest and woodland is comprised of mixed conifer forests at montane elevation. The four main alliances in this system are found on slightly different, but intermingled, biophysical environments: *Abies concolor* dominates at higher, colder locations; *Picea pungens* represents mesic conditions; *Pseudotsuga menziesii* dominates intermediate zones. As many as seven conifers can be found growing in the same occurrences, with the successful reproduction of the diagnostic species determining the association type. Common conifers include *Pinus ponderosa, Pinus flexilis, Abies lasiocarpa, Abies lasiocarpa, Juniperus scopulorum*, and *Picea engelmannii*. *Populus tremuloides* is often present as intermingled individuals in remnant aspen clones, or in adjacent patches. The composition and structure of overstory is dependent upon the temperature and moisture relationships of the site, and the successional status of the occurrence (DeVelice et al. 1986, Muldavin et al. 1996).

A number of cold-deciduous shrub and graminoid species are found in many occurrences (e.g., *Arctostaphylos uvaursi, Mahonia repens, Paxistima myrsinites, Symphoricarpos oreophilus, Jamesia americana, and Quercus gambelii*). Other important species include *Acer glabrum, Acer grandidentatum, Amelanchier alnifolia, Arctostaphylos patula, Holodiscus dumosus, Jamesia americana, Juniperus communis, Physocarpus monogynus, Quercus X pauciloba, Rubus parviflorus*, and *Vaccinium myrtillus*. Where soil moisture is favorable, the herbaceous layer may be quite diverse, including graminoids *Bromus ciliatus (= Bromus canadensis), Calamagrostis rubescens, Carex geyeri, Carex rossi, Carex siccata (= Carex foenea), Festuca occidentalis, Koeleria macrantha, Muhlenbergia montana, Muhlenbergia virescens, Poa fendleriana, Pseudoroegneria spicata*, and forbs *Achillea millefolium, Arnica cordifolia, Erigeron eximius, Fragaria virginiana, Linnaea borealis, Luzula parviflora, Osmorhiza berteroi, Packera cardamine (= Senecio cardamine), Thalictrum occidentale, Thalictrum fendleri, Thermopsis rhombifolia, Viola adunca*, and species of many other genera, including *Lathyrus, Penstemon, Lupinus, Vicia, Arenaria, Galium*, and others.

Vegetation in the inter-mountain basins aspen-mixed conifer forest and woodland is open to moderately closed, mixed evergreen needle-leaved and deciduous broad-leaved tree canopy is composed of short to moderately tall trees, and is codominated by *Populus tremuloides* and conifers, including *Pseudotsuga menziesii, Abies concolor, Abies lasiocarpa, Picea engelmannii, Picea pungens, Pinus contorta, Pinus flexilis*, and *Pinus ponderosa*. As the occurrences age, *Populus tremuloides* is slowly reduced until the conifer species becomes dominant (Mueggler 1988). The sparse to moderately dense understory may be structurally complex and includes tall-shrub, short-shrub and herbaceous layers, or simple with just an herbaceous layer. Because of the open growth form of *Populus tremuloides*, more light can penetrate the canopy than in a pure conifer occurrence. Typically the understory is usually denser in younger occurrences that are dominated by *Populus tremuloides*, and in more mesic sites with open canopies. If present the tall-shrub layer may be dominated by *Amelanchier alnifolia, Prunus virginiana*, or *Acer grandidentatum*, and short-shrub by *Symphoricarpos oreophilus, Juniperus communis*, or *Mahonia repens*. Other common shrubs include *Paxistima myrsinites, Rosa woodsii, Spiraea betulifolia, Symphoricarpos albus*, and in wet areas *Salix scouleriana*. Where dense, the herbaceous layer is often dominated by graminoids such as *Bromus carinatus, Calamagrostis rubescens, Carex geyeri, Elymus glaucus, Poa* spp., and *Stipa* spp. More sparse herbaceous layers are generally a more even mixture of forbs like *Achillea millefolium, Arnica cordifolia, Eucephalus engelmannii (= Aster engelmannii), Erigeron speciosus, Fragaria vesca, Galium boreale, Geranium viscosissimum, Lathyrus* spp., *Lupinus argenteus, Mertensia arizonica, Mertensia lanceolata, Maianthemum stellatum, Osmorhiza berteroi (= Osmorhiza chilensis)*, and *Thalictrum fendleri*. Annuals are typically uncommon. The exotic species *Poa pratensis* and *Taraxacum officinale* are more common in livestock-impacted occurrences (Mueggler 1988).

Dynamics: Occurrences of the aspen forest and woodland ecological system often originate, and are likely maintained, by stand-replacing disturbances such as crown fire, disease and windthrow, or clearcutting by man or beaver. The stems of these thinbarked, clonal trees are easily killed by ground fires, but they can quickly and vigorously resprout in densities of up to 30,000 stems per hectare (Knight 1993). The stems are relatively short-lived (100-150 years), and the occurrence will succeed to longer-lived conifer forest if undisturbed. Occurrences are favored by fire in the conifer zone (Mueggler 1988). With adequate disturbance a clone may live many centuries. Although *Populus tremuloides* produces abundant seeds, seedling survival is rare because of the long moist conditions required to establish are rare in the habitats that it occurs in. Superficial soil drying will kill seedlings (Knight 1993).

Within the subalpine dry-mesic spruce-fir forest and woodlands *engelmannii* can be very long-lived, reaching 500 years of age. *Abies lasiocarpa* decreases in importance relative to *Picea engelmannii* with increasing distance from the region of Montana and Idaho where maritime air masses influence the climate. Fire is an important disturbance factor, but fire regimes have a long return interval and so are often stand-replacing. *Picea engelmannii* can rapidly recolonize and dominate burned sites, or can succeed other species such as *Pinus contorta* or *Populus tremuloides*. Due to great longevity, *Pseudotsuga menziesii* may persist in occurrences of this system for long periods without regeneration. Old-growth characteristics in *Picea engelmannii* forests will include treefall and windthrow gaps in the canopy, with large downed logs, rotting woody material, tree seedling establishment on logs or on mineral soils unearthed in root balls, and snags.

Forests in the montane dry-mesic mixed conifer forest and woodland represent the gamut of fire tolerance. Formerly, *Abies concolor* in the Utah High Plateaus were restricted to rather moist or less fire-prone areas by frequent ground fires. These areas experienced mixed fire severities, with patches of crowning in which all trees are killed, intermingled with patches of underburn in which larger *Abies concolor* survived. With fire suppression, *Abies concolor* has vigorously colonized many sites formerly occupied by open *Pinus ponderosa* woodlands. These invasions have dramatically changed the fuel load and potential behavior of fire in these forests. In particular, the potential for high-intensity crown fires on drier sites now codominated by *Pinus ponderosa* and *Abies concolor* has increased. Increased landscape connectivity, in terms of fuel loadings and crown closure, has also increased the potential size of crown fires. *Pseudotsuga menziesii* forests are the only true 'fire-tolerant' occurrences in this ecological system. *Pseudotsuga menziesii* forests were probably subject to a moderate-severity fire regime in presettlement times, with fire-return intervals of 30-100 years. Many of the important tree species in these forests are fire-adapted (*Populus tremuloides*, *Pinus ponderosa*, *Pinus contorta*) (Pfister et al. 1977), and fire-induced reproduction of *Pinus ponderosa* can result in its continued codominance in *Pseudotsuga menziesii* forests (Steele et al. 1981). Seeds of the shrub *Ceanothus velutinus* can remain dormant in forest occurrences for 200 years (Steele et al. 1981) and germinate abundantly after fire, competitively suppressing conifer seedlings. Successional relationships in this system are complex. *Pseudotsuga menziesii* is less shade-tolerant than many northern or montane trees such as *Tsuga heterophylla*, *Abies concolor*, *Picea engelmannii*, and seedlings compete poorly in deep shade. At drier locales, seedlings may be favored by moderate shading, such as by a canopy of *Pinus ponderosa*, which helps to minimize drought stress. In some locations, much of these forests have been logged or burned during European settlement, and present-day occurrences are second-growth forests dating from fire, logging, or other occurrence-replacing disturbances (Mauk and Henderson 1984, Chappell et al. 1997). *Picea pungens* is a slow-growing, long-lived tree which regenerates from seed (Burns and Honkala 1990a). Seedlings are shallow-rooted and require perennially moist soils for establishment and optimal growth. *Picea pungens* is intermediate in shade tolerance, being somewhat more tolerant than *Pinus ponderosa* or *Pseudotsuga menziesii*, and less tolerant than *Abies lasiocarpa* or *Picea engelmannii*. It forms late-seral occurrences in the subhumid regions of the Utah High Plateaus. It is common for these forests to be heavily disturbed by grazing or fire. In general, fire suppression has lead to the encroachment of more shade-tolerant, less fire-tolerant species (e.g., climax) into occurrences and an attendant increase in landscape homogeneity and connectivity (from a fuels perspective). This has increased the lethality and potential size of fires.

Within the inter-mountain basins aspen-mixed conifer forest and woodland *Populus tremuloides* is thin-barked and readily killed by fire. It is a fire-adapted species that generally needs a large disturbance to establish and maintain dominance in a forest. These mixed forests are generally seral and, in the absence of stand-replacing disturbance such as fire, will slowly convert to a conifer-dominated forest (Mueggler 1988). The natural fire-return interval is approximately 20 to 50 years for seral occurrences (USFS 1996). Intervals that approach 100 years are typical of late-seral occurrences (USFS 1996). Although the young conifer trees in these occurrences are susceptible to fire, older individuals develop self-pruned lower branches and develop thick corky bark that makes them resistant to ground fires. Most of the occurrences sampled by Mueggler (1988) have had a history of livestock grazing as evidenced by relative abundance of the exotic plants *Taraxacum officinale*, *Poa pratensis*, and other grazing-tolerant plants, and the scarcity of grazing-susceptible plants (Mueggler 1988). Most occurrences that we see today represent a late-seral stage of aspen changing to a pure conifer occurrence. Nearly a hundred years of fire suppression and livestock grazing have converted much of the pure aspen occurrences to the present-day aspen-conifer forest and woodland ecological system.

Desired Future Condition: It will be difficult to provide detailed DFC's for each of the individual components of this grouping. For specific questions and project level activities the Ecological Site Guides should be consulted, along with an understanding of the dynamics of these systems.

However, in general the DFC for vegetation communities within these various groups should consist of mixed conifer stands and an array of age classes, structure, and densities. Tree planting should occur following disturbance to restore or rehabilitate the forest resource to promote forest regeneration. Treatments should result in a landscape containing patches of large old trees.

L.3.9 RIPARIAN / WETLANDS

Corresponding SW ReGAP Landcover Classification:

- S093 - Rocky Mountain Lower Montane Riparian Woodland and Shrubland
- S102 - Rocky Mountain Alpine-Montane Wet Meadow

Environment: Riparian/wetland systems are found throughout the Rocky Mountain and Colorado Plateau regions within a broad elevation range from approximately 2,950 to 9,100 feet. These systems often occur as a mosaic of multiple communities that are often tree-dominated with a diverse shrub and grass component. Riparian areas are typically dependent on a natural hydrologic regime, especially annual to episodic flooding. Wetland areas typically dependent upon continuous saturation or inundation of soils to support wetland obligate species. Occurrences are found within the flood zone of rivers, on islands, sand or cobble bars, and immediate streambanks. They can form large, wide occurrences on mid-channel islands in larger rivers or narrow bands on small, rocky canyon tributaries and well-drained benches. Wetland areas are typically found in backwater channels and other perennially wet but less scoured sites, such as floodplains swales and irrigation ditches. Both riparian and wetland systems may also occur in upland areas of mesic swales and hillslopes below seeps and springs.

The climate of riparian/wetland systems is continental with typically cold winters and hot summers. Surface water is generally high for variable periods. Soils are typically alluvial deposits of sand, clays, silts and cobbles that are highly stratified with depth due to flood scour and deposition. Highly stratified profiles consist of alternating layers of clay loam and organic material with coarser sand or thin layers of sandy loam over very coarse alluvium. Soils are often fine-textured with organic material over coarser alluvium. Some soils are more developed due to a slightly more stable environment and greater input of organic matter.

Riparian/wetland areas commonly contain specialized vegetation associated with surface or subsurface moisture. Riparian resources include wetland areas which require prolonged saturation of soils and contain certain vegetative species dependent upon saturation. Less than 2 percent of the Moab FO planning area contains riparian/wetland resources, which are commonly located along major rivers, drainages, or spring sites

Moisture for <u>wet meadow</u> community types is acquired from groundwater, stream discharge, overland flow, overbank flow, and on-site precipitation. Salinity and alkalinity are generally low due to the frequent flushing of moisture through the meadow. Depending on the slope, topography, hydrology, soils and substrate, intermittent, ephemeral, or permanent pools may be present. These areas may support species more representative of purely aquatic environments. Standing water may be present during some or all of the growing season, with water tables typically remaining at or near the soil surface. Fluctuations of the water table throughout the growing season are not uncommon, however. On drier sites supporting the less mesic types, the late-season water table may be one meter or more below the surface. Soils typically possess a high proportion of organic matter, but this may vary considerably depending on the frequency and magnitude of alluvial deposition (Kittel et al. 1998). Organic composition of the soil may include a thin layer near the soil surface or accumulations of highly sapric material of up to 120 cm thick. Soils may exhibit gleying and/or mottling throughout the profile. Wet meadow ecological systems provide important water filtration, flow attenuation, and wildlife habitat functions.

<u>**Vegetation:**</u> Dominant trees may include *Acer negundo*, *Populus angustifolia*, *Populus balsamifera*, *Populus deltoides*, *Populus fremontii*, *Salix amygdaloides*, *Salix goodingii*, *Fraxinus velvutina*, or *Celtis* sp. Dominant shrubs include *Acer glabrum*, *Alnus incana*, *Betula occidentalis*, *Cornus sericea*, *Crataegus rivularis*, *Forestiera pubescens*, *Prunus virginiana*, *Rhus trilobata*, *Salix monticola*, *Salix drummondiana*, *Salix exigua*, *Salix irrorata*, *Salix lucida*, *Shepherdia argentea*, or *Symphoricarpos* spp. Invasive vegetation is common within riparian areas, consisting of exotic trees (*Elaeagnus angustifolia*, *Tamarix* spp). dominant in many stands, and noxious species (*Acroptilon repens*, *Lythrum salicaria*) Generally, the upland vegetation surrounding this riparian system is different and definable and ranges from grasslands to forests and can include *Quercus gambelii*, *Pseudotsuga menziesii*, *Picea pungens*, *Juniperus scopulorum*, *Atriplex canescens* and *Chrysothamnus nauseosus*.

Grass communities and species are a major component in most riparian and wetland areas. A mix of grasses can normally be found, with wide variability in the number of species, extent or location within the riparian/wetland area. Depending on the degree of inundation or saturation, grasses can include obligate wetland species where sufficient saturation occurs yearlong (*Juncus bufonius*, *Scirpus* spp., *Carex* spp., *Typha* spp.); facultative wetland grasses (*Distchlis spicata*, *Phragmites* spp.); or upland grass species (*Oryzopsis*,spp., *Sporobolus* spp.).

<u>**Dynamics:**</u> This ecological system contains early-, mid- and late-seral riparian plant associations. It also contains non-obligate riparian species. Cottonwood communities are early-, mid- or late-seral, depending on the age class of the trees and the associated species of the occurrence (Kittel et al. 1998). Cottonwoods, however, do not reach a climax stage as defined by Daubenmire (1952). Mature cottonwood occurrences do not regenerate in place, but regenerate by "moving" up and down a river reach. Over time a healthy riparian area supports all stages of cottonwood communities (Kittel et al. 1999b). Riparian ecosystems are extremely susceptible to

fire, containing native woody species which are fire intolerant (*Populus fremontii*), often resulting in catastrophic loss to fire in response to exotic species including tamarisk.

Associations in this ecological system are adapted to soils that may be flooded or saturated throughout the growing season. They may also occur on areas with soils that are only saturated early in the growing season, or intermittently. Typically these associations are tolerant of moderate-intensity ground fires and late-season livestock grazing (Kovalchik 1987). Most appear to be relatively stable types, although in some areas these may be impacted by intensive livestock grazing.

Desired Future Condition: The DFC for riparian/wetland areas is to support the appropriate ecological conditions, composition and age-class of native communities to maintain a healthy and properly functioning ecosystem as identified by Utah BLM Standards and Guidelines. Proper management and restoration of native riparian/wetland is a primary goal where systems are degraded. Reduction of flammable tamarisk and other invasive species can be common and widespread to improve native diversity, functioning condition, and reduce fire hazards.

Apply high priority to suppression of wildfires within riparian/wetland areas to maintain diverse native communities and reduce erosion into adjacent waterways (maintain buffer strips). Limit use of fire retardants near waters to reduce contamination of water quality and fisheries resources. Consider active restoration options, when native riparian and wetland communities are unlikely to recover with passive restoration (due to invasive species, stream bank erosion, etc).

Restore native riparian and wetland species through adjustment of management practices and/or implementation of mechanical, chemical, biological and fire treatments. Mechanical treatment as the initial fire treatment would be emphasized where there is a moderate to high potential for riparian and wetland to be burned to a high severity. For prescribed fire, allow low intensity fire to back into riparian and wetland areas through ignition outside of riparian and wetland.

L.3.10 INVASIVES

Corresponding SW ReGAP Landcover Classification:

- D04 - Invasive Southwest Riparian Woodland and Shrubland
- D08 - Invasive Annual Grassland

Environment: Invasive species can occur in nearly any environment within the Moab Field Office, however the major occurrences are in lower elevations (<6,500 feet). The major native vegetation types that have been displaced by invasives are salt desert scrub, sagebrush and grasslands. Observations indicate they are found to a greater extent in areas that have been disturbed by natural events or management activities. Drought also plays a key role in distribution of these species by limiting competition from native species for moisture.

This category does not include exotic species such as tamarisk or Russian olive, nor does it include other types of listed weeds which occur in smaller patches.

Vegetation: Within the distribution of vegetation normally associated with grasslands, salt desert scrub and sagebrush communities, the primary invasive species present include: Bromus spp., Salsola spp. and Halogeton glomeratus.

Dynamics: The invasives share the overall system dynamic features of the communities they occur in, and in some cases can be primary system dynamic drivers once established. The invasives take advantage of moisture earlier in the year than most native species, in some instances they alter soil characteristics of a site to favor nutrient uptake, both to the point of becoming dominate in the system they occur within. Fire and other management tools can often invigorate growth rates for these species. The complete role of invasives and their relationship to disturbance is not conclusive, but large scale occurrences with areas of certain types and intensities of management overuse or natural disturbance events, particularly on saline soil types, seems to indicate a strong link.

Cheat Grass Dynamics: Cheatgrass or downy brome (*Bromus tectorum* L.) is a winter annual C_3 grass that is self-pollinating (McKone 1985, Allen & Meyer 2002). Cheatgrass normally germinates in the fall, but seeds germinate at other times of year as well (Mack 1981). Seedlings that emerge in the fall develop a rudimentary root and shoot system that remains quiescent during the winter. Cheatgrass begins rapidly growing in late winter and early spring with warmer night and daytime temperatures and reaches full vegetative and reproductive maturity over a period of 6 to 8 weeks (Mack & Pyke 1983, Pierson & Mack 1990). These life history traits, especially rapid growth and corresponding depletion of soil water and N, which results in lower resource availability for perennial neighbors (Gordon et al. 1989, Welker et al. 1991), have contributed to the success of cheatgrass. Cheatgrass has large impacts on plant communities and ecosystems. It has been implicated in increasing fire frequencies and intensities (Klemmedson & Smith 1964, Stewart & Hull 1949, Knick & Rotenberry 1997), which has led to its replacement of shrubs and perennial grasses (DiTomaso 2000). It is the most ubiquitous weed in steppe vegetation in Western North America (Mack 1981). Cheatgrass is known to have negative effects on native species through competition, reducing establishment and growth of native perennial grasses (Harris 1967, Young & Evans 1985, Svejcar 1990, Rafferty and Young 2002). Cheatgrass can change N dynamics in ecosystems (Paschke et al. 2000, Evans et al. 2001) and its dominance can alter the composition of microbial communities (Belnap and Phillips 2001, Al-Qarawi 2002, Kuske et al. 2002), which can result in loss of plant species diversity (van der Heijden et al. 1998). Land managers report that cheatgrass now occurs at elevations where it was not found in the past.

Desired Future Condition: Where invasive species are present or in areas determined to be at risk, the DFC is to control this spread and take actions to restore the native vegetation community that has been invaded. Fires in cheatgrass invaded areas or areas with high potential for invasion should be aggressively suppressed and aggressively rehabilitated following wildfire. Wildland fire use would not be appropriate in cheatgrass/halogeton-invaded sites or in areas with high potential for invasion because of the lack of ability to properly rehabilitate.

L.3.11 DISTURBED AREAS

Corresponding SW ReGAP Landcover Classification:

- D11 - Recently Chained Pinyon-Juniper Areas

Environment: These mapped areas consist predominantly of management treatment areas for pinyon-juniper and sagebrush control that have occurred over the past 50 years. They typically occur on flat to gentle terrain. In some cases the treatment has been maintained, in other case the pinyon-juniper or sage has returned to varying degrees of success.

Vegetation: In those areas where the treatments were successful, the predominant vegetation consists of various grasses, crested wheat grass in many instances, and various forbs and shrubs. In less successful areas, the vegetation treated for has retuned and in some instances the areas have been subject to invasive species spread.

Dynamics: Over time many of these treatment areas have not been maintained with proper tools such as fire or herbicide. In some cases livestock were allowed onto the treated areas too early which altered the preferred vegetation composition.

Desired Future Condition: The assumption is made that since time and funding were invested to conduct these treatment operations, there would be interest in seeing the treatments maintained. The desired future condition for these treatments should therefore be the same as the rationale for initiating the treatment. In some instances species composition may need to be altered through re-seeding, in other areas recruitment of new woody species may require fire to reduce recruitment to acceptable levels.

DFC Table: Moab RMP Desired Future Conditions (DFC) - Vegetative Community Analysis Groupings[1]

Vegetation Groupings from Draft Utah FMP	Land Cover Groupings from Southwest ReGAP Analysis Occurring within Moab FO Boundaries	Final Grand RMP DFC Vegetation Community Groupings and Associated SW ReGAP Cover Types and Utah FMP Vegetation Groupings		Acres
Salt Desert Scrub Pinyon and Juniper Woodland Sagebrush Grassland Blackbrush Mountain Shrub Mixed Conifer Ponderosa Pine Creosote Bursage[2]	D01 - Disturbed, non-specific D02 - Recently burned D03 - Recently mined or quarried D04 - Invasive Southwest Riparian Woodland and Shrubland D06 - Invasive Perennial Grassland D08 - Invasive Annual Grassland D09 - Invasive Annual and Biennial Forbland D10 - Recently Logged Areas D11 - Recently Chained Pinyon-	**Salt Desert Scrub**	S011 - Inter-Mountain Basins Shale Badland S045 - Inter-Mountain Basins Mat Saltbush Shrubland S065 - Inter-Mountain Basins Mixed Salt Desert Scrub S079 - Inter-Mountain Basins Semi-Desert Shrub Steppe S096 - Inter-Mountain Basins Greasewood Flat	648,817

DFC Table: Moab RMP Desired Future Conditions (DFC) - Vegetative Community Analysis Groupings[1]

Vegetation Groupings from Draft Utah FMP	Land Cover Groupings from Southwest ReGAP Analysis Occurring within Moab FO Boundaries	Final Grand RMP DFC Vegetation Community Groupings and Associated SW ReGAP Cover Types and Utah FMP Vegetation Groupings		Acres
Riparian Wetland Aspen[3]	Juniper Areas D14 - Disturbed, Oil Well N21 - Developed, Open Space—Low Intensity N22 - Developed, Medium – High Intensity N80 - Agriculture S002 - Rocky Mountain Alpine Bedrock and Scree S006 - Rocky Mountain Cliff and Canyon S010 - Colorado Plateau Mixed Bedrock Canyon and Tableland S011 - Inter-Mountain Basins Shale Badland S012 - Inter-Mountain Basins Active and Stabilized Dune S023 - Rocky Mountain Aspen Forest and Woodland S028 - Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland S030 - Rocky Mountain Subalpine Mesic Spruce-Fir Forest and	**Pinyon and Juniper Woodland**	S039 - Colorado Plateau Pinyon-Juniper Woodland S052 - Colorado Plateau Pinyon-Juniper Shrubland S010 - Colorado Plateau Mixed Bedrock Canyon and Tableland	1,111,114
		Sagebrush	S054 - Inter-Mountain Basins Big Sagebrush Shrubland S056 - Colorado Plateau Mixed Low Sagebrush Shrubland S071 - Inter-Mountain Basins Montane Sagebrush Steppe	273,242
		Grassland	S090 - Inter-Mountain Basins Semi-desert Grassland	61,087
		Blackbrush	S059 - Colorado Plateau Blackbrush-Mormon Tea Shrubland	254,509

DFC Table: Moab RMP Desired Future Conditions (DFC) - Vegetative Community Analysis Groupings[1]

Vegetation Groupings from Draft Utah FMP	Land Cover Groupings from Southwest ReGAP Analysis Occurring within Moab FO Boundaries	Final Grand RMP DFC Vegetation Community Groupings and Associated SW ReGAP Cover Types and Utah FMP Vegetation Groupings		Acres
	Woodland S032 - Rocky Mountain Montane Dry- Mesic Mixed Conifer Forest and Woodland S034 - Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland S036 - Rocky Mountain Ponderosa Pine Woodland S039 - Colorado Plateau Pinyon-Juniper Woodland S042 - Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland S045 - Inter-Mountain Basins Mat Saltbush Shrubland S046 - Rocky Mountain Gambel Oak-Mixed Montane Shrubland S047 - Rocky Mountain Lower Montane-Foothill Shrubland S052 - Colorado Plateau Pinyon-Juniper Shrubland S054 - Inter-Mountain Basins Big Sagebrush Shrubland S056 - Colorado Plateau Mixed Low Sagebrush Shrubland S059 - Colorado Plateau Blackbrush-Mormon Tea Shrubland S065 - Inter-Mountain Basins Mixed Salt Desert Scrub S071 - Inter-Mountain Basins Montane Sagebrush Steppe S079 - Inter-Mountain Basins Semi-Desert Shrub Steppe S083 - Rocky Mountain Subalpine Mesic Meadow S085 – Southern Rocky Mountain	**Mixed Conifer**	S023 - Rocky Mountain Aspen Forest and Woodland S028 - Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland S030 - Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland S032 - Rocky Mountain Montane Dry- Mesic Mixed Conifer Forest and Woodland S034 - Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland S042 - Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	173,169
		Ponderosa Pine	S036 - Rocky Mountain Ponderosa Pine Woodland	20,347
		Riparian Wetland	S093 - Rocky Mountain Lower Montane Riparian Woodland and Shrubland S102 - Rocky Mountain Alpine-Montane Wet Meadow	36,000
		Disturbed Areas	D11 - Recently Chained Pinyon-Juniper Areas	19,730
		Invasives	D04 - Invasive Southwest Riparian Woodland and Shrubland D08 - Invasive Annual Grassland	43,230

DFC Table: Moab RMP Desired Future Conditions (DFC) - Vegetative Community Analysis Groupings[1]

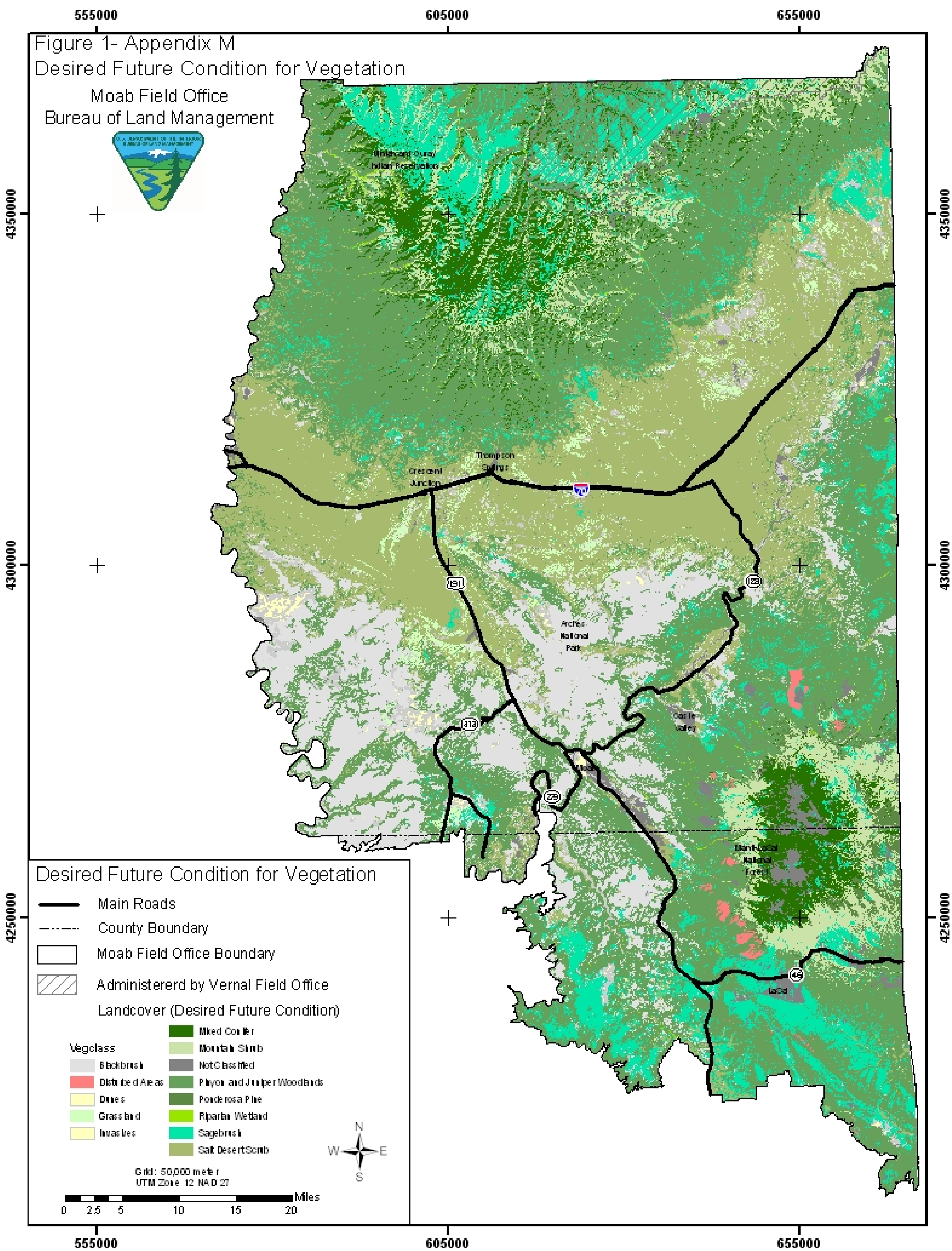
Vegetation Groupings from Draft Utah FMP	Land Cover Groupings from Southwest ReGAP Analysis Occurring within Moab FO Boundaries	Final Grand RMP DFC Vegetation Community Groupings and Associated SW ReGAP Cover Types and Utah FMP Vegetation Groupings		Acres
	Montane-Subalpine Grassland S090 - Inter-Mountain Basins Semi-desert Grassland S093 - Rocky Mountain Lower Montane Riparian Woodland and Shrubland S096 - Inter-Mountain Basins Greasewood Flat S102 - Rocky Mountain Alpine-Montane Wet Meadow S136 - Southern Colorado Plateau Sand Shrubland	**Dunes**	S012 - Inter-Mountain Basins Active and Stabilized Dune S136 - Southern Colorado Plateau Sand Shrubland	28,022
		Mountain Shrub	S046 - Rocky Mountain Gambel Oak-Mixed Montane Shrubland S047 - Rocky Mountain Lower Montane-Foothill Shrubland	159,292

[1] The following SW ReGAP classification covers will not be used for RMP DFC because they do not occur in sufficient distribution to be considered, or occur on lands administered by another agency.

D01 - Disturbed, non-specific
D02 - Recently burned
D03 - Recently mined or quarried
D06 - Invasive Perennial Grassland
D09 - Invasive Annual and Biennial Forbland
D10 – Recently logged areas
D14 - Disturbed, oil well
N21 - Developed, Open Space—Low Intensity
N22 - Developed, Medium – High Intensity
N80 - Agriculture
S002 - Rocky Mountain Alpine Bedrock and Scree
S006 - Rocky Mountain Cliff and Canyon
S083 - Rocky Mountain Subalpine Mesic Meadow
S085 – Southern Rocky Mountain Montane-Subalpine Grassland

[2] Creosote Bursage does not occur in the Moab Field Office.

[3] Aspen within the Moab Field Office is relatively small aerial extent and is grouped with the mixed conifer community.


555000
605000
655000
Figure 1- Appendix M
Desired Future Condition for Vegetation
Moab Field Office
Bureau of Land Management
4350000
4300000
4250000
Crescent Junction
Thompson Springs
Arches National Park
Castle Valley
Moab
Manti-LaSal National Forest
LaSal
Desired Future Condition for Vegetation
Main Roads
County Boundary
Moab Field Office Boundary
Administererd by Vernal Field Office
Landcover (Desired Future Condition)
Vegclass
Blackbrush
Disturbed Areas
Dunes
Grassland
Invasives
Mixed Conifer
Mountain Shrub
Not Classified
Pinyon and Juniper Woodlands
Ponderosa Pine
Riparian Wetland
Sagebrush
Salt Desert Scrub
N
W
E
S
Grid: 50,000 meter
UTM Zone 12 NAD 27
Miles
0 2.5 5 10 15 20