Conservation Strategy
for
Calochortus longebarbatus Wats. var. *peckii* Ownbey

For Ochoco and Malheur National Forests
and the Prineville BLM District

Prepared by Rick Dewey,
Deschutes National Forest
2011

a revision of
Final Draft
Species Management Guide for
***Calochortus longebarbatus* Wats. var. *peckii* Ownbey**
Prepared by Jimmy Kagan
Oregon Natural Heritage Program
1996

U.S.D.A. Forest Service Region 6 and
U.S.D.I. Bureau of Land Management, Oregon and Washington

Signature Page

Conservation Strategy Approval

Ochoco and Malheur National Forests and Prineville District BLM agree to implement this Conservation Strategy for Peck's longbeard mariposa lily (Calochortus longebarbatus var. peckii) as available funding permits. This document will be used to guide management decisions for this species during project planning and in project specific NEPA decisions until further notice.

Kate Klein — 10/4/2011
Kate Klein, Forest Supervisor, Ochoco National Forest — Date

12/1/2011
Teresa Raaf, Forest Supervisor, Malheur National Forest — Date

8/19/2011
Deborah Henderson-Norton, District Manager, Prineville District BLM — Date

Acknowledgments

The information included in this Conservation Strategy was obtained largely from an initial draft document prepared and Jimmy Kagan and by reports and personal communications provided by a large number of federal botanists and other natural resource professionals with experience managing lands that include populations of either *Calochortus longebarbatus* var. *peckii* or *Calochortus longebarbatus* var. *longebarbatus*. Funding for preparation of this revised Conservation Strategy was provided by the Interagency Special Status Sensitive Species Program (ISSSSP), which is a collaborative effort between the Pacific Northwest Region of the USFS and the Oregon and Washington State Office of the BLM.

Cover photo by Tanya Harvey

Table of Contents

Disclaimer …….. …….. …….. …….. …….. …….. …….. …….. …….. 4
Executive Summary …….. …….. …….. …….. …….. …….. …….. …….. 4
Introduction …….. …….. …….. …….. …….. …….. …….. …….. …….. 6
Goal …….. …….. …….. …….. …….. …….. …….. …….. …….. 6
Scope …….. …….. …….. …….. …….. …….. …….. …….. …….. 6
Management Status …….. …….. …….. …….. …….. …….. …….. 6
Taxonomy …….. …….. …….. …….. …….. …….. …….. …….. …….. 7
Systematics and Synonymy …….. …….. …….. …….. …….. …….. 7
Description …….. …….. …….. …….. …….. …….. …….. …….. 7
Biology and Ecology …….. …….. …….. …….. …….. …….. …….. …….. 8
Life History and Reproductive Biology …….. …….. …….. …….. 8
Range, Distribution and Abundance …….. …….. …….. …….. …….. 9
Population Trends …….. …….. …….. …….. …….. …….. ……..10
Habitat…….. …….. …….. …….. …….. …….. …….. …….. ……..10
Ecological Considerations …….. …….. …….. …….. …….. ……..11
Conservation …….. …….. …….. …….. …….. …….. …….. …….. ……..11
Threats to Species …….. …….. …….. …….. …….. …….. ……..11
Conservation Objective …….. …….. …….. …….. …….. ……..15
Selection of Management Areas …….. …….. …….. …….. ……..16
Management Area Requirements …….. …….. …….. …….. ……..16
Inventory, Research and Monitoring …….. …….. …….. …….. …….. ……..17
Inventory …….. …….. …….. …….. …….. …….. …….. ……..17
Research Questions …….. …….. …….. …….. …….. …….. ……..17
Monitoring Requirements …….. …….. …….. …….. …….. ……..18
Adaptive Management…….. …….. …….. …….. …….. …….. …….. ……..22
References …….. …….. …….. …….. …….. …….. …….. …….. ……..24
Appendix …….. …….. …….. …….. …….. …….. …….. …….. ……..27

Disclaimer

This Conservation Strategy was prepared to compile published and unpublished information on the subject taxon. Although this Strategy does not represent a management decision by the U.S. Forest Service (Region 6) or the Bureau of Land Management (OR/WA BLM), it will be used in project-level decision documents on Ochoco and Malheur National Forests, and on the Prineville BLM District. Although the best scientific information available was used, and subject experts were consulted in preparation of this document, it is expected that new information will arise. In the spirit of continuous learning and adaptive management, if you have information that will assist in conserving the subject taxon, please contact the interagency Special Status/Sensitive Species Conservation Planning Coordinator in the Portland, Oregon Forest Service Region 6 and OR/WA BLM offices or via the website: http://www.fs.fed.us/r6/sfpnw/issssp/contactus/ .

Executive Summary

Species and Taxonomic Group

Calochortus longebarbatus var. *peckii* is an herbaceous, perennial flowering plant included in the lily family (Liliaceae).

Management Status

Calochortus longebarbatus var. *peckii* has Global and State Ranks of G4T3 and S3. It is a US Fish and Wildlife Service Species of Concern, an Oregon Department of Agriculture Candidate taxon, and included on List 1 (List 1 taxa are considered endangered or threatened throughout their range or presumed extinct) of the Oregon Natural Heritage Information Center. It is an Oregon BLM Bureau Sensitive taxon and a USFS Region 6 Sensitive Species. Status of rare/uncommon taxa on ORNHIC, Oregon BLM and USFS Region 6 lists is periodically modified as new information concerning individual taxa is acquired. Current species status information can be found at the following locations: <http://oregonstate.edu/ornhic/index.html> (ORNHIC) and <http://www/fs.fed.us/r6/sfpnw/issssp> (Sensitive and Strategic Species for USFS Region 6 and OR/WA BLM).

Range and Habitat

Calochortus longebarbatus var. *peckii* is endemic to central Oregon, where it occurs in portions of Crook, Wheeler, Grant and Harney counties. The taxon's approximately 215 populations/sites (see definition in caption to Table 2) occupy a total of 3404 acres distributed among 37 subwatersheds (6th field hydrologic units). *Calochortus longebarbatus* var. *peckii* is always found at seasonally moist sites, generally associated with either bunchgrass-forb meadows or in non-forested habitats along intermittent streams.

Threats

Threats include 1) alterations in local hydrology (roads, channel down-cutting, soil compaction), 2) non-native invasive plants, 3) fire suppression (accumulation of litter,

expansion of adjacent forest communities), 4) direct physical impacts (heavy equipment, slash and skidded logs, fire suppression activities, camping, ATVs, trampling by livestock and native ungulates) and 5) herbivory (particularly, bulb predators). *Calochortus longebarbatus* var. *peckii* appears to occur principally on federal land managed by Ochoco and Malheur National Forests, and the Prineville BLM District.

Conservation

The response of this taxon to grazing by cattle is complex and not well understood. Formal and informal observations of *Calochortus longebarbatus* var. *longebarbatus* on the Fremont-Winema National Forest and of *Calochortus longebarbatus* var. *peckii* in central Oregon suggest that livestock grazing need not cause a decline in this species. Adherence to included guidelines for management of relatively clearly identified threats, and implementation of all existing, applicable grazing standards and guidelines, is expected to largely allow achievement of the taxon's persistence objectives. Determining the efficacy of *Calochortus longebarbatus* management is difficult due to challenges associated with estimating population size and, in turn, population trend, in this taxon. Until additional critical information about the species is obtained (see below, under Research and Monitoring), this Strategy relies on the management/protection of all currently known sites/populations of this species. Site-specific management direction regarding these populations would be made through project-specific NEPA documents, relying on the Management Area Requirements included in this Strategy. Those recommendations address: 1) weed prevention and control measures, 2) pasture rotations, 3) salt lick locations, 4) range improvement locations, 5) tree cutting operations, 6) wildfire suppression plans, 7) implementation of applicable aquatic and terrestrial management standards and guidelines and 8) implementation of a monitoring plan.

Research and Monitoring

Better understanding of at least three aspects of *Calochortus longebarbatus* var. *peckii* biology would assist in efforts to conserve this taxon: 1) bulblet biology, including conditions that favor production, dispersal and establishment of these propagules; 2) extent and geographic pattern of genetic variation; and 3) incidence and significance of bulb herbivory by small mammals.

Three different types of monitoring systems - statistically-based sampling, habitat condition monitoring and non-statistically-based monitoring - are analyzed. A rationale for selecting non-statistically-based monitoring is presented, along with the details of a proposed monitoring plan.

Adaptive Management

After a pilot year of monitoring, responsible inter-forest and inter-agency staff will jointly review the monitoring protocol and, if deemed necessary, make appropriate modifications. An action threshold concerning detectable change in population size, is defined, and a set of appropriate management actions are provided. It is anticipated that this conservation strategy will remain in effect until such time as responsible inter-forest and inter-agency staff agree that populations of *Calochortus longebarbatus* var. *peckii*

across their distribution on federal lands in central Oregon are stable, secure, and will not continue to benefit from species-specific management guidelines.

Introduction

Goal

The goal of this Conservation Strategy is to summarize existing knowledge regarding the biology and ecology of *Calochortus longebarbatus* var. *peckii*, identify threats to the species, and provide management guidelines that will promote the conservation objectives for this taxon.

Policy objectives for Forest Service Sensitive Species (FSM 2670.22) are to 1) ensure that species do not become Threatened or Endangered due to Forest Service actions, 2) maintain viable populations of all native and desired plant and animal species in habitats distributed across their range on National Forest System lands, and 3) develop and implement management objectives for populations and/or habitat of Sensitive Species. Forest Land and Resource Management Plans may encourage or require the development of guides or plans for management of selected Sensitive Species.

For OR/WA BLM administered lands, SSS policy details the need to manage for species conservation.

The conservation objective for *Calochortus longebarbatus* var. *peckii* is the indefinite maintenance of this taxon across its current range on federally managed lands in central Oregon. This includes maintenance, in at least its current population sizes, within each of the subwatersheds (6th field hydrologic units) it currently occupies.

Scope

The geographic scope of this document is the known range of *Calochortus longebarbatus* var. *peckii*, which includes portions of Crook, Wheeler, Grant and Harney counties in central Oregon. Information applicable to this taxon is drawn largely from studies and observations of the taxon on Ochoco NF and Prineville BLM, and from studies and observations of *Calochortus longebarbatus* var. *longebarbatus* on federal lands in southern Oregon and Northern California. Not for want of effort, there is little statistically supported understanding of population trends or response to likely significant, human-related disturbances such as cattle grazing and fire. Consequently, circumstantial evidence and informal observations are particularly important in the construction of biological/ecological models for this taxon. It is particularly important that as our understanding of the threats to this taxon improves, the management actions prescribed to counter these threats are open to modification.

Management Status

Calochortus longebarbatus var. *peckii* has Global and State Ranks of G4T3 and S3. It is a federal Species of Concern, an Oregon Department of Agriculture Candidate taxon, and included on List 1 of the Oregon Natural Heritage Information Center (List 1 taxa are considered endangered or threatened throughout their range or presumed extinct). It is an

Oregon BLM Bureau Sensitive taxon and a USFS Region 6 Sensitive Species. Status of rare/uncommon taxa on ORNHIC, OR BLM and USFS Region 6 can change from time to time. Current species status information can be found at the following locations: <http://oregonstate.edu/ornhic> (ORNHIC) and <http://www/fs.fed.us/r6/sfpnw/issssp> (Sensitive and Strategic Species for USFS Region 6 and OR/WA BLM).

Federal field units that include some portion of the range of *Calochortus longebarbatus* var. *peckii* are Ochoco NF, Malheur NF and Prineville BLM District. The management plans associated with each of these field units are: Land and Resource Management Plan, Ochoco NF, 1989; Land and Resource Management Plan, Malheur NF, 1990; the Two Rivers Resource Management Plan, 1986 (northern Prineville BLM District), and the Brothers/La Pine Resource Management Plan, 1989 (southern Prineville BLM District). Each of these plans basically repeats general agency requirements for managing special status/sensitive species, but none include direction that is specific to *Calochortus longebarbatus* var. *peckii*. A Final Draft Species Management Guide for *Calochortus longebarbatus* Wats. var. *peckii* Ownbey was prepared for Ochoco NF by Jimmy Kagan of the Oregon Natural Heritage Program in 1996. This Draft has subsequently been cited in Forest Biological Evaluations, but was never officially approved and signed by an Ochoco NF supervisor.

Taxonomy

Systematics and Synonymy

Calochortus is one of more than 20 PNW genera recognized within the lily family (Liliaceae). *Calochortus longebarbatus* was first collected by Suksdorf in 1882 near Glenwood, Washington. Ownbey (1943) described var. *peckii* based on his collection from the headwaters of Marks Creek, Wheeler County, OR. The common name applied by the USDA NRCS Plants Database (http://plants.usda.gov) to both varieties of this species is "longbeard mariposa lily." The Oregon Natural Heritage Information Center and the OR/WA BLM refer to var. *peckii* as "Peck's mariposa lily". According to the Plants Database, the scientific name of this taxon has no synonyms. *Calochortus longebarbatus* var. *peckii* is the only triploid taxon within the genus *Calochortus* (Ferrari et al., 1996). Ferrari et al. (1996) examined ribosomal DNA in *C. longebarbatus*. For what apparently was a combination of technical, as well as biological reasons, the study results "were inconclusive with respect to elucidating clear difference between the two varieties of *Calochortus longebarbatus*, and among populations of the varieties."

Description

Calochortus species are few-leaved, herbaceous perennials from deep-seated bulbs. The varieties of *Calochortus longebarbatus* receive no mention in the popular single-volume version of Flora of the Pacific Northwest (Hitchcock and Cronquist, 1973). The following technical description of *Calochortus longebarbatus*, as well as line drawings differentiating the two varieties is available in Hitchcock et al. (1969).

> Stem erect, 1-3 dm. tall, regularly with a bulblet in the axil of the narrow, nearly basal, cauline leaf, subumbellately 1- to 3-flowered; basal leaf flat, 2-3 dm. long,

5-10 mm. broad, tapering gradually toward both ends, usually shorter than the inflorescence; bracts usually 2, opposite, narrowly lanceolate, long-acuminate, 2-6 cm. long, unequal; flowers lavender-pink, with a deep purplish-red band on each petal just above the gland, drying purple, erect on rather slender pedicels; sepals shorter than the petals, ovate to lanceolate, acuminate, glabrous; petals broadly obovate, cuneate, obtuse and rounded or acute at apex, with a few scattered, very long, flexous hairs on the inner face above the gland; gland transversely oblong, the surface naked, slightly to deeply depressed, bordered below with a broad, deeply fringed membrane and above with a band of short, thick processes, both processes and fringe of the membrane beset with numerous papillae; anthers oblong, obtuse to short-apiculate, about half as long as the filaments; ovary 3-winged, contracted to a short style and a persistent, trifid stigma; fruit elliptic to nearly orbicular, 3-winged, erect.

Hitchcock et al. (1969) note that the two varieties can be distinguished by floral features: flowers of var. *longebarbatus* are narrowed toward the base, while those of var. *peckii* are broad-based and cup-shaped. Further, Kagan , who worked with var. *peckii* on Ochoco NF as well as var. *longebarbatus* on Winema NF, observed (1996) that var. *peckii* plants typically occur at a density of less than two plants per square meter and produce thin, empty fruits, while var. *longebarbatus* plants occur at densities ranging from 2-50 plants per square meter and produce fruits filled with seeds. To restate: *Calochortus longebarbatus* var. *peckii* can curently be differentiated from *C. longebarbatus* var. *longebarbatus* primarily by 1) petal and flower shape, 2) reproductive potential of fruits and 3) ploidy level.

The only other *Calochortus* species which grows with *Calochortus longebarbatus* var. *peckii* is *Calochortus eurycarpus*. *Calochortus longebarbatus* var. *peckii* is usually easily distinguished by its much smaller size and pink flowers, as compared to the large, white flowers of *C. eurycarpus*. Note, however, that *C. eurycarpus* flowers can turn pink with age, and small plants with old flowers can look very similar to *C. longebarbatus*. *Calochortus macrocarpus* also occurs within the range of *C. longebarbatus* var. *peckii*, but generally grows in drier, more upland microsites.

Biology and Ecology

Life History and Reproductive Biology

While *Calochortus longebarbatus* var. *longebarbatus* is a fertile diploid taxon, *Calochortus longebarbatus* var. *peckii* is a sterile triploid that reproduces only through small bulblets produced in the axil of the basal leaf, or occasionally, in the axils of the flower bracts. The bulblets appear to survive only in areas with open, bare soil (Kagan, 1996). Ness et al. (1990) reported 2n = 20 in *Calochortus longebarbatus* collected in Siskyou and Modoc Counties, CA, and Klickitat County, WA. However, material collected in Crook County, OR, was found to have 2n = 30. The geography of these collections corresponds well with the known distributions of the varieties *longebarbatus* and *peckii*.

Kagan (1996) noted the following phenology for this taxon. The leaf emerges from the bulb in the early spring. If the plant has significant resources (which seems to relate directly to leaf size), a flowering stalk will appear in June or early July, with flowers appearing typically in July or early August (with a flowering range of late June to mid-August). If a plant's resources are low, which may be due to being young and small, or because of inadequate winter and/or spring precipitation, the leaf may wither and brown in June or July, and no flower stalk will develop. Kagan (1996) further noted that plants within a single population can flower over a long period of time, especially with the occurrence of summer rainfall. Individual populations were observed where flowering plants were present between June 20 and August 15, although no individual plant appeared to flower more than two weeks. Fiedler (in Goldenberg, 1995) believes that most *Calochortus* species are slow-growing and long-lived. In contrast, Kagan (1996), based on an observed mortality rate of 25% per year during a three-year study, speculated that *Calochortus longebarbatus* var. *peckii* individuals may be much shorter lived than expected.

Range, Distribution and Abundance

The current range of *Calochortus longebarbatus* var. *peckii* includes portions of Crook, Wheeler, Grant and Harney counties, Oregon. The taxon is known primarily from sites on Ochoco NF, Malheur NF, and the Prineville BLM District. It has been observed, but not documented, on private land at Big Summit Prairie and north of the community of Paulina. The gross area of the known range is approximately 1.3 million acres, or about 2,030 square miles (see Appendix, Map 1). GIS records at agency field units indicate that, on federal land, 215 sites occupy approximately 3400 acres included in 37 subwatersheds (6th field hydrologic units; see Appendix, Table 1, for list of subwatersheds that include *Calochortus longebarbatus* var. *peckii*). The majority of sites (77%) and acreage (87%) occur on Ochoco NF, with lesser occurrences on Malheur NF (14% of sites, 9% of acres) and the Prineville BLM District (9% of sites, 4% of acres). See Appendix, Table 2, for a more complete description of the sizes and distribution of sites of *Calochortus longebarbatus var. peckii*. Within the full distribution of the taxon, there are three more or less geographically distinct areas of occurrence. The largest and northern-most of these areas (see Appendix, Map 2), with a gross area of about 298,000 acres or about 465 square miles, is comprised of portions of Paulina and Lookout Mountain Ranger Districts (not including the Maury Mountains) of Ochoco NF, and immediately adjacent Prineville BLM land. The second largest area, representing the southeastern corner of the taxon's range (see Appendix, Map 3), occurs on the Emigrant Creek RD of Malheur NF. This area occupies about 80,000 acres or about 125 square miles. The third geographically distinct area of distribution is southern (see Appendix, Map 4), occurring in the Maury Mountains subunit of the Lookout Mountain RD, and on immediately adjacent Prineville BLM land. Gross area is about 9800 acres, or about 15 square miles. Although, in general, sites within the known distribution of this taxon are rather clumped, some sites exist many miles from the next nearest occurrence. The nature of this taxon's historic range and distribution is not known. It is reasonable to suspect the presence of *Calochortus longebarbatus* var. *peckii* on the northern portion of the Burns BLM District. Doug Linn reports (2009) that he has kept the taxon in mind during clearance work for forest fringe projects, but has not yet attempted to map areas of

suitable habitat.

Calochortus longebarbatus var. *peckii* sites are strongly associated with water courses. Local drainages are likely to have multiple *Calochortus longebarbatus* var. *peckii* sites or none. GIS analysis indicates that across its range, 57% of all *Calochortus longebarbatus* var. *peckii* sites occur within 10 meters of a perennial or intermittent stream, while 69% of all sites occur within 50 meters of a perennial or intermittent stream. This distribution pattern suggests that 1) stream courses provide moisture and disturbance conditions that favor establishment of *Calochortus longebarbatus* var. *peckii*, and 2) moving water is an important dispersal vector for this taxon, presumably through the transport of its bulblets.

In a sterile taxon such as *Calochortus longebarbatus* var. *peckii*, it is not possible to define a "population" based on either supposed or measured frequency of genetic exchange. Given the strong tendency for this taxon to be distributed along stream courses and intermittent drainages, and the inferred importance of moving water as a dispersal vector for the taxon's asexual propagules, there is good cause, both considering biology and convenience, to generally define a "population" based on drainage boundaries. It seems reasonable to regard a set of plants, all of which could have been established by the same up-drainage propagule source, and all of which may very well be related as clones, as a "population".

Population Trends

The number of flowering individuals at any *Calochortus longebarbatus* site can vary dramatically from year to year. For example, numbers of flowering individuals within an ungrazed *Calochortus longebarbatus* var. *longebarbatus* plot on Fremont NF, monitored from 1997-2001 fluctuated more than ten-fold annually (450/5710/100/1200/18; Wooley, 2001). This fluctuation in apparent population size is strongly correlated to the timing and volume of precipitation with higher winter levels, and perhaps especially, good late spring rains, often resulting in a conspicuous incidence of flowering (Kagan, 1996; Goldenberg, 1995; Wooley, 2005; Spivey, 2005). This large annual amplitude in numbers of flowering stems has, to date, frustrated efforts to determine population trends.

Habitat

The following description of *Calochortus longebarbatus* var. *peckii* habitat is provided by Kagan (1996) and is drawn principally from observations on Ochoco NF. Confidence in the knowledge of habitat association expressed below is high.

Calochortus longebarbatus var. *peckii* is always found in seasonally moist sites which usually include patches of open, exposed, moderately deep soil. The largest known populations are a component of bunchgrass and forb communities that occur either as isolated, drier meadows, or as part of the transitional zone between wet meadows and drier upland plant communities. These bunchgrass and forb communities are dominated by native bunchgrasses including *Danthonia californica*, *Festuca rubra*, *Poa nevadensis*, *Agropyron caninum* and *Festuca idahoensis* along the edges of meadows, and *Poa secunda* and *Danthonia unispicata* in rocky areas. Introduced grasses include *Poa pratensis*, *Phleum pratense*, *Agropyron intermedium*, *Arrhenatherum elatius* and

Dactylus glomerata. Common forbs in these meadows include *Potentilla gracilis*, *Lupinus* species, *Sidalcea oregana*, *Achillea millefolium*, *Perideridia gardneri*, *Zigadenus venenosus*, *Brodiaea hyacinthina* and *Allium acuminatum*.

The other common habitat of *Calochortus longebarbatus* var. *peckii* is open riparian strips along seasonal streams, occasionally with western juniper, often with lodgepole pine, or more commonly, with ponderosa pine. While very wet in early spring, these sites are usually dry by July. *Calochortus longebarbatus* var. *peckii* is found in a narrow band along the edges of the dry stream, and in adjacent grassy openings. Associated species are often the same as at the meadow sites, but these habitats are much stonier and shallow-soiled, and the populations are linear and often run along a stream for a long distance. In general, soil type is not a significant determinant of the habitat and/or distribution of *Calochortus longebarbatus* var. *peckii* (Kagan, 1996). See Appendix, Table 3, for a list of Potential Natural Communities known to include at least one occurrence of *Calochortus longebarbatus* var. *peckii*.

Ecological Considerations

Goldenberg (1995) gave consideration to Grime's (1979) three-way continuum to classify plant "strategies", which features the concepts of "competitors" (fast-growing plants of highly productive environments), "stress tolerators" (slow-growing plants of low-productivity environments) and "ruderals" (fast growing, short-lived taxa of disturbed environments). Goldenberg noted that while *Calochortus longebarbatus* var. *peckii* appears to most act as a stress tolerator, a better understanding of growth rates, biomass allocation and propagule production (and success) for this taxon is needed.

Conservation

Threats to Species

Hydrological Alterations. As *Calochortus longebarbatus* var. *peckii* tends to occupy sites whose soil moisture levels are transitional between wet meadow and near-stream plant communities, and distinctly drier upland plant communities, it is reasonable to expect that the taxon would be very sensitive to minor, but persistent changes in local hydrology. Several management actions can result in such changes. Roads can disrupt and reroute the subsurface and surface flow of water. Down-cutting in stream channels can lower water tables. Soil compaction associated with heavy equipment (e.g., logging at the edges of *Calochortus longebarbatus* var. *peckii* populations) or cattle grazing on damp spring soils, can reduce soil porosity, decreasing the infiltration rates of water, with a consequent increase in rates of surface flow. Increased surface flow may result not only in lower rates of water capture and retention at *Calochortus longebarbatus* var. *peckii* sites, but also increase the risk of habitat degradation due to soil erosion. Reference to potential or actual degradation of *Calochortus longebarbatus* habitat due to hydrological alterations has been made by Kagan (1996), Goldenberg (1995), Wooley (2005) and can be found in the Westside Allotments Environmental Assessment (USDA-USFS, 2005).

Non-native Invasive Plants. Currently, there are more than 2200 mapped occurrences of non-native invasive plants (NNIP) on Ochoco NF. GIS analysis indicates

that 5% of the *Calochortus longebarbatus* var. *peckii* sites on Ochoco NF are within 10 meters of a NNIP site while 7% are within 100 meters of a NNIP site. While these percentages may not appear particularly high, the incidence of NNIPs on Ochoco NF, and presumably, on adjacent federal lands, is high. Helliwell (1993) noted that *Dipsacus sylvestris* (teasel) appears to have displaced at least one documented site of *Calochortus longebarbatus* var. *peckii* along Marks Creek on Ochoco NF. Given that 1) *Calochortus longebarbatus* var. *peckii* habitat (relatively open, sunny, seasonally damp sites, often with patches of bare soil due to the disturbance of grazing cattle) is generally highly suitable to NNIPs, and 2) developed NNIP dispersal routes (roads) and vectors (stock, wildlife, federal and private vehicles, ATVs) are numerous, the risk to *Calochortus longebarbatus* var. *peckii* habitat posed by NNIPs must be regarded as very significant.

Fire Suppression. It has been suggested that historically fire may have helped maintain forest openings that provide habitat for *Calochortus* on the Fremont NF (Kaye, 1991), Ochoco NF (Kagan, 1996) and in Washington (Gamon, 1990). Ochoco NF botanists (Lesko, 2005; Mafera, 2005) have noted degradation of some meadow and stream course *Calochortus longebarbatus* var. *peckii* habitat due to expansion of forest plant communities, particularly lodgepole and pondersosa pine. Both note, however, that it is difficult to discern the extent to which these expansions are due to fire suppression versus local hydrological alterations. Halvorson (2005) described a marked decline in *Calochortus longebarbatus* var. *peckii* correlating to its presence within exclosures meant to protect it from the grazing of cattle. In 1987, exclosures ranging in size from 0.2-1.0 hectare were constructed within several of the largest *Calochortus longebarbatus* var. *peckii* populations on BLM land. Eight years later, almost no *Calochortus longebarbatus* var. *peckii* occurred within the exclosures. Halvorson speculates that an observed build-up of organic material (living and dead) within the exclosures favored other plant species at the expense of *Calochortus longebarbatus* var. *peckii*. Halvorson notes that presumably either fire or grazing would have removed or reduced this material. Kagan (1996) describes a large incidence of flowering in a burned population of *Calochortus longebarbatus* var. *longebarbatus* on Winema NF. The population had been monitored for several years prior to being burned in a major wildfire in 1993. No more than 75 flowering plants were observed during any pre-fire year. The year following the fire, over 50,000 flowering plants were observed in the three-acre meadow (precipitation that year was not described). In contrast, Goldenberg (1995), suspects that *Calochortus longebarbatus* var. *longebarbatus* meadows on Winema NF may be edaphically maintained. This would be due to soils being seasonally too wet and/or too heavy, or too shallow. Nevertheless, Goldenberg noted (1997), although without statistical support, that prescribed fire appeared to benefit *Calochortus longebarbatus* var. *longebarbatus* on Winema NF.

Direct Physical Impacts. Several types of management actions can have adverse direct physical impact on *Calochortus longebarbatus* var. *peckii* plants. Although *Calochortus longebarbatus* var. *peckii* typically occurs in non- or lightly forested areas, Kagan (1996) noted that numerous individuals of this taxon have been destroyed by logging on Ochoco NF. Logging at the edges of meadows and in the vicinity of intermittent streams has the potential to damage local *Calochortus longebarbatus* var.

peckii. Threatening logging-related activities include the movement of heavy equipment, skidding of logs, piling of slash, and the construction of new or temporary roads. Movement of any heavy equipment associated with stream restoration or fire suppression activities, and recreational use of ATVs, also pose a risk to individual plants. Trampling by large grazing mammals (cattle, sheep, deer and elk) poses a significant direct physical threat to *Calochortus longebarbatus* var. *peckii* plants. Kagan (1996) noted that trampling destruction of bulbs (on damp soils) accounted for a significant portion of *Calochortus longebarbatus* var. *peckii* mortality during his three-year study. Trampling of green leaves (June-July) interferes with a plant's ability to capture and store energy, which presumably, reduces its ability to engage in asexual reproduction.

Herbivory. Kagan (1996) found that native mammalian bulb predators (gophers and voles) caused significant mortality of *Calochortus longebarbatus* var. *peckii* on his sampling plots. This was especially true within the small (1 square meter) exclosure cages. Kagan speculated that rodent activity within the exclosures may have been higher due to the protection from predators (hawks, owls, coyotes) that the exclosures provided. Spivey (2005) speculates that *Calochortus longebarbatus* var. *peckii* leaves are probably not a preferred forage for large mammalian grazers, but are simply inadvertently consumed along with adjacent preferred species. Holmes (2006) cites a study in the Umpqua Valley indicating that deer specifically target the flowers and fruits of a local rare *Calochortus* species, and that their browsing on this species was identified as "one of the two reasons for dramatic reductions in the frequency of flower and fruit production over the course of the growing season."

Cattle Grazing. The argument is sometimes heard that rare native plants present today in central Oregon must be in some sort of equilibrium with current grazing practices. The rationale behind this argument is that grazing impacts on native herbaceous plant communities were far more intense in the late 1800s and early 1900s, than at present. Therefore, those taxa that survived this earlier, more intensive, grazing pressure should have few persistence issues under current grazing regimes. This argument may be misleading in its simplification of a very complex matter of disturbance ecology. Implicit in this argument appears to be an over-estimate of ecosystem resiliency. This may be particularly true in riparian areas, which receive a disproportionately large amount of livestock use. It has been noted, for instance, that the effects of management activities from this early period, including grazing, continue to affect channel morphology at present (USDA-USFS/USDI-BLM, 2000). Altered, or degraded channel morphology, in turn, often leads to a sequence of further riparian ecosystem alterations including less water recharge of floodplains, lowered water tables, and reduced geographic extent of riparian communities (USDA-USFS/USDI-BLM, 2000). It is quite possible that these altered riparian ecosystems, even under current, less intensive grazing regimes, are quite susceptible to continuing degradation, as evidenced by reduced complexity of community structure and composition, increased frequency of early successional taxa and presence of invasive, non-native species (USDA-USFS/USDI-BLM, 2000).

There appear to be differences of understanding concerning the response of *Calochortus*

longebartatus to grazing by cattle. Most of these observations are based on informally collected data, not subject to statistical analysis. On Modoc NF, Jokerst (1983) observed higher densities of *Calochortus longebarbatus* var. *longebarbatus* outside of fenced cow pastures, even lightly grazed pastures. Gamon (1990) observed an inverse relationship between grazing pressure and density of *Calochortus longebarbatus* var. *longebarbatus* in Washington. Goldenberg (1995) describes a personal communication with Peggy Fiedler, a professor with substantial field experience with *Calochortus* species, including *Calochortus longebarbatus* var. *longebarbatus*. Fiedler shared the opinion that grazing, at any time during the growing season, is harmful to any *Calochortus* species.

In contrast, based on surveys on Fremont NF during a period (1993-1996) of favorable precipitation, Wooley (1996) determined that, where grazing followed the range management standards included in the Forest Plan, there was no evidence of decline in populations of *Calochortus longebarbatus* var. *longebarbatus*. It was noted that all of the surveyed sites had a history of light to heavy grazing. At least three statistically-based studies of grazing effects on *Calochortus longebarbatus* have been undertaken. Following a five-year monitoring study on Winema NF, no significant difference was observed between control and grazed plots, although it was noted that "changes in plant numbers are idiosyncratic and inexplicable, with wide variability among sites" (Goldenberg, 1997). Likewise, a three-year study of grazing and burning effects on Ochoco NF found no significant differences between any combination of treatments, including grazing versus ungrazed, although it was noted that this was due in part to 1) uneven fire effects, 2) uneven intensity and timing of grazing, and 3) a short study period that prevented application of multiple year burns (Kagan, 1996). An effort to perform a statistically-based study of grazing response in *Calochortus longebarbatus* var. *longebarbatus* in northern California failed due to an inability to induce seed germination under laboratory/greenhouse conditions (Denton, 2005).

The response of *Calochortus longebarbatus* to grazing by cattle is complex and remains poorly understood. The numerous possible influences of grazing in the biology of this taxon is reflected in the inclusion of grazing in the discussions of each of five threats presented above. Virtually all known populations of *Calochortus longebarbatus* var. *peckii* on federal land occur within grazing allotments and are subject to grazing by cattle. In reviewing various studies and field observations of botanists/ecologists who have worked with this species, it is apparent that cattle grazing can have both beneficial and detrimental effects on *Calochortus longebarbatus*. The proportional amount and degree of benefit or harm probably relates to the three elements of "improper livestock grazing" presented in Chaney et al. (1990): season, intensity, and duration. Available evidence suggests that with appropriate oversight, grazing herbivory can benefit *Calochortus longebarbatus* by limiting competition by other herbaceous species, and providing disturbance, by trampling, to the surfaces of the existing site or adjacent areas, providing opportunities for establishment by *Calochortus longebarbatus* bulblets.

The risk of grazing-induced harm to *Calochortus longebarbatus* seems strongly related to season. Grazing a *Calochortus longebarbatus* site during a period when the soil is damp and soft (spring) is likely to cause harm (damage to bulbs and leaves; soil compaction

and susceptibility to erosion) that will outweigh possible benefits. As soil at a *Calochortus longebarbatus* site dries and becomes more firm, it is more resistant to compaction, bulbs are increasingly protected from trampling, and leaves are well along in their annual process of manufacturing and storing photosynthate. Toward the end of the growing season (as early as June in a low precipitation year, or late July or August in an abundant precipitation year) *Calochortus longebarbatus* is minimally susceptible to grazing-related damage (Kagan, 1996). At this time, the soil is dry, firm, and little susceptible to compaction; bulbs are not in danger of direct or indirect physical harm; plants have essentially completed their photosynthesis and reproduction for the year. A central question in management decisions specific to *Calochortus longebarbatus* var. *peckii* appears to be not so much whether grazing should be permitted, but rather, when and in what numbers and for what duration. Assuming the implementation of biologically sound range management practices designed to maintain or improve native plant communities, it would not be expected, based on most observations, that livestock grazing would contribute to population declines of this taxon. There appears, however, to be insufficient information to confidently identify the earliest date, each year, on which cattle should be released into pastures including *Calochortus longebarbatus*. Optimal timing, presumably, would allow grazing-related *Calochorus* benefits to exceed, or at least match, grazing-related *Calochortus* harm. It is apparent that this release date should vary from year to year, as it should relate to soil moisture level and phenology of *Calochortus longebarbatus* var. *peckii*, which in turn, will likely relate to the timing and amounts of winter and spring precipitation.

Single Species Management. It has been observed (Lesko, 2005) that efforts to conserve a single taxon, may have unintended, negative consequences for other species. For instance, late entry measures to protect *Calochortus longebarbatus* var. *peckii* plants and their habitat, may result in cattle moving straight to the creeks where intense utilization may occur. Consequent adverse impacts to riparian soils and vegetation can, in turn, adversely impact in-stream organisms, including redband trout. This observation simply points to the general importance of a multi-disciplinary approach to resource management.

Conservation Objective

The reference distribution of *Calochortus longebarbatus* var. *peckii*, for the purposes of this document, is its current, entire known range.

This taxon is of concern because it is a relatively narrowly distributed regional endemic that occurs largely on federal lands subject to extensive human-induced disturbance. Additionally, population trends in this taxon are very difficult to assess. Federal management for this species follows USFS Region 6 Sensitive Species and OR/WA BLM Special Status Species policies.

The taxon conservation objective for *Calochortus longebarbatus* var. *peckii* is the indefinite maintenance of this taxon, in at least its current population sizes, within each of the subwatersheds (6th field hydrologic units) it currently occupies, across its current range on federally managed lands in central Oregon.

Selection of Management Areas

Management Area is a concept described at some length in the R6 ISSSSP guide to Draft Conservation Strategy Format (2006). This is posted online at http://www.fs.fed.us/r6/sfpnw/issssp. As noted in this document, "specific sites or populations may require management in order to meet the conservation objective. Management Areas are those locations on the landscape where species management is determined to be necessary to meet the (conservation) objective. These Areas may be of varying sizes and degrees of active management associated with them, depending on the local need for the species." Management Areas are conceptually and functionally no different than the activity-specific protection zones that are applied to populations of sensitive/special status species during project-related NEPA.

Until the acquisition of additional critical information allows an identification of biological, economic, or other criteria which will allow categorization of populations according to their perceived significance, management of all currently known populations (and populations yet to be discovered) will follow Management Area Requirements as outlined below.

Management Area Requirements

Central to this conservation strategy is the understanding that land management that is compliant with existing direction, including all applicable aquatic and terrestrial management standards and guidelines, and monitoring schedules for sites occupied by *Calochortus longebarbatus* var. *peckii* will, at the very least, pose no threat to the persistence of this species. However, supplemental to this general management direction, and within each identified Management Area, the following apply:

1) In all projects including or adjacent to populations of *Calochortus longebarbatus* var. *peckii*, take measures to reduce risk of introduction or spread of non-native invasive plants. This is best accomplished by implementing direction in the local weed EIS, which will include preventative measures such as use of weed-free off-road equipment, consulting current weed maps to avoid or minimize entry to weed sites, and treatment of weed sites within or immediately adjacent to project areas prior to initiation of project. Project sites will be monitored for weeds, and treated as needed.

2) See Appendix, Table 6, for monitoring requirements specific to USFS and BLM grazing allotments.

3) Salt licks/mineral blocks will not be placed within 100 meters of a *Calochortus longebarbatus* var. *peckii* site, nor placed in a location that will encourage travel through a *Calochortus longebarbatus* var. *peckii* site en route to a salting location.

4) Avoid constructing new range improvements, including fences and water developments, where they would concentrate livestock in, or encourage trailing through, *Calochortus longebarbatus* var. *peckii* populations.

5) Tree-cutting operations, including commercial logging and pre-commercial thinning near occurrences of *Calochortus longebarbatus* var. *peckii* will observe the following measures: no machinery use within 50 feet of the population boundaries; no new roads within 100 feet of population boundaries. These measures will preclude any skidding, yarding, decking or slash piling on known populations and are intended to protect individual plants and to prevent soil compaction and displacement that would degrade existing or potential habitat for *Calochortus longebarbatus* var. *peckii*. Pre-commercial thinning operations should be designed to avoid heavy slash concentrations that can bury plants. Thinning in stages (e.g., at 3-5 year intervals) may be necessary in some areas. Tree-cutting or other vegetation management operations involving ground-based equipment are permitted when conducted over frozen ground or snow. This is with the understanding that, in winter, the living portion of *Calochortus longebarbatus* var. *peckii* plants have retreated underground, and the frozen ground or snow is expected to protect the soil from the impacts associated with mechanical entry. Vegetation management actions needed to improve habitat for *Calochortus longebarbatus* var. *peckii* are encouraged. Actions could include hand-thinning to reduce conifer encroachment or fall burning to reduce herbaceous thatch.

6) Assure that planning for initial wildfire suppression efforts includes reference to maps showing locations of occurrences of *Calochortus longebarbatus* var. *peckii*. This information should help minimize disturbance to occupied sites by use of heavy machinery or through placement of safety zones, staging areas or camps.

7) To address management of the entire species' population across all three Administrative units, implement a monitoring plan that will allow an assessment of trend among *Calochortus longebarbatus* var. *peckii* populations (see below section for specifics).

Inventory, Research, and Monitoring

Inventory

Relatively few new *Calochortus longebarbatus* var. *peckii* sites have been located since extensive surveys were conducted in the early 1990s. For Ochoco NF and BLM land associated with Big Summit Prairie (included within Ochoco NF), most suitable habitat of *Calochortus longebarbatus* var. *peckii* has been surveyed, and most occurrences are assumed to be known (Kagan, 1996; Lesko, 2005; Mafera, 2005). Extensive surveys have not been conducted on BLM lands immediately south and west of the main body of Ochoco NF, or on BLM lands bordering the Maury Mountains (Halvorson, 2005). BLM ownership in this area is highly fragmented and collectively totals roughly 50 square miles. On northern Burns BLM District, especially in areas adjacent to Emigrant Creek Ranger District of Malheur National Forest, surveys following efforts to map suitable habitat would be very appropriate.

Research Questions

Monitoring. At least two basic and related questions bearing on grazing management

need resolution: 1) When, in what numbers, and for what duration will grazing be permitted in or near sites of *Calochortus longebarbatus* var. *peckii*; and 2) How do grazing effects on *Calochortus longebarbatus* var. *peckii* vary depending on a) phenology of the lily and b) soil moisture conditions.

Recruitment. As a sterile triploid, reproductive efforts in *Calochortus longebarbatus* var. *peckii* individuals are apparently solely asexual. Bulblets, which are produced in the axil of the primary basal leaf, appear to be the principal means of asexual reproduction, but little is known about the conditions that favor the production of these propagules, or their rate and schedule of production. Likewise, little is known about their dispersal vectors, or especially, the conditions that favor bulblet establishment, or rate at which successful establishment occurs. This information would be very helpful in developing a better understanding of the taxon's response (positive, negative or neutral) to various disturbance factors (e.g., trampling by livestock and native ungulates, herbivory, fire) that impact its habitat. This information should also provide some predictive insights regarding the relationship between habitat conditions and population trend. This information is of special interest given Fiedler's (in Goldenberg, 1995) understanding that most *Calochortus* species are long-lived, and Kagan's (1996) observation that individuals of *Calochortus longebarbatus* var. *peckii* may have a mortality rate of 25% per year.

Mortality. A better understanding of rates and circumstances of mortality is important. To what extent do trampling and herbivory account for loss of individual plants? Are rates of bulb-loss to small mammalian herbivores as high as Kagan's (1996) limited observations suggest? What circumstances promote high levels of bulb herbivory? Are populations of *Calochortus longebarbatus* var. *peckii* limited or in decline due to bulb predation?

Population size trend. Although a methodology for detecting trends in population size is suggested below, intensive, statistically-based sampling to assess trend in populations size is not economically practical to undertake. Nevertheless, such sampling, although challenging to design, test, and implement for this taxon, could play an important role in efforts to conserve *Calochortus longebarbatus* var. *pecki* (see below). Potentially, sampling could be designed to simultaneously address questions concerning population size trend, recruitment, mortality and important habitat requirements.

Genetic variation. A better understanding of the extent and geographic pattern of genetic variation in *Calochortus longebarbatus* var. *pecki* would allow more enlightened monitoring design and management of this taxon. For instance, if genetic variation exists, is it distributed among, rather than within individual drainages? Do unusual genetic combinations exist at the periphery of the range? Are individuals across the range of the taxon essentially monoclonal?

<u>Monitoring Requirements</u>

As noted elsewhere in this document, estimating population size and, in turn, monitoring population trend in *Calochortus longebarbatus* var. *peckii*, is very challenging. During the growing season, if not in flower, individual plants are visible only as one or two

nearly basal, linear leaves, which generally are very difficult to detect in a graminoid-forb dominated plant community. In a dry year, even this small bit of vegetative presence will wither rather quickly. For most types of surveys, counting individuals is practical only if they are in flower. However, it is apparent that in most years, and dependent on timing and amount of precipitation, only a very small percentage of the individuals within a *Calochortus longebarbatus* var. *peckii* population will flower. Further, individuals within a population of this taxon have very asynchronous flowering periods. A single visit to a flowering population of *Calochortus longebarbatus* var. *peckii* will likely allow only a very incomplete accounting of the full number of plants within that population that will flower that year.

In spite of the challenges noted above, population trend monitoring is essential to an ongoing assessment of achievement of the taxon conservation objective. Three basic methodologies for monitoring *Calochortus longebarbatus* var. *peckii* have been considered: statistically-based sampling, habitat condition monitoring, and non-statistically-based sampling. *Non-statistically-based sampling is recommended for immediate use in implementing this Conservation Strategy*.

Review of the three monitoring methodologies listed above suggests that there is probably no monitoring system that is without significant limitations when applied to *Calochortus longebarbatus* var. *peckii*. Given the strengths and shortcomings of the each of these three basic monitoring approaches, it can be argued that non-statistically-based monitoring is the most responsible choice for *Calochortus longebarbatus* var. *peckii*. Overriding concerns regarding statistically-based sampling are 1) attempts at statistical analysis of numbers trends in *Calochortus longebarbatus* have, to date, been frustrated by the large annual fluctuations in flower production within its populations and 2) budget/staffing limitations currently place severe limits on ability of local federal botanists to engage in an intensive sampling program. Likewise, the uncertain connection between the assessed condition of habitat where *Calochortus longebarbatus* var. *peckii* occurs, and the ability of that habitat to provide the specific ecological requirements of this taxon, is also a significant concern. On the other hand, the limitations of non-statistically-based monitoring, relating to authority and thresholds, can perhaps be somewhat accommodated by monitoring design. A more extended discussion of the strengths and shortcomings of these three basic monitoring systems is provided in Table 5 of the Appendix.

Non-statistically-based monitoring design.

Selection of monitoring areas.

The low-intensity nature of this monitoring system allows an emphasis on numbers of populations included in the monitoring program. Agency field units (districts for USFS) will determine the number of days, annually, that can be dedicated to *Calochortus longebarbatus* var. *peckii* monitoring. In using non-statistically-based methods to monitor this taxon , Kagan (2005) recommends three site visits during the flowering period, per population, each year (due to the asynchrony of flowering). Given that agency botanists may be able to fund no more than two visits per population, it is recommended that field units commit to a minimum of four days of *Calochortus*

longebarbatus var. *peckii* monitoring (two days for visit #1, and two days for visit #2) annually. Following the initial establishment of sampling areas within selected populations, it is reasonable to anticipate an ability to monitor *Calochortus longebarbatus* var. *peckii* at a rate of 3-4 populations per day. In selecting populations, an effort should be made to represent population diversity within the field unit, including habitat association (creek terrace vs. meadow), grazing intensity/habitat condition, population size, geographic location, or location relative to next-nearest populations (edge/outlier populations). Other bases for population selection might include existing evidence of decline in a particular population, or an ability to integrate presence/absence monitoring with condition monitoring that is underway or planned. It is anticipated that initial selection of monitoring areas can be accomplished in the office, with adjustments, as necessary, made in the field.

Monitoring and precipitation.

Kagan (1996) proposes the following annual precipitation categories within the range of *Calochortus longebarbatus* var. *peckii* (with snow expressed in equivalent inches of rain): Wet = at least 16 inches of rain between October and June, with at least 4 inches falling between April to June; Dry = less than 10 inches between October and June; Normal = neither Wet nor Dry. For the purposes of this monitoring plan, the precipitation period of concern will be October 1 - June 30. Kagan (1996) recommends that monitoring not be conducted during dry years, and when possible, during wet years rather than normal years. In the context of this recommendation, it is notable that, within the range of *Calochortus longebarbatus* var. *peckii*, the incidence of wet and normal precipitation years may be in a period of protracted decline (See Appendix, Table 4).

Monitoring procedures.

In the first year of monitoring, shortly after the initiation of flowering in *Calochortus longebarbatus* var. *peckii*, populations selected in the office will be field-checked to determine if they satisfy the criteria for their initial selection. Identify a more suitable population in the same locality of a rejected population, if necessary. Use GIS-generated maps to assist in locating these populations in the field.

If a selected population is small, it may be possible to count the number of flowering individuals for the entire population. For larger populations, establishment of one or more permanent count areas (macroplots) is recommended. The number and design of count areas will be site specific and determined during the initial site visit. The count area may be described by pre-existing features such as roads, culverts, fences, distinctive trees or rock outcrops, or by placement of hardware such as steel fence posts or rebar. Where the count area is installed with hardware, it is recommended that the areas be narrow, perhaps two meter-wide rectangular "belts" that are centered along a linear transect. The beginning and end points of each transect would be permanently marked. Counting would occur as the transect is walked while holding a two meter-long rod which is held perpendicular to, and centered over, the transect. In populations more or less dispersed about a central point (such as meadow populations), it is recommended that transects be established along one or more radians from the population center to an outer

edge. In populations with a linear distribution, such as those along drainages, two options may be considered. In very narrow populations, transects might proceed along the center of the drainage. The two-meter rod could then be used to count flowering plants within a two meter-wide belt on one or both sides of the drainage. For linear populations with greater width, it is suggested that one or more transects be laid out perpendicular to the main axis of the population, with each transect extending to the outer edge of target plants on either side of the population.

Flowering plant numbers tallied within the one or more count areas within a population or subpopulation will become representative of the size of that population or subpopulation. During the initial establishment of count areas, detailed, accurate notes, including drawings and GPS coordinates as appropriate, describing the locations of pre-existing count area boundaries, or transects and their associated two-meter belts, will be critical to all subsequent monitoring efforts at these sites.

Notes concerning site conditions will also be recorded at each sampling site. Does local hydrology appear to be influenced by roads or culverts? Are previous forest management activities (e.g., burning, thinning, harvest) evident at or near the sampling site? Were management guidelines for *Calochortus longebarbatus* var. *peckii* implemented? Is encroachment by native (e.g., lodgepole pine) or non-native invasive species evident? What level of grazing intensity is apparent? Are ongoing activities at the site compliant with the management guidelines for *Calochortus longebarbatus* var. *peckii*? Instances of non-compliance with the management guidelines will be discussed with the appropriate resource personnel and remedial action(s) taken. Effectiveness of any remedial actions will be noted on subsequent monitoring visits to this site.

Database.

A simple interagency spreadsheet will be developed to record raw monitoring data for all monitored *Calochortus longebarbatus* var. *peckii* populations. This is to insure timely, annual, collection of monitoring data, and to insure convenient availability of range-wide monitoring data to any interested agency staff. Other relevant element occurrence field observations will be entered in the appropriate agency data system (GeoBOB for BLM; NRIS TESP for USFS).

Schedule of monitoring.

As noted above, two annual monitoring visits are recommended for each *Calochortus longebarbatus* var. *peckii* population selected for non-statistically-based monitoring. This is not so much an effort to estimate the total number of plants to flower over the course of the growing season, as it is an attempt to record the largest number of plants to flower in a single day, during the course of the growing season. Although certainly an inaccurate underestimate, the largest number obtained from these two visits will be the measure of a population's size that year. Kagan's (1996) observations suggest that a period of three weeks between first and second sampling visits will provide a good opportunity to visit a given population at or near a period of peak flowering. The options of monitoring each year, or only during wet or normal years, are available. It is recommended that monitoring be conducted annually for the first five years following

initiation of monitoring. This will provide an opportunity to gather range-wide data that can test/affirm the current understanding of precipitation behavior and flowering response. It is also recommended that baseline numbers for count areas be derived from counts made during the first three wet or normal precipitation years following the initiation of monitoring. The schedule of monitoring will be revisited by agency botanists/ecologists at the end of the fifth year.

Additionally, in an effort to maintain a direct awareness of status of *Calochortus longebarbatus* var. *peckii* on federal lands, each field unit will develop a schedule for visiting *Calochortus longebarbatus* var. *peckii* populations documented in GIS. Selected subpopulations (i.e., occurrences represented by selected GIS polygons) within occupied subwatersheds (6th field hydrologic units) will be visited at least once every five years. Estimated number of flowering plants, site conditions and presence of noxious weeds will be noted and recorded in a spreadsheet dedicated to these regular, but infrequent, visits.

Adaptive Management

Pilot period

Following the first year of monitoring, responsible staff on each field unit will share assessments of the experience. Possible modifications to the monitoring process will be discussed, and upon group consent, adopted. As warranted by degree of alteration, amending a revised monitoring design, to the existing conservation strategy, may be appropriate.

Thresholds

For purposes of this monitoring plan, a population decline will be indicated by a sustained drop in associated count area plant numbers, relative to baseline, of 50% or greater. "Sustained" here means persisting over three consecutive wet or normal precipitation years following the establishment of baseline numbers (see Precipitation and Monitoring section above for definitions of "wet" and "normal"). If decline in a population is indicated, potential causes will be examined. How do conditions at this site compare to those at sites of populations not showing decline? Confirm that *Calochortus longebarbatus* var. *peckii* management guidelines presented in this document are being implemented. Does litter accumulation indicate a need for prescribed burning? If there is evidence of excessive grazing intensity, solicit an interdisciplinary effort to determine pasture and/or hydrologic condition (functional/functioning at risk/non-functional). As assessed condition warrants, alter grazing practices to initiate resource recovery. Just as it may take years of monitoring to develop a sense of population trend, it may take years to detect population response to any corrective actions taken. In any instances where causes of population decline cannot be inferred or corrective actions cannot be reasonably prescribed, or are implemented without apparent effect, research to determine causation should be pursued.

Strategy lifetime

It is anticipated that this conservation strategy will remain in effect indefinitely, or, at least until such time as responsible inter-forest and inter-agency staff agree that

populations of *Calochortus longebarbatus* var. *peckii* across their distribution on federal lands in central Oregon are stable, secure, and will not continue to benefit from species-specific management guidelines. During the life of this conservation strategy, responsible inter-forest and inter-agency staff will need to establish a regular schedule at which to share perceptions concerning the effectiveness of the strategy and to jointly consider any proposed modifications/amendments deemed necessary to enhance the conservation effectiveness of this strategy.

References

Chaney, E., W. Elmore & W. Platts. 1990. Livestock grazing on western riparian areas. Denver, Colorado: U.S. Environmental Protection Agency, Region 8. 45 p.

Denton, R. 2005. Telephone visit on 10-17-2005. Denton is a research scientist with the USFS Pacific Southwest Research Station in Fresno, CA.

Elzinga, C., D. Salzer & J. Willoughby. 1998. Measuring and Monitoring Plant Populations. BLM Technical Reference 1730-1. The authors represent a private ecological consulting firm, the Nature Conservancy of Oregon, and the California Bureau of Land Management.

Ferrari, V., R. Zebell & P. Fiedler. 1996. Final Report Molecular Genetics of *Calochortus longebarbatus* S. Watson. Research performed out of San Francisco State University. Submitted to Lisa Croft, Forest Botanist, Ochoco National Forest.

Gamon, J. 1990. Report on the status in Washington of *Calochortus longebarbatus* var. *longebarbatus*. Washington Natural Heritage Program. Olympia, WA.

Goldenberg, D. 1995. Interim Conservation Strategy for *Calochortus longebarbatus* var. *longebarbatus* on the Winema National Forest. Goldenberg was the District Botanist on Chiloquin Ranger District, Winema National Forest.

Goldenberg, D. 1997. 1997 Monitoring Results, *Calochortus longebarbatus* var. *longebarbatus*. Goldenberg was the District Botanist on the Chiloquin Ranger District, Winema National Forest.

Grime, J. 1979. Plant strategies and vegetation processes. John Wiley and Sons.

Hall, F. 1998. Pacific Northwest Ecoclass Codes for Seral and Potential Natural Communities. USDA-USFS, Pacific Northwest Research Station, Portland, Oregon. General Technical Report PNW-GTR-418.

Halvorson, R. 2005. Written responses to a question set, September, 2005. Halvorson is the District Botanist for the Prineville District BLM.

Helliwell, R. 1993. Note, via Data General, to fellow botanists on Ochoco National Forest. Helliwell was the District Botanist on Big Summit Ranger District, Ochoco National Forest.

Hitchcock, L., A. Cronquist. 1973. Flora of the Pacific Northwest. University of Washington Press, Seattle. 730 pp.

Hitchcock, L., A. Cronquist, M. Ownbey & J. Thompson. 1969. Vascular Plants of the Pacific Northwest. Part 1: Vascular Cryptogams, Gymnosperms, and Monocotyledons.

University of Washington Press, Seattle.

Holmes, R. 2005. Written comments received on 12/7/2005. Holmes was formerly the District Botanist on the Roseburg BLM District and is currently the Regional Botanist for Region 6, USFS.

Holmes, R. 2006. Telephone visit on 5/18/2006.

Johnson, Jr., C. and R. Clausnitzer. 1992. Plant Associations of the Blue and Ochoco Mountains. USDA-USFS, Region 6, R6-ERW-TP-036-92.

Jokerst, J. 1983. The ecology and geography of *Calochortus longebarbatus* var. *longebarbatus* Watson with an updated view of its population status in California. Unpublished report for the Shasta-Trinity National Forest.

Kagan, J. 1996. Final Draft Species Management Guide for *Calochortus longebarbatus* Wats. var. *peckii* Ownbey. Oregon Natural Heritage Program. Financial support provided by Ochoco National Forest.

Kagan, J. 2005. Telephone visit on 10/24/2005. Kagan is Director of the Oregon Natural Heritage Information Center within the Institute for Natural Resources at Oregon State University.

Kaye, T. 1991. Draft Species Management Guide for *Calochortus longebarbatus* var. *longebarbatus*. Conservation Biology Program, Natural Resources Division, Oregon Department of Agriculture. Prepared for Fremont National Forest in consultation with S. Popovich and B. Rittenhouse, District Botanists on Fremont National Forest.

Lesko, M. 2005. Written responses to a question set, September, 2005. Lesko is the District Botanist on the Lookout Mountain Ranger District, Ochoco-Deschutes National Forest.

Linn, Doug. 2009. E-mail on 2/23/2009. Linn is a botanist on the Burns BLM District.

Mafera, D. 2005. Written Responses to a question set, September, 2005. Mafera is the District Botanist on the Paulina Ranger District, Ochoco-Deschutes National Forest.

Ness, B., D. Soltis and P. Soltis. 1990. An Examination of Polypoidy and Putative Introgression in Calochortus Subsection Nudi (Liliaceae). American Journal of Botany, Vol. 77, No. 12, pp. 1519-1531.

Oregon Climate Service @ http://www.ocs.oregonstate.edu/index.html.

Spivey, T. 2005. Telephone visit on 10/18/2005. Spivey is the Botany Program Manager for Bly and Lakeview Ranger Districts, Fremont-Winema National Forsest.

Wooley, R. 1996. *Calochortus longebarbatus* Protected Population Amendments. A memorandum to the Forest Supervisor, Fremont National Forest, September 20, 1996, recommending amendment to the Conservation Strategy for *Calochortus longebarbatus* var. *longebarbatus*. Wooley was the Forest Botanist/Ecologist for Fremont National Forest.

Wooley, R. 2001. Fremont National Forest Sensitive Plant Monitoring Report for 2001. Available on internet at <http://www.fs.fed.us/r6/fremont/botany/plantmonitor.html>. Wooley was the Forest Botanist/Ecologist.

Wooley, R. 2005. Telephone visit on 10/4/2005. Wooley is the Forest Botanist on Beaverhead-Deerlodge National Forest.

USDI-BLM. 1986. Two Rivers Resource Management Plan. Prineville, Oregon.

USDI-BLM. 1989. Brothers/LaPine Resource Management Plan. Prineville, Oregon.

USDA-USFS/USDI-BLM. 2000. Interior Columbia Basin Ecosystem Management Project. Interior Columbia Basin Supplemental Draft Environmental Impact Statement, Vol. 1.

USDA-USFS. 1989. Land and Resource Management Plan. Ochoco National Forest. Prineville, Oregon.

USDA-USFS. 1990. Land and Resource Management Plan. Malheur National Forest. John Day, Oregon

USDA-USFS. 2005. Westside Allotments Environmental Assessment. Prineville, Oregon.

USDA-USFS. 2006. Joint aquatic and terrestrial programmatic biological assessment for Federal lands within the Deschutes and John Day River Basins Administered by the Deschutes and Ochoco National Forests. Bend, Oregon.

USDA-USFS. 2006. Maury Grazing Allotments Final Environmental Impact Statement. Prineville, Oregon.

APPENDIX

Table 1. Subwatersheds which include *Calochortus longebarbatus* var. *peckii*.

Subbasin	**Watershed**	**Subwatershed**	**Agency**
Northern Distribution			
Lower Crooked	McKay Creek	Upper Mckay Creek	FS
	Upper Ochoco Creek	Duncan Creek	FS
		Headwaters Ochoco Creek	FS
		Upper Marks Creek	FS
South Fork Crooked	Lower Beaver Creek	North Wolf Creek	BLM
	Paulina Creek	Dry Paulina Creek	BLM
		Upper Paulina Creek	BLM
	Upper Beaver Creek	Beaverdam Creek	BLM
Upper Crooked	Deep Creek	Jackson Creek	FS
		Little Summit Prairie Creek	FS
		Lower Deep Creek	FS
	Lower North Fork Crooked River	Lower North Fork Canyon	BLM
		Upper North Fork Canyon	FS
	Upper Crooked River	Lost Creek	BLM
		Upper Horse Heaven Creek	FS
	Upper North Fork Crooked River	Elliot Creek	BLM/FS
		Gray Creek	FS
		Headwaters North Fork Crooked River	BLM/FS
		Howard Creek	BLM/FS
		Johnson Creek	BLM/FS
		Lower Big Summit Prairie	BLM/FS
		Peterson Creek	BLM/FS
Upper John Day	Mountain Creek	Upper Mountain Creek	FS
Southern Distribution (Maury Mountains)			
Upper Crooked	Bear Creek	Headwaters Bear Creek	BLM/FS
	Upper Crooked River	Drake Creek	FS
		Pine Creek	FS
Southeastern Distribution			
Silver	Claw Creek	Upper Claw Creek	FS
	Headwaters Silver Creek	Cooper-Silver	FS
		Dodson Creek	FS
		Howard Creek	FS
		Nicholl Creek	FS
		Sawmill Creek	FS
	Emigrant Creek	Bear Canyon Creek	FS
		Crowsfoot Creek	FS
		Sawtooth Creek	FS
		Whiskey Creek	FS
Upper John Day	Lower South Fork John Day	Utley Creek	FS

Table 2. Sites of *Calochortus longebarbatus* var. *peckii* on federal land within the extent of the taxon's range. Information obtained from agency GIS records (Ochoco NF, 2009; Malheur NF and Prineville BLM, 2006). Each TES# or Site_ID# represents a "population" or "site" as these terms are used within the text of this document.

Ochoco National Forest									
TES#	**Acres**	**TES#**	**Acres**	**TES#**	**Acres**	**TES#**	**Acres**	**TES#**	**Acres**
100006	17.6	100057	69.6	100114	2.9	100220	0.3	200057	7.6
100008	1.6	100058	44.5	100115	1.1	100221	8.6	200058	1.0
100009	25.9	100059	17.0	100116	14.5	100222	0.6	200059	4.6
100010	31.1	100060	7.1	100120	1.2	100223	0.3	200060	0.8
100011	0.6	100061	6.4	100121	7.7	100224	0.9	200061	1.3
100012	7.7	100062	12.6	100122	2.0	100225	0.2	200062	0.9
100013	93.5	100063	3.9	100123	3.4	100226	0.2	200063	11.0
100014	11.8	100064	3.5	100124	33.6	100227	0.4	200064	1.8
100016	1.0	100065	40.6	100125	5.0	100228	0.6	200065	2.5
100017	24.1	100066	6.0	100126	4.6	100230	19.9	200066	2.0
100019	94.8	100067	4.2	100127	1.1	100231	0.9	200067	31.8
100020	46.6	100073	1.3	100128	2.8	200005	2.1	200068	2.3
100021	13.3	100074	4.1	100129	19.6	200006	32.5	200069	38.5
100022	3.1	100075	20.0	100130	105.7	200018	147.1	200070	3.8
100023	12.4	100077	5.3	100131	0.4	200019	111.2	200071	17.5
100024	0.4	100078	12.5	100138	1.4	200022	209.1	200100	10.8
100025	6.7	100079	12.3	100139	11.6	200023	109.0	200101	8.2
100026	19.4	100080	2.9	100141	1.5	200024	45.2	200102	52.1
100027	24.2	100081	6.0	100144	13.8	200025	0.9	200103	2.0
100028	26.9	100082	0.5	100145	3.9	200026	79.0	200105	33.8
100029	3.8	100083	14.7	100146	6.5	200039	0.6	200106	51.7
100030	2.6	100084	24.2	100147	2.5	200040	146.4	200107	18.6
100031	20.6	100085	29.8	100149	0.8	200041	0.9	200108	4.9
100032	10.0	100088	0.5	100150	0.8	200043	39.7	200109	11.2
100033	4.2	100090	1.6	100158	3.9	200044	154.1	200126	5.4
100034	1.5	100091	0.7	100161	0.9	200046	7.1	200148	1.7
100035	2.3	100092	0.8	100162	0.9	200047	50.2	**Sum**	**2963.5**
100036	0.5	100098	0.3	100205	8.7	200048	5.1	**Count**	**166**
100037	8.7	100104	0.4	100206	1.4	200050	3.5	**Mean**	**17.9**
100038	10.5	100105	1.7	100207	1.8	200051	0.2		
100041	9.5	100106	20.2	100208	4.3	200052	63.6		
100042	35.3	100107	54.5	100209	2.2	200053	5.0		
100049	10.9	100108	10.2	100216	0.2	200054	2.8		
100053	2.4	100109	75.7	100217	3.5	200055	1.1		
100054	1.8	100113	3.2	100218	2.2	200056	1.9		

Table 2 (cont.).

Malheur NF			**Prineville BLM**	
TES#	**Acres**		**SiteID #**	**Acres**
20101	0.2		80	6.3
20102	15.9		83	21.7
20104	18.6		85	2.7
20105	0.6		86	0.8
20106	39.5		87	12.8
20107	6.1		88	13.8
20202	0.1		89	0.5
20203	0.1		90	0.4
40005	5.2		91	1.8
40034	4.1		92	0.3
40035	3.9		93	20.7
40036	15.4		95	29.5
40038	14.9		96	1.4
40039	16.1		97	0.7
40041	52.4		98	0.5
40042	8.7		407	30.8
40043	7.3		413	3.4
40044	9.1		450	0
40045	4		451	2
40046	3.3		**Sum**	150.1
40047	36		**Count**	19
40051	2.6		**Mean**	7.9
40052	1.2			
40053	1.4			
40054	2.1			
40055	4.7			
40056	2.3			
40057	3			
40058	3.7			
99999	7.9			
Sum	290.4			
Count	30			
Mean	9.7			

Table 3. Potential Natural Communities (PNC) associated with occurrences of *Calochortus longebarbatus* var. *peckii* on federal lands within the extent of the taxon's range

PNC_Label	Sum_acres	PNC_Name
CWG113	391.4	ABGR/CARU-BLUE: Grand fir/pinegrass-Blue Mountains
CPG221	264.9	PIPO/CARU: ponderosa/pinegrass
SD9111	177	ARRI/POSA3-SCAB: rigid sage/bluegrass scabland
CPG112	126.6	PIPO/FEID-BLUE: ponderosa/Idaho fescue-Blue Mountains
CDG112	120.2	PSME/CARU-BLUE: douglas-fir/pinegrass-Blue Mountains
CPG222	108.7	PIPO/CAGE: ponderosa/elk sedge
MW	100.7	Wet meadow (surface moist or wet all growing season)
MM	91.2	Moist meadow (water table available all growing season)
MD	88.3	Dry meadow (water table available part of the growing season)
SD9221	78.9	ARAR/POSA3: low sage/bluegrass scabland
CWG111	66.7	ABGR/CAGE-BLUE: grand fir/elk sedge-Blue Mountains
CDG111	61.3	PSME/CAGE-BLUE:douglas fir/elk sedge-Blue Mountains
SD1911	47.1	ARAR/FEID-AGSP: low sage/Idaho fescue-wheatgrass
SW20	42	Alder wetlands
CLS416	29.1	PICO/CARU: lodgepole/pinegrass, climax
CPS222	26.9	PIPO/PUTR/CAGE: ponderosa/bitterbrush/elk sedge
RIP	23.4	Riparian
CPS131	19.8	PIPO/ARTRV/FEID-AGSP: ponderosa/big sage/Idaho fescue-wheatgrass
CPS1	18.5	PIPO/ARAR: ponderosa/low sage
CPS226	17.6	PIPO/PUTR/FEID-AGSP: ponderosa/bitterbrush/fescue-wheatgrass
HQ	14.7	Quaking aspen
CWS811	14.7	ABGR/VASC:grand fir/grouse huckleberry
CWG112	14	ABGR/CARU-ASH: grand fir/pinegrass-ash soil
GB9111	11.7	POSA-DAUN:bluegrass-onespike oatgrass
CDS624	11	PSME/SYAL-BLUE: douglas fir/common snowberry-Blue Mountains
SW	10.9	Shrub wetlands, shrubs less than 16 feet tall
SD2311	9	ARTR/POCU: big sage/Cusick bluegrass
CWG211	7.2	ABGR/BRVU: grand fir/woodland brome
CJS226	5.4	JUOC/ARTR/AGSP-FEID-FLAT: juniper/sage/bunchgrass, flat
CPS221	4.7	PIPO/PUTR/CARO: ponderosa/bitterbrush/ross sedge
CPG111	3.8	PIPO/AGSP-BLUE: ponderosa/wheatgrass-Blue Mountains
CW	3.8	White fir, grand fir
SD2911	3.7	ARTRV/FEID-AGSP: big sage/Idaho fescue-wheatgrass
CJS42	3.2	JUOC/CELE: juniper/mountain mahogany
CPF0	3.1	Ponderosa, Jeffrey pine with forb ground vegetation, resource inventory
CJS1	3	Juniper/low sagebrush, resource inventory

SS4911	3	ARTRV/CAGE: alpine sage/elk sedge
CP	2.6	Ponderosa
CPS524	2.3	PIPO/SYAL: ponderosa/common snowberry
CWS331	2.3	ABGR/SYMPH: grand fir/snowberry
GB59	1.9	Fescue-wheatgrass grasslands
SW10	1.1	Willow wetlands
CJG111	0.9	JUOC/FEID-AGSP: juniper/Idaho fescue-wheatgrass
CJS2	0.7	Juniper/big sagebrush, resource inventory
CJS321	0.7	JUOC/PUTR/FEID-AGSP: juniper/bitterbrush/fescue-wheatgrass
CWF312	0.7	ABGR/LIBO2-BLUE: grand fir/twinflower-Blue Mountains
SD4111	0.6	CELE/FEID-AGSP: mountain mahogany/fescue-wheatgrass
CD	0.5	Douglas fir
CPS231	0.3	PIPO/PUTR/AGSP: ponderosa/bitterbrush/wheatgrass
SD	0.3	Dry shrubland, sagebrush, non-forest zone shrubland not desert
CJS8	0.1	Juniper/stiff sage scabland

Note: It is important to note that data in Table 3 are somewhat misleading. These data were derived from analysis using GIS PNC layers developed from field data where only PNCs five or more acres in area were mapped. *Calochortus longebarbatus* var. *peckii* (CALOP) consistently occurs in either meadow or riparian PNCs. However, the meadows occupied by CALOP are frequently too small to qualify for mapping in GIS, so the GIS polygons associated with these CALOP meadow sites often appear as inclusions within the local, generally drier PNCs that are large enough in area to be mapped in GIS. Likewise, due to the narrowness of riparian communities, as mapped in GIS, polygons associated with riparian CALOP occurrences often intersect the local upland PNCs that are large enough in area to be mapped in GIS. PNC codes and names used in this table are found in Johnson and Clausnitzer (1992) and Hall (1998).

Table 4. Precipitation data for the Ochoco Ranger Station, Lookout Ranger District, Ochoco National Forest. Precipitation categories match those defined in this Conservation Strategy ("Wet" is > or = 16" Oct-Jun with > or = 4" Apr-Jun; "Dry" is < 10" Oct-Jun; "Normal" is neither Wet nor Dry). Data in this table extracted by Ron Halvorson by internet link to the Oregon Climate Service.

Ochoco Ranger Station Precipitation								
Water Year	Oct-Jun	Apr-Jun	Category		Water Year	Oct-Jun	Apr-Jun	Category
1937	16.80	7.45	Wet		1970	13.44	3.38	Normal
1938	20.61	4.86	Wet		1971	17.11	3.60	Normal
1939	12.63	3.01	Normal		1972	13.42	3.43	Normal
1940	12.87	2.64	Normal		1973	8.67	1.90	Dry
1941	15.45	7.25	Normal		1974	18.97	1.58	Normal
1942	17.36	5.11	Wet		1975	13.54	2.76	Normal
1943	24.35	4.50	Wet		1976	12.25	2.65	Normal
1944	11.83	5.26	Normal		1977	7.59	3.97	Dry
1945	17.11	6.11	Wet		1978	18.81	7.17	Wet
1946	21.38	3.18	Normal		1979	11.61	4.93	Normal
1947	17.51	6.25	Wet		1980	14.01	4.06	Normal
1948	20.59	9.94	Wet		1981	16.43	4.58	Wet
1949	9.50	0.96	Dry		1982			
1950	17.48	4.71	Wet		1983	15.18	4.55	Normal
1951	17.49	3.18	Normal		1984			
1952	18.16	3.58	Normal		1985	10.29	2.28	Normal
1953	21.65	6.77	Wet		1986	8.79	0.90	Dry
1954	18.18	4.88	Wet		1987	7.44	1.21	Dry
1955	11.37	3.72	Normal		1988	9.14	3.70	Dry
1956	21.23	5.98	Wet		1989	7.80	3.60	Dry
1957	16.07	3.29	Normal		1990			
1958	23.28	7.24	Wet		1991	10.85	4.25	Normal
1959	11.74	2.77	Normal		1992	10.40	4.55	Normal
1960	11.94	3.75	Normal		1993			
1961	16.78	5.02	Wet		1994			
1962	16.53	5.04	Wet		1995	8.18	3.99	Dry
1963	19.14	5.56	Wet		1996	13.98	4.06	Normal
1964	13.58	2.75	Normal		1997	9.21	1.90	Dry
1965	20.75	4.00	Wet		1998	12.10	2.03	Normal
1966	11.47	2.14	Normal		1999	14.45	1.07	Normal
1967	13.33	1.76	Normal		2000	13.62	1.89	Normal
1968	10.24	2.58	Normal		2001	13.48	4.52	Normal
1969	20.57	7.89	Wet		2002	12.41	1.54	Normal
					2003	7.73	2.96	Dry

Table 5. Strengths and shortcomings of three basic approaches to trend monitoring for *Calochortus longebarbatus* var. *peckii*.

Monitoring System	**Advantages**	**Shortcomings**
Statistically-based sampling	This is regarded as the most powerful monitoring tool available to applied biologists (Elzinga et al., 1998). It can provide the most legally defensible assessments of effects and trends. It also allows establishment of clearly identified thresholds in resource conditions, at which, pre-determined management measures will be triggered. Frequency sampling at permanently located quadrat positions along permanent transects is a relatively simple, accurately repeatable sampling method that can not only provide good trend data for a target species, but track change in community species composition and abundance, as well as change in substrate features (e.g., amount of bare soil or duff/litter).	One principal shortcoming of statistically-based sampling is that it requires intensive effort, and given the limited resources currently available to most field units, this will allow only a very small number of populations to be sampled. A second, and seemingly prohibitive shortcoming, is that this taxon's very large annual amplitudes in population size, tend to confound efforts to identify any statistically defensible trend. However, Holmes (2005) notes that statistical sampling procedures have been developed for other rare Calochortus species in Oregon, and these could be tested for feasibility with *Calochortus longebarbatus* var. *peckii* (see Research section of this document).
Habitat Condition Monitoring	This approach is a resourceful way to monitor a taxon that presents formidable challenges to direct monitoring. This methodology would assess condition of habitat occupied by *Calochortus longebarbatus* var. *peckii* using, perhaps, measures such as soil disturbance/stability, ground cover, seral status of vegetation, utilization, and presence or absence of non-native invasive plants. As employed in the Environmental Assessment for the Westside Allotments (Ochoco NF, 2005),	This sort of habitat assessment, whether it identifies a "functional" or "non-functional" condition, is general, and currently does not necessarily apply to the specific ecological requirements of individual taxa within the community. If the requirements of a specific taxon are difficult to infer, and perhaps especially, if among community taxa, it has a rather uncommon habit or behavior (e.g., *Calochortus longebarbatus* var. *peckii* is bulbiferous perennial whose congeneric taxa are notoriously difficult to successfully transplant),

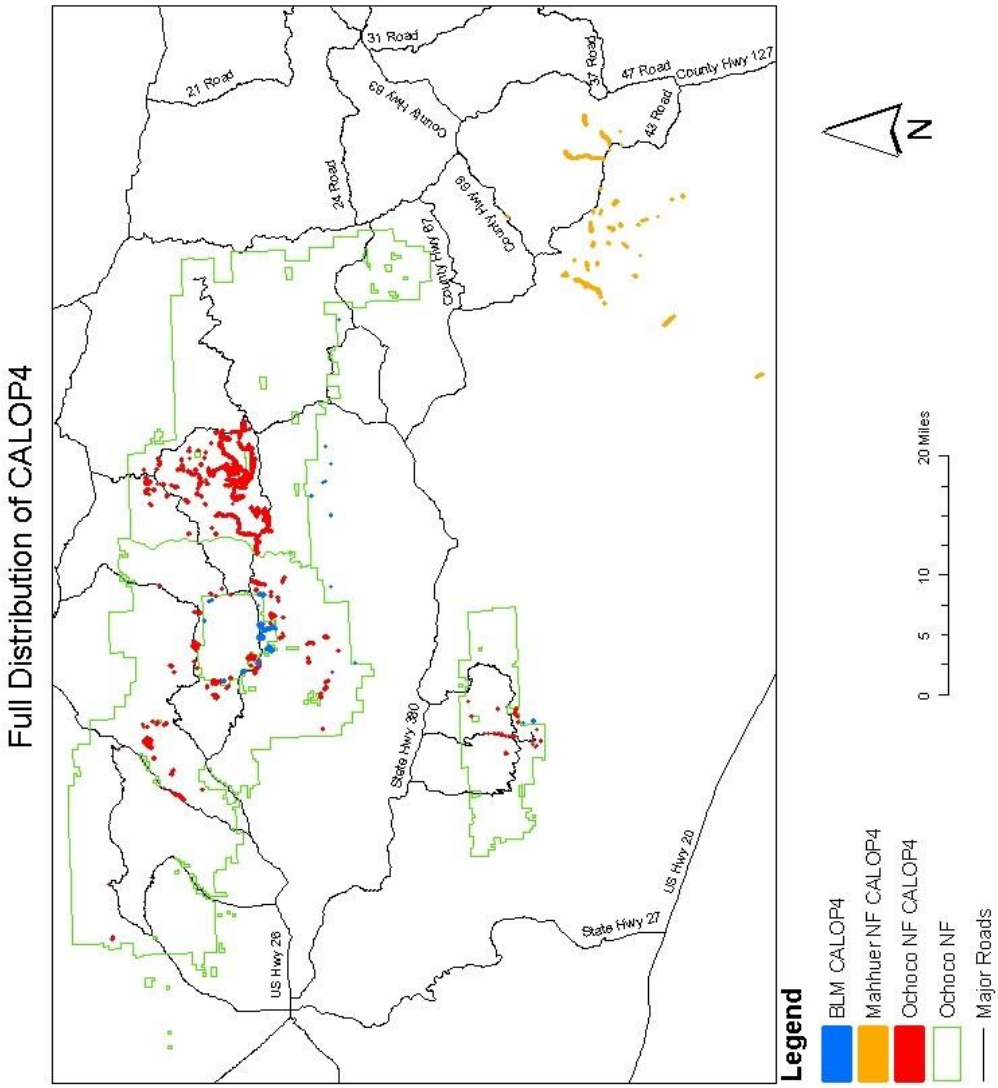
	condition classes (e.g., functional, functioning at risk, non-functional) could be assigned with appropriate management guidelines applied to the habitat, dependent on its assigned condition class. This approach is very appropriate in that it employs a number of monitoring methods already in use, and generates information that is necessary for adherence to agency and field unit land management standards, not simply conservation of rare and uncommon taxa. Further, specific monitoring requirements, such as channel width-depth ratios and other cattle use-related channel alteration measurements, and species composition and cover measurements, have the potential to be correlated with any local trend data available for *Calochortus longebarbatus* var. *peckii*.	general habitat condition may not be a strong indicator of the status of that taxon.
Non-statistically-based sampling	This type of sampling can be very simple in design and implementation. It provides an opportunity to assess distribution and population trends, even with relative limited monitoring resources.	A significant shortcoming of this type of monitoring is that there is no opportunity for statistical analysis of data and hence, there are limitations on ability to detect and declare population trends. Also, thresholds of resource condition that will trigger management actions are difficult to set.

Table 6. Monitoring requirements specific to USFS and BLM grazing allotments.

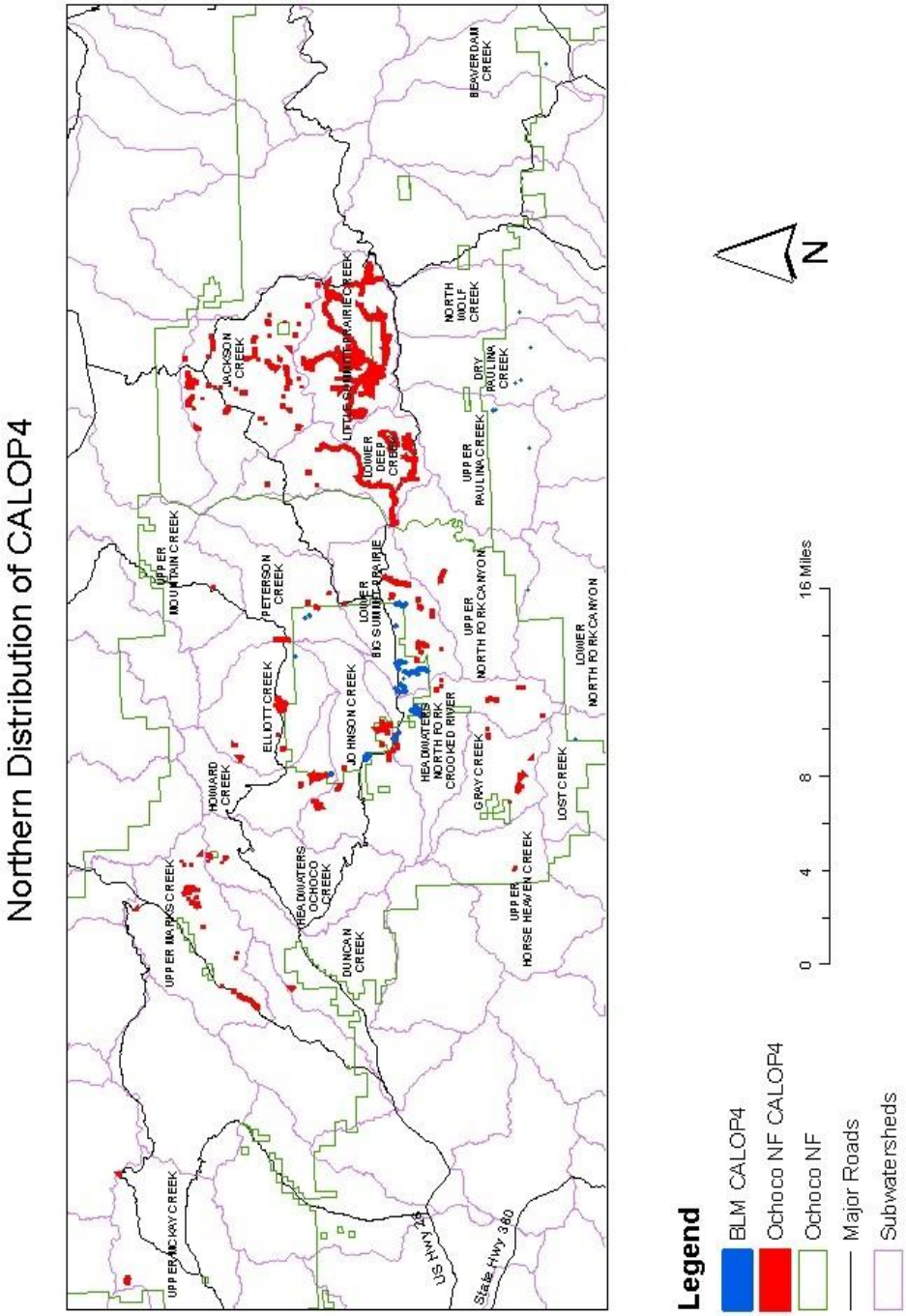
Field Unit	**Management Requirement**
Ochoco and Malheur National Forests	Monitoring of *Calochortus longebarbatus* var. *peckii* within grazing allotments will be conducted by a combination of annual monitoring of Range Program Designated Monitoring Areas (DMA – a general habitat monitoring tool) and annual joint Botany/Range Program monitoring of selected populations of *Calochortus longebarbatus* var. *peckii* (See monitoring protocol within this document). Where feasible, conduct monitoring of DMAs and populations of *Calochortus longebarbatus* var. *peckii* within pastures where long-term Multiple Indicator Method plots exist. Following five years of such annual monitoring, Range and Botany will meet to assess the effectiveness of this monitoring methodology and the condition of *Calochortus longebarbatus* var. *peckii* habitat, and plan for the next interval of habitat and population monitoring. Grazing permittees will be reminded of the following permit condition (which while applicable to all grazing allotments, is, for the purposes of this Conservation Strategy, considered especially important for allotments including *Calochortus longebarbatus* var. *peckii*): Permittees not meeting grazing standards within a particular allotment/pasture as indicated by results of annual DMA data, will receive a Notice of Non-Compliance. Failure to meet grazing standards a second consecutive year will result in the issuance of a Notice of Permit Action. This action will require a temporary, two-year, 25% reduction in either herd size or grazing period. Failure to meet grazing standards a third consecutive year will result in issuance of another Notice of Permit Action. This Notice will make permanent the 25% reduction in herd size or grazing period and require an additional, temporary, 25% reduction in herd size or grazing period. Failure to meet grazing standards a fourth consecutive year will result in another Notice of Permit Action. This Notice will make permanent the most recent 25% reduction in herd size or grazing period (permanent reduction now = 50%) and require another temporary 25% reduction in herd size or grazing period. Failure to meet grazing standards a fifth consecutive year will result in a permanent reduction in herd size or grazing period to 25% of its original level and following a sixth consecutive year of failure to comply with grazing standards, the permittee's grazing permit for this allotment/pasture will be permanently revoked.
Prineville BLM District	Conduct population census at each *Calochortus longebarbatus* var. *peckii* site at least once every five years. In planning annual utilization monitoring for allotments, include presence of *Calochortus longebarbatus* var. *peckii* in prioritizing allotments to be monitored. It

	is strongly recommended that botany and range staff jointly conduct annual census and utilization monitoring. The BLM will conduct allotment-based Land Health Assessments (as guided by the National Standards for Rangeland Health [1997]) and will include *Calochortus longebarbatus* var. *peckii* populations in the assessments. If the allotment fails the Land Health Assessment, adjustments may be made in grazing permits in accordance with current BLM protocols. NEPA associated with renewal of grazing permits should include an assessment of condition of included *Calochortus longebarbatus* var. *peckii* habitat.

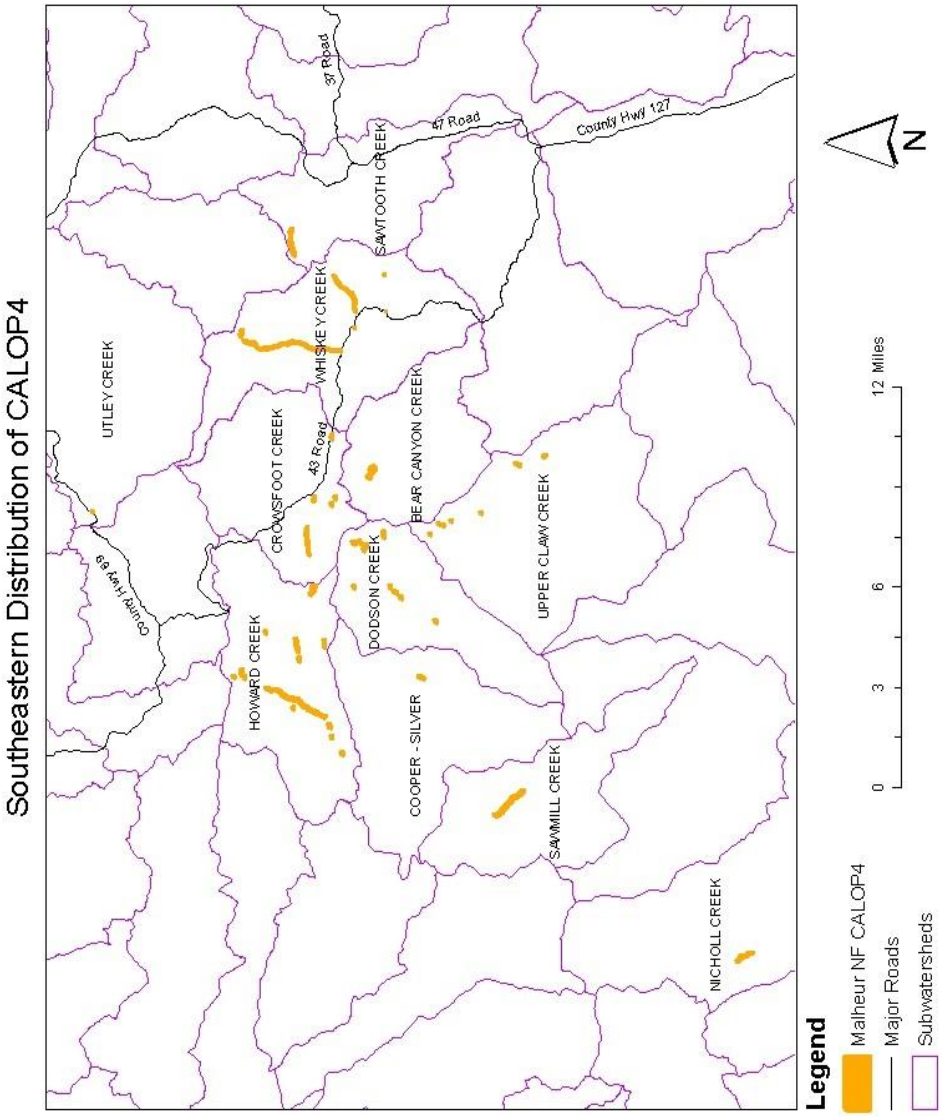
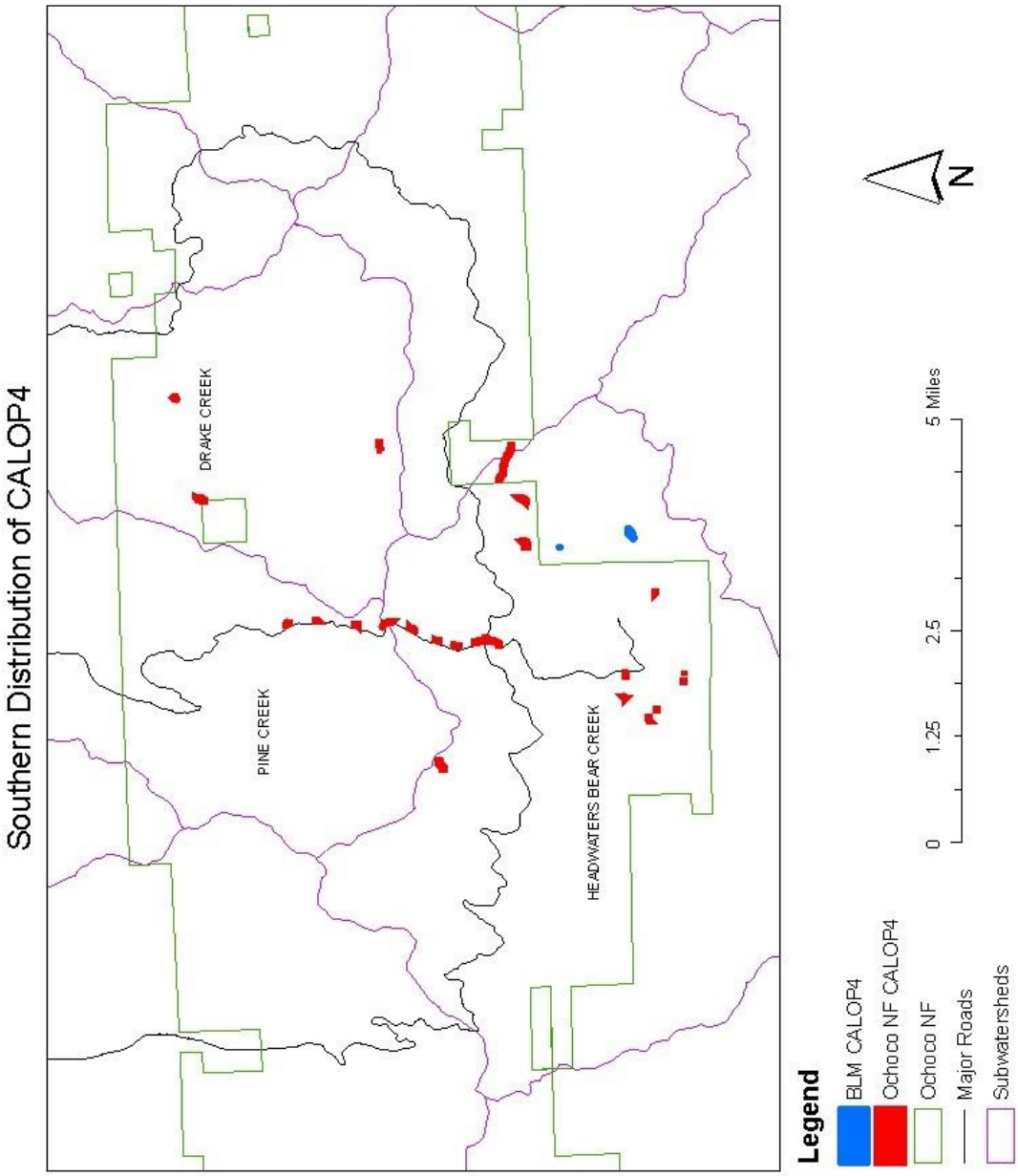
Map 1. Full distribution of *Calochortus longebarbatus* var. *peckii* in central Oregon.



Map 2. Northern distribution of *Calochortus longebarbatus* var. *peckii* within central Oregon.



Map 3. Southeastern distribution of *Calochortus longebarbatus* var. *peckii* in central Oregon.



Map 4. Southern distribution of *Calochortus longebarbatus* var. *peckii* in central Oregon.