Steamboat buckwheat
(Eriogonum ovalifolium var. *williamsiae)*

5-Year Review:
Summary and Evaluation

James Morefield, Nevada Natural Heritage Program
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U.S. Fish and Wildlife Service
Nevada Fish and Wildlife Office
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5-YEAR REVIEW

Species reviewed: Steamboat buckwheat (*Eriogonum ovalifolium* var. *williamsiae)*

TABLE OF CONTENTS

I. General Information…… 1
- A. Methodology…… 1
- B. Reviewers…… 1
- C. Background…… 1

II. Review Analysis…… 2
- A. Application of the Distinct Population Segment Policy…… 2
- B. Recovery Criteria…… 3
- C. Updated Information and Current Species Status…… 6
  1. Biology and Habitat…… 6
  2. Five-Factor Analysis……13
- D. Synthesis…… 17

III. Results…… 18

IV. Recommendations for Future Actions…… 19

V. References…… 20

Figures

Figure 1. General distribution of *Eriogonum ovalifolium* var. *williamsiae* showing land ownership of parcels in the vicinity……..25

5-YEAR REVIEW
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I. GENERAL INFORMATION

I.A. Methodology Used to Complete the Review: This review was conducted by Steve Caicco, Botanist, with the Nevada Fish and Wildlife Office, based on all information contained in files at that office.

I.B. Reviewers

Lead Regional Office – Diane Elam and Jenness McBride, Region 8, California and Nevada, (916) 414-6464

Lead Field Office – Nevada Fish and Wildlife Office, Steve Caicco (775) 861-6341 (Steve_Caicco@fws.gov)

I.C. Background

I.C.1. FR Notice Citation Announcing Initiation of This Review:
On March 22, 2006, the U.S. Fish and Wildlife Service (Service) announced initiation of the 5-year review for Steamboat buckwheat and asked for information from the public regarding the species' status (71 FR 14538-14542, March 22, 2006). No information was received as a result of that announcement.

I.C.3. Listing History
Original Listing
FR Notice: 51 FR 24669
Date Listed: July 8, 1986
Entity listed: Subspecies
Classification: Endangered

I.C.4. Associated Rulemakings: N/A

I.C.5. Review History: N/A

I.C.6. Species' Recovery Priority Number at Start of 5-year Review: 6c. This taxon was previously considered to have a high degree of threat and low potential for recovery due to its small population size and location within an industrial site; the occurrence within an industrial site was considered a conflict with economic activity.

I.C.7. Recovery Plan or Outline
Name of Plan: Steamboat buckwheat
Date Issued: September 29, 1995

II. REVIEW ANALYSIS

II.A. Application of the 1996 Distinct Population Segment (DPS) policy

II.A.1. Is the species under review listed as a DPS?

__X__ ***No.*** The Endangered Species Act defines species as including any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate wildlife. This definition limits listings as distinct population segments (DPS) only to vertebrate species of fish and wildlife. Because the species under review is a plant and the DPS policy is not applicable, the application of the DPS policy to the species listing is not addressed further in this review.

II.A.2. Species overview:

Steamboat buckwheat is a small, densely matted herbaceous plant belonging to the wild buckwheat family (Polygonaceae). It is one of seven varieties of the species *Eriogonum ovalifolium* known from Nevada. As summarized in the Recovery Plan (Service 1995), individual plants exhibit extensive systems of underground rhizomes, suggesting clonal propagation may be the predominant mode of reproduction, with occasional instances of seed production through sexual recombination. Steamboat buckwheat is endemic to substrates derived from hot springs deposits in the Steamboat Hills, located approximately 10 miles (mi) (15 kilometers (km)) south of Reno, Nevada. The Steamboat Hills are at the base of the eastern slope of the Carson Range in the Sierra Nevada and are characterized by shrubs such as big sagebrush (*Artemisia tridentata*), bitterbrush (*Purshia tridentata*), and rabbitbrush (*Chrysothamnus nauseosus*). The Steamboat Hills are an area of significant geothermal activity; however, a decline in hot springs activity has been observed since about 1987, and surface flows (including geyser activity) from the springs ceased in mid-1989. Steamboat buckwheat is largely restricted to shallow to moderately deep (< 21 inch (in) (53 centimeter(cm)), siliceous hot springs deposits known as sinter, in open areas of relatively low density vegetation (CH2M Hill, 1986, pp. III-6 to III-8, III-14, III-46; Table 1, pg. III-1; Table 5, pp. III-11). It is a colonizing species on sinter deposits and may eventually be out-competed by other plant species. Steamboat buckwheat is locally abundant, but apparently restricted to approximately 50 acres (ac) (20 hectares (ha)) of plants in an area of approximately 250-373 ac (100-150 ha) on a combination of private and public lands. About half of the lands on which Steamboat buckwheat occurs is under a 30-year lease by the Ormat Technologies Inc. (Ormat) for geothermal power production. In association with this lease, a formal agreement between The Nature Conservancy and Steamboat Development Corporation, the original geothermal development company at the site, was signed to provide protection for Steamboat buckwheat for the duration of the lease; Ormat continues to provide protection for the species in cooperation with the Nevada Division of Forestry (NDF), the state agency with authority over state-listed plants in Nevada. The remainder of the population and its habitat are on private property and public lands managed by the Bureau of Land Management (BLM).

II.B. Recovery Criteria

II.B.1. Does the species have a final, approved recovery plan containing objective, measurable criteria?

_X_ ***Yes***

II.B.2. Adequacy of recovery criteria.

II.B.2.a. Do the recovery criteria reflect the best available and most up-to-date information on the biology of the species and its habitat?

_X_ ***Yes***

II.B.2.b. Are all of the five listing factors that are relevant to the species addressed in the recovery criteria (and is there no new information to consider regarding existing or new threats?

_X ***Yes***

II.B.3. List the recovery criteria as they appear in the recovery plan, and discuss how each criterion has or has not been met, citing information. For threats-related recovery criteria, please note which of the five listing factors[1] are addressed by that criterion. If any of the five listing factors are not relevant to this species, please note that here.

We have no evidence that the Steamboat buckwheat faces a significant threat from any factor other than the threatened destruction, modification, or curtailment of its habitat or range (Factor A). Seed predation (Factor C) has been noted but not quantified and we are unable to assess its significance at this time other than to note that both asexual and sexual reproduction are documented to occur and the population has appeared to be self-sustaining over the past 25 years. The parcel of public land on which a portion of the population occurs remains open to mineral exploration and development but, because of the existing geothermal facilities, seems unlikely to face a significant threat from such activities (Factor D).

Recovery Objective: The objective of the Recovery Plan is to improve the status of Steamboat buckwheat so that it may be reclassified to threatened status. Due to lack of information on the taxon, the Recovery Plan did not include delisting criteria.

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[1] A) Present or threatened destruction, modification or curtailment of its habitat or range;
B) Overutilization for commercial, recreational, scientific, or educational purposes;
C) Disease or predation;
D) Inadequacy of existing regulatory mechanisms;
E) Other natural or manmade factors affecting its continued existence.

Recovery Criteria: Reclassification of Steamboat buckwheat to threatened status will be considered when:

1) Protective conservation easements, fee acquisitions, or land exchanges secure approximately 185 ac (75 ha) of occupied[2] habitat currently under private ownership. This criterion addresses listing factor A; it has not been met.

   Numerous attempts have been made to obtain conservation easements or to purchase and/or exchange lands for conservation of this species. The State of Nevada has agreed to accept any lands with habitat, if funding for maintenance and management is included, but lacks cost-share money. Most of the private land on which plants occur is held in trust but leased for 30 years by Ormat for geothermal energy production. Because of the extensive geothermal development on the property, fee acquisition is not feasible. The geothermal company has been very cooperative with efforts to conserve the species and has expressed interest in a conservation agreement. Some portions of this property with buckwheat habitat may have exchange potential, but this would be complicated because actual ownership of the property is held by a private trust. It may be possible to obtain the other parcel of private land through fee title acquisition. This 12 ac (4.9 ha) parcel was recently inventoried by a private consultant and found to have 6.7 ac (2.7 ha) of occupied habitat. A 2004 application for a Recovery Land Acquisition Grant (provided under section 6 of the Endangered Species Act) to acquire this parcel was not funded. We have not reapplied due to lack of a source of non-Federal funding to meet the cost-share requirement.

2) Cooperative agreements are established for approximately 80 ac (32 ha) of occupied public lands and approximately 37 ac (15 ha) of occupied State highway easement lands. This criterion addresses listing factor A; it has not been met and may not be necessary, as explained below.

   The Federal public lands with Steamboat buckwheat habitat are isolated parcels with few, if any, direct threats to the species. One parcel was designated by the BLM as an Area of Critical Environmental Concern for its geothermal features prior to the time the plant was listed. Management was transferred to Washoe County under the Recreation and Public Purposes Act (RPPA) for development as a day-use park, but no action has taken place and none is planned because of the industrial nature of the surrounding area. The most recent Land Use Plan for the Steamboat area establishes an Industrial

[2] The term "occupied" must be qualified as there is unlikely to be 75 acres of occupied habitat on private lands, nor under recovery criteron 2 does there appear to be 80 acres of occupied public lands; see section II.C.1.d. Our best estimate based on a 2006 field survey on Ormat leased land and public domain land (Caicco 2006), and information in our files, is that there is a total of about 50 ac (20.2 ha) of occupied habitat, of which perhaps two-thirds is private. Therefore, it would not be possible to satisfy criteria 1 and 2 of the recovery plan unless there was a substantial expansion of the population on both private and public lands.

zoning designation for the entire area except for the RPPA parcel which is zoned as open space (City of Reno 2005, p. 16); the land use plan acknowledges the significance of the Steamboat buckwheat, stipulates that it be protected and preserved (City of Reno 2005, pp. 9-10), and incorporates the 1993 management plan developed between TNC and SB Geo as an appendix. The remaining Federal lands in the area support a large portion of the buckwheat population and require little management. Public access is limited by the surrounding private lands so no specific conservation agreement seems necessary at this time.

The State highway easement lands along U.S. Highway 395 that support Steamboat buckwheat plants are peripheral to the main population. A proposed highway widening project that would have impacted thousands of buckwheat plants has been scaled back because a freeway that bypasses the site to the west is under construction; when finished, the freeway bypass would mitigate the need for the highway widening project as originally proposed. Based on the Service's recommendation, the Nevada Department of Transportation (NDOT) erected a fence along their right-of-way adjacent to Highway 395. The fence has been successful in restricting access to the private lands that provide habitat for the Steamboat buckwheat. No formal conservation agreement has been necessary.

3) Cooperative management plans have been developed and implemented on all occupied habitat. This criterion addresses listing factor A; it has been partially met.

Various groups of individuals have met since prior to the time the Steamboat buckwheat was listed in attempts to develop and implement a cooperative management plan to conserve the species. A management plan was completed with Section 6 funding in 2005 (BMP Ecosciences 2005); the plan itself is conceptual and offers a vision of restoration of the Steamboat Springs geothermal ecosystem for public enjoyment and education. As such, it takes a long-term view and proposes to restore the ecosystem integrity in a way that sustains power production. This plan is unlikely to be implemented in full because of the reluctance of the geothermal company to allow public access to the area due to safety concerns. The plan also proposes a research-based approach to restoring surface flows of geothermal water; the geothermal company has also expressed concerns about this proposal because related practices such as reinjection are strictly regulated by the Nevada Division of Environmental Protection to protect the water table and the geothermal resource and to protect the users of the water of Nevada and not subject to discretionary action (Morris 2004, p. 1). It should be noted that the Steamboat buckwheat is not a wetland species and individual plants do not depend on saturated soils for their survival; the primary importance of the geothermal flow is in creation of the sinter soils on which the plant grows. All existing sinter soils will eventually weather to develop a deeper soil that may allow the

establishment of other plant species that could out-compete the Steamboat buckwheat, but this is a process likely measured in hundreds or thousands of years (BLM 1993). Moreover, current areas of exposed sinter bedrock are likely to weather over the same time frame to create more habitat suitable for the Steamboat buckwheat. It is more feasible that some portions of the 2005 management plan will be incorporated into a more realistic plan for managing the species in cooperation with the land owner and the lessee.

II.C. Updated Information and Current Species Status

II.C.1. Biology and Habitat

II.C.1.a. Abundance, population trends (e.g., increasing, decreasing, stable), demographic features (e.g., age structure, sex ratio, family size, birth rate, age at mortality, mortality rate, etc.), or demographic trends:

In the original listing rule (51 FR 24670), reference was made to the Steamboat buckwheat growing in seven scattered colonies. The Recovery Plan noted this reference to colonies and stated that subsequent mapping had shown the plant was restricted to approximately 50 ac (20 ha) within an overall area of 375 ac (150 ha) (Service 1995, pp. 6-7). In addition, a monitoring strategy developed and implemented since 2000 refers to "subpopulations." While there are certainly areas where the buckwheat does and does not occur, as well as areas where its density varies, the distribution is relatively contiguous with the greatest separation between occupied habitat patches on the order of 164 feet (50 meters) or less. Therefore, there is no reason to believe that there currently exists more than a single, interbreeding population on the site. The use of the term "subpopulation" in this or other documents in reference to this species should be interpreted only as a convenient geographic reference with no biological implications.

Various estimates of the abundance of the Steamboat buckwheat have been made over the 20 years since the plant was listed. These estimates have ranged from 10,000 to 15,000 individual plants in the final rule listing the species (51 FR 24670) to 85,000 plants by Knight (1993, p. 3), who noted that a precise enumeration of individual plants is infeasible because the species is rhizomatous and propagates primarily by vegetative runners. During a 2006 survey throughout the Ormat leased lands and the public lands, tens of thousands of plants were observed with the largest concentrations on the deeper sinter-derived soils (Caicco 2006). We concur that it is infeasible to ever know how many individual plants exist at any one time.

A demographic monitoring study was implemented in 2003 with sampling conducted along permanent transects in two areas within the population, one in the Central Drainage and the other on the Main Terrace. The Central Drainage is a shallow ephemeral drainage basin with deep colluvial sinter soils that support

high densities of the buckwheat. It contrasts sharply with the Main Terrace, which is a largely unvegetated expanse of exposed sinter bedrock with little soil development and very few buckwheat plants; the Main Terrace was until the mid-1980's the location of several geysers that expelled boiling waters dozens of meters into the air.

Three management objectives were identified in the demographic monitoring protocols: 1) Subpopulations of Steamboat buckwheat in Main Terrace and Central Drainage habitats will be within ± 15 percent (or mean ± 95 percent confidence interval, whichever is largest) of their baseline density after 5 and 10 consecutive years, with baseline density calculated from the 2003 survey; 2) Subpopulations of Steamboat buckwheat in Main Terrace and Central Drainage habitats will each produce a significant cohort of seedlings at least once during 5 consecutive years of monitoring (or twice in 10 years); and 3) Total live absolute cover by common regional shrubs, perennial grasses, and common regional weeds, as well as Steamboat buckwheat, in Main Terrace and Central Drainage habitats will be within ± 15 percent of their baseline levels (or mean ± 95 percent confidence interval, whichever is largest) 5 and 10 years later (BMP Ecosciences 2002, p. 6; 2003, p. 3). Objectives 1 and 3 are "stasis" objectives, i.e., under current levels of direct and indirect human impacts, the expectation is that there will be no change from the baseline established in 2003. Objective 2 emphasizes episodic reproduction because there have been relatively few observations of seedlings over the past 20 years, and seeds collected and endowed with the Center for Plant Conservation's National Collection in the early 1990's were found to contain less than 1 percent live seed (Knight 1994, as cited in the Recovery Plan, p. 11).

Although the monitoring program specifies that plots should be monitored at 5 and 10 years post-installation, plots were re-sampled in June 2005 to take advantage of a wet spring and a consequent increased potential for a rare recruitment event. In the Central Drainage macroplot, the mean number of live Steamboat buckwheat plants increased by 57 percent along with a significant increase in overall cover of 2.4 percent; these data also showed that the number of small plants increased by 23 percent, the number of medium plants increased by 49 percent, and the number of large plants increased by 170 percent, suggesting that small plants are being replaced by new recruits and medium plants are growing into the large size class (BMP Ecosciences 2007, p. 3). A total of 401 seedlings were counted in the Central Drainage; these were often less than 0.4 in (1 centimeter (cm)) in diameter and sometimes only cotyledons (the first small leaves produced by seedlings) were present. This establishes that the taxon is able to sexually reproduce despite the apparent low viability of seeds (BMP Ecosciences 2007, p. 4). Weed cover in the Central Drainage remained low, with less than 2 percent cover, a number that likely reflects the inability of most plants, including weeds, to successfully colonize the unusual sinter substrate.

In contrast, the results for the Main Terrace macroplot showed the total number of Steamboat buckwheat plants to have declined by 13 percent, no seedlings were observed, as in the Central Drainage, weed cover remained low (less than 3 percent), and shrub cover remained sparse (less than 1 percent), presumably reflective of the inability of most plants to colonize the sinter soils (BMP Ecosciences 2007, p. 2). The researchers concluded that a reliable flow of geothermal water was probably essential for reproduction on the dry, shallow soils characteristic of this environment (BMP Ecosciences 2007, p. 4). While this may be true, it should be noted that the Main Terrace habitat is atypical of the overall habitat currently occupied by the Steamboat buckwheat; most occupied habitat is more similar to the habitat within Central Drainage macroplot. We believe that a failure of the Steamboat buckwheat to reproduce by seed on the Main Terrace appears more likely to affect only the distribution of the species, and does not compromise the overall viability of the species. As noted earlier, we also expect the Main Terrace to become more suitable habitat for the buckwheat over time as the exposed sinter bedrock weathers and develops into the deep sinter gravels that support high densities of the buckwheat elsewhere on the site.

II.C.1.b. Genetics, genetic variation, or trends in genetic variation (e.g., loss of genetic variation, genetic drift, inbreeding, etc.): Archibald *et al.* (2001) investigated the genetic structure of *Eriogonum ovalifolium* var. *williamsiae*. Using allozyme (protein) markers, they suggest that the taxon has relatively high genetic variability for a narrow endemic. The data also indicated that the taxon does not appear to be inbreeding. The plant also reproduces vegetatively, but the clones appear to be small (less than 27 in (70 cm) each). However, the study was not designed to assess the extent of clonal growth in the population. Finally, they found that *E. o.* var. *williamsiae* (Steamboat buckwheat) appears to be genetically similar to five other varieties of *Eriogonum ovalifolium* they examined, although the similarities were not higher than typically encountered among varieties of the same species (Archibald *et al*. 2001, p. 613).

Although the results of this allozyme study showed that there was more similarity (i.e., a relatively close genetic identity) between the endangered *Eriogonum ovalifolium* var. *williamsiae* and one population of *E. o.* var. *ovalifolium* than there was between the latter and two other populations of var. *ovalifolium*, Archibald *et al.* (2001, p. 613) concluded that it was premature to merge the two varieties. This conclusion was based on: 1) genetic identities between varieties often approach or equal values among populations within the same variety; 2) the genetic identity calculated was based on a relatively small sample of allozyme loci (i.e., genes) within the entire genome; and 3) the two varieties differ substantially in their morphology, including many aspects of size as well as flower color (Archibald *et al.* 2001, p. 613). Therefore, they concluded that a more detailed genetic and ecological analysis was warranted.

The researchers also suggested that the genetic similarity between the endangered *Eriogonum ovalifolium* var. *williamsiae* and the common *E. o.* var. *ovalifolium*

could be due to a hybrid origin of *E. o.* var. *williamsiae* (i.e., perhaps *E. o.* var. *williamsiae* arose from hybridization between *E. o.* var. *ovalifolium* and some other variety) (Archibald *et al.* 2001, p. 613). Although they suggested several *E. o.* var. *williamsiae* characteristics that are consistent with a hybrid origin (e.g., low production of viable seed, restriction to a novel habitat), they concluded that further work is necessary to determine whether a hybridization hypothesis represents the true history of the group.

Given the unique habitat in which the Steamboat buckwheat occurs, which is dissimilar from the habitat of any of the other varieties of *Eriogonum ovalifolium*, and other morphological and ecological differences that distinguish it from other taxa of *Eriogonum ovalifolium*, there does not appear to be any valid reason to question its taxonomic status based on the genetics results to date.

II.C.1.c. Spatial distribution, trends in spatial distribution (e.g., increasingly fragmented, increased numbers of corridors, etc.), or historic range (e.g., corrections to the historical range, change in distribution of the species' within its historic range, etc.): The overall distribution of the Steamboat buckwheat has changed little since the time of listing in 1986 (Figure 1). A geothermal facility constructed in one portion of the site eliminated about 0.15 ac (0.06 ha) of occupied habitat. In 1992, prior to the construction of the facility, 17,000 plants were removed from the impact area and transplanted to other areas, with an estimated overall survival rate of 40 percent (Knight 1996). These mitigation areas were visited in June 2006, during a Service overall survey of the distribution of the species (Caicco 2006). Thousands of plants were present in these areas, although it was not possible to tell whether any of them had persisted after transplanting or were descendents of the original transplants. On sites where plants were transplanted to revegetate into two-track dirt roads, plants now exist within larger colonies and do not differ obviously from their (presumably) naturally-occurring neighbors other than by the faint tracks that persist from the old road.

II.C.1.d. Habitat or ecosystem conditions (e.g., amount, distribution, and suitability of the habitat or ecosystem): In general, the remaining habitat is in good condition, and may have improved somewhat since the time of listing due to the restrictions placed on public access after the area was developed for geothermal power production. Several weeds are present on the site, including cheatgrass (*Bromus tectorum*) and whitetop (*Lepidium latifolium*). The cheatgrass generally occupies sites with deeper soils while most of the Steamboat buckwheat plants are in areas with shallower soils developed from sinter deposits. The main threat over the short term from cheatgrass, therefore, is not direct competition with the buckwheat but the fine fuel it creates when dried, which increases the potential for wildfire. Human-related ignition sources are highly likely given the proximity of the highway to the site. However, even in wet years the fuel load is discontinuous due to the mosaic of thin soils and rock outcrops, so extensive areas are unlikely to burn. Monitoring results showed no significant increase in weeds

on either the Main Terrace or in the Central Drainage in 2005 when compared to the 2003 baseline data; the total weed cover remains low in the two macroplots, at less than 3 percent and 2 percent of the total cover of all plant species, respectively (BMP Ecosciences 2007, pp. 1-2). Moreover, because of the industrial facilities, which use a highly flammable gas under pressure, fire containment is a high priority and recent fires in the area have been quickly controlled. Both NDOT and the Nevada Department of Agriculture have active weed control programs and have cooperated with the landowners and the Service in controlling the spread of whitetop in suitable areas on the site. As with cheatgrass, whitetop is unlikely to invade the thin soils typical of buckwheat habitat.

There is a long-term concern over the sustainability of the habitat upon which the Steamboat buckwheat depends because deposition of the siliceous sinter has been suspended or permanently stopped. Declines in hot spring activity at the Steamboat buckwheat site were observed by various individuals in 1986, the same year that the species was listed. A systematic decline in hot spring activity was apparent by 1987, and by mid-1989 all of the springs had ceased flowing. Several studies have been conducted to determine the cause of the decline and cessation of spring activity. An investigation over a 55-day period in the summer of 1988 concluded that the periods of power production and shut-down appeared to correlate well with water level fluctuations measured in several thermal springs (Huntley *et al.* 1988, pp. 6, 31, but concluded that because the monitoring was conducted during only a single season, it was unclear whether the geothermal production was the principal source of water decline or only a contributing factor (Huntley *et al*. 1988, p. 33). A subsequent study found the hydrologic and geologic systems beneath Steamboat Hills to be extremely complex and that there appeared to be no direct connection of the deep geothermal aquifer with shallower zones; the authors concluded that the changes in spring discharge were more likely related to changing hydrologic conditions perhaps due to a natural decline noted since the beginning of the 20th Century and, partly, to regional drought (van de Kamp and Goranson 1990, p. 13). The Huntley *et al.* (1988) study has also been criticized for various technical reasons (Petty 1992, p. 6). Nork (1992, p. 27, 30) concluded that the cessation was likely influenced more by groundwater withdrawal for domestic and quasi-municipal use and consequently the thermal springs would not resume flowing even if power production ceased. A subsequent study suggested that only a few feet of the long-term water level decline observed in some wells could be attributed to the geothermal production wells and that 85 to 90 percent of the observed decline may be due to the effects of declines n the shallow groundwater system (Sorey and Colvard 1992, p. 97). More recent research suggests that fault-controlled groundwater flow between the geothermal system and the alluvial aquifer is the dominant hydrologic process and that the thermal water component in the alluvial aquifer has increased in most areas (Skalbeck et al. 2002, p. 1). According to a newspaper article, the recent construction of Galena 3, Ormat's newest geothermal plant at the Steamboat complex, geothermal development at the site is now complete as further tapping

of geothermal resources at the site would risk reducing the temperature of the reservoir from which the thermal waters are pumped (Reno Gazette Journal, 2008).

II.C.1.e. Reproductive Biology. Gynodioecious taxa contain two types of plants; plants either have all female flowers (i.e., nectar-producing and potentially seed-producing) or are hermaphroditic (with both male [pollen-producing] and female flowers on the same plant). Research has shown that the Steamboat buckwheat is gynodioecious, with roughly half the population in either category (Tepedino *et al.* 2000, pp. 4, 6). The hermaphroditic plants are about the twice the size of the female plants and produce about twice as many inflorescences (Tepedino *et al.* 2000, pp. 6-7). The female plants tend to bloom earlier, and early blooming plants of each type tend to produce many more inflorescences than later blooming plants (Tepedino *et al.* 2000, pp. 6-7). In addition, early inflorescences on individual plants were larger than later inflorescences. Maturation of the female and hermaphroditic flower types are similar, except that female flowers rush rapidly through their non-functional male phase and arrive at their female phase sooner than do hermaphrodites (Tepedino *et al*. 2000, p. 7).

The breeding systems studies suggest that plants of both types require pollinators (Tepedino *et al*. 2000, p. 9). Hermaphroditic plants, with both male and female flowers on the same individual, are self-compatible (Tepedino *et al*. 2000, p. 9). There was no difference in seed production between plants pollinated with their own pollen (selfed) and plants crossed with other individuals (outcrossed). In addition, no difference in seed production was detected between plants crossed with individuals located near them and plants crossed with individuals further away from them. This suggests the absence of both inbreeding depression (reduction in fitness due to matings among relatives) and outbreeding depression (reduction in fitness due to matings among distantly related individuals) (Tepedino *et al.* 2000, p. 9). These results were considered tentative because their interpretation was based on signs of seed maturation rather than actual seed production, since seeds and flowers were decimated in both study years by larval populations of a lycaenid butterfly tentatively identified as *Euphilotes enoptes enoptes* (Tepedino *et al.* 2000, p. 9).

Over 50 species of insects were recorded visiting the flowers for nectar and pollen (Tepedino *et al.* 2000, p. 10). Flower visitors may or may not be pollinators. Bees and flies were especially common, all of which may be pollinators of the small, easily accessed flowers (Tepedino *et al.* 2000, p. 10). Only 12 species were judged abundant enough to be consistent pollinators (Tepedino *et al.* 2000, p. 10). Insects were more common on hermaphroditic than on female flowers, perhaps because the former supply both pollen and nectar and the latter nectar only, and more abundant on the flowers in mid-morning than in the later afternoon (Tepedino *et al.* 2000, p. 11).

The researchers postulated that the absence of inbreeding (see genetic discussion in section II.C.1.b., above) in this population is likely due to the diverse group of insects that visit the flowers and may act as pollinators, which includes bees, wasps, flies, and butterflies (Tepedino *et al.* 2000, p. 13). Because pollination possibly may not be a problem for the Steamboat buckwheat due to the diversity of insects that visit the flowers, the low seed production may be due to the high degree of flower and seed predation by butterfly larvae, although other genetic incompatibility factors may also be affecting seed production (see genetic discussion in II.C.1.b.) (Tepedino *et al.* 2000, p. 14).

II.C.1.g. Soil Chemistry and other Soil Factors. Two studies of factors affecting the distribution of the Steamboat buckwheat have been conducted (CH2M Hill 1986; Johnson 2000). The earlier study was conducted to describe plant associations and soil and moisture characteristics of sites where the plant did and did not occur (CH2M Hill 1986, p. I-2). The conclusions reached by this study were suggestive, but not definitive, and included: 1) the Steamboat buckwheat is restricted to sinter soils (CH2M Hill 1986, p. III-6); 2) the plants cannot tolerate moist soils (CH2M Hill 1986, p. IV-2); 3) the plants did not receive direct moisture from the hot spring vents during the study (CH2M Hill 1986, III-14); and 4) the plants grow in areas distant from actively flowing springs, but may not thrive at these locations (CH2M Hill 1986, p. IV-2).

The second study looked more closely at soil chemistry on sites where the Steamboat buckwheat grows and sites without the Steamboat buckwheat to test the hypothesis proposed in the previous study that the plants are restricted to sinter soils that have been partially leached of their salt content (Johnson 2000, p. 2). No statistically significant relationships were found between the presence or absence of the Steamboat buckwheat and any soil chemistry factor measured (Johnson 2000, p. 5), and the plant had a very high tolerance for extremely large variations in soil chemical properties (Johnson 2000, p. 18). There was some slight suggestion that high soluble salts may inhibit Steamboat buckwheat growth (Johnson 2000, p. 18), in concert with the finding of CH2M Hill (1986, pg. IV-1) that the plant does not occur on sites with high soluble salt levels. The hypothesis that it is restricted to soils with circumneutral pH derived from siliceous sinter substrates that have been partially leached of its salt content was not supported (Johnson 2000, p. 18).

No studies of soil factors other than chemistry and moisture have been conducted. Our own observations suggest that, like most varieties of *Eriogonum ovalifolium*, the variety *williamsiae* is restricted to shallow to moderately deep well-drained soils. In this case, a suitable substrate is provided by the weathering of the sinter deposited by the geothermal springs, which creates a unique habitat island within the surrounding Wyoming sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) dominated vegetation on deeper soils derived from alluvium. We do not consider it necessary to invoke soil chemistry (i.e., soil pH, salinity, etc) to explain why the Steamboat buckwheat does not grow on deeper alluvium or other zonal soils not

developed from sinter. In our opinion, this variety may not grow on deeper soils because of its inability to compete with other species better adapted to such habitats, as suggested by CH2M Hill (1986, pg. IV-1).

II.C.2. Five-Factor Analysis (threats, conservation measures, and regulatory mechanisms)

III.C.2.a. Present or threatened destruction, modification or curtailment of its habitat or range: The final rule listing the Steamboat buckwheat identified drilling of geothermal test wells, development of a park on a BLM parcel leased to the Washoe County Parks and Recreation Department, a planned commercial development on private land adjacent to a colony of plants, potential mining of private lands, off-road vehicle activity, refuse dumping, and changes in moisture availability as threats to the species in 1986 (51 FR 24669-24672, July 8, 1986).

As noted in the biological discussion above (Section II.C.1.e.), hot spring activity on the site has ceased, and while the complex geothermal system is still not well understood, the cause is likely related to numerous factors including geothermal production, drawdown of the regional groundwater table resulting from increased domestic and municipal use, and possible lack of recharge due to drought (BLM 1993). It should be noted, however, that surface flow has not reappeared despite several wet/dry climatic cycles since the latter conjecture was made. Nevertheless, there is currently adequate habitat to support a robust population of the Steamboat buckwheat, and while the cessation of sinter creation may pose a long-term threat to its persistence, the species' survival does not appear at current risk due to the cessation of hot spring activity. Although our observations suggest that the species thrives in well-drained habitats distant from actively flowing springs (see II.C.1.g. above), it is worth noting that the absence of seedlings in 2005 on the Main Terrace may indicate that a reliable source of geothermal water is needed for germination and/or seedling establishment on the dry, shallower soils typical of this habitat (BMP Ecosciences 2007, p. 4). By contrast, on the deeper soils in the Central Drainage, 401 seedlings were identified within the permanent plots. The Main Terrace is atypical of the currently occupied habitat of the Steamboat buckwheat and we do not believe that a failure to reproduce on the Main Terrace would have a significant effect on the overall viability of the species. However, we concur with the recent assessment (BMP Ecosciences 2005, p. 42) that exploration of potential methods of restoration of the hydrothermal processes, including a cost/benefit and risk analysis, is warranted, both to ensure that the reproductive processes of the Steamboat buckwheat in the Main Terrace area are maintained, and more importantly over the long-term, that the associated process of sinter deposition is ensured.

The Washoe County Department of Parks and Recreation continues to lease the BLM parcel under the Recreation and Public Purposes Act. The County has not proposed any plans for a park and is unlikely to do so because the adjacent geothermal company opposes public use for safety reasons. In addition, the cessation of hot spring activity has substantially reduced the natural feature value

as originally envisioned. Development of the park, therefore, no longer poses a significant threat to the species. The County has proposed no other uses for the parcel.

A substantial portion of the Steamboat buckwheat occurs on a private parcel adjacent to U.S. Highway 395, giving it high potential for commercial development. About 60 percent of this 12 ac (4.9 ha) parcel, labeled Moana Lane Nursery in Figure 1, is occupied habitat comprising an estimated 15 percent of the total occupied habitat for the Steamboat buckwheat and over 20 percent of the two-thirds of the entire population that occurs on private land; moreover, the habitat on this property is believed to support dense concentrations of the buckwheat based on observations of similar habitat on adjacent Ormat-leased lands. For these reasons, conservation of this habitat is considered integral to the recovery of the Steamboat buckwheat. The landowner has repeatedly expressed interest in protecting the property either through fee title acquisition or through a conservation easement. The Nevada Department of State Lands has indicated a willingness to accept the property and the NDF has agreed to manage it, but to date no funding has been available to secure this part of the population. Although this private property remains subject to the permitting requirements of NDF (see Factor D, Section II.C.2.d), the development of this property remains a potential threat.

An active mining claim exists on a portion of the population on BLM land, but seems unlikely to be developed while the surrounding private lands are in geothermal production. Therefore, mining does not appear to be a significant threat at this time and is unlikely to become significant while the geothermal plant remains in operation.

Off-road vehicle use has been substantially reduced due to fencing of the industrial areas, vigilance of the geothermal facility staff, and the installation of a right-of-way fence along U.S. Highway 395 by NDOT. The geothermal facility has recently installed a locked gate along their main access road which limits unauthorized access from this point. Occasional off-road vehicle use, usually by motorcycle, still occurs via other access points, but does not constitute a significant threat to the species. There is no evidence of recent refuse dumping in the area so this activity is no longer considered to be a significant threat.

Changes in moisture availability were cited in the final rule based on observations that plants have been observed to die when more than normal moisture, presumably precipitation, is received. This led to speculation that off-road vehicle use and refuse dumping might alter moisture patterns, thereby affecting plants. As noted above, both off-road vehicle use and refuse dumping no longer pose a significant threat to the species. The possibility that geothermal test wells might contribute to changes in water regimes has been discussed above. Some alteration in water flow patterns may have resulted from road and/or facility

construction, but their effects are unknown and unlikely to be significant because of their limited extent.

Minor impacts continue to affect small numbers of individuals, usually in peripheral areas adjacent to the highway or industrial sites. For example, in 2002 the NDF reported that a Nevada Department of Transportation (NDOT) project resulted in the loss of one plant. In 2004, NDF reported the transplantation of four plants to avoid loss during construction of a pipeline and geothermal facility, the loss of one plant hit by a snow plow during a storm, and the killing of an estimated 15 plants which were driven over by a crew servicing a billboard. In 2005, NDF reported that NDOT had killed one plant during construction of a right-of-way fence. In 2006, NDF reported that a spill of drilling mud had impacted 107 plants, all of which survived. These impacts, individually or collectively, do not constitute a significant loss of habitat for this variety and are far below a level that would jeopardize its existence. The current transportation plan for the area developed by Washoe County proposes a road that would likely impact occupied habitat, but this action would be subject to permitting by NDF.

II.C.2.b. Overutilization for commercial, recreational, scientific, or educational purposes: The final rule listing the Steamboat buckwheat noted that the rare status of the plant might make it a desirable garden plant and possibly pose a threat to the species. We have no evidence that this has, or is, occurring and do not consider it to be a significant threat at this time. Although some common varieties of *Eriogonum ovalifolium* are available in the commercial trade, *E. o.* var. *williamsiae* is not. Moreover, var. *williamsiae* has no features of noteworthy horticultural interest as compared to more common varieties. Moreover, access to the site is highly controlled by the geothermal company, so there is little likelihood of this becoming a significant threat.

II.C.2.c. Disease or predation: Some of the poor seed production observed in this variety has been attributed to high seed predation by larvae of a lycaenid butterfly species in the genus *Euphilotes* (Tepedino *et al*. 2000, p. 9). However, seed tested by the Berry Botanical Garden has shown seed viability of less than 1 percent, which strongly suggests that other factors, including genetic incompatibility factors, may be more significant in limiting sexual reproduction (see, however, the results of seedling monitoring during 2006 discussed in II.C.1.a. above). At this time, there is no evidence that disease or seed predation are significant threats to the species.

II.C.2.d. Inadequacy of existing regulatory mechanisms: The Steamboat buckwheat was listed as critically endangered by the State of Nevada in 1982 under Nevada Revised Statute 527.270-300. State-listed plants are protected from removal or destruction unless a permit authorizing the taking has been issued by the State Forester. To date, this statute has been very effective in limiting take of the Steamboat buckwheat and ensuring its conservation. Adverse impacts to individuals of the species have been isolated, non-significant events and have

typically resulted from lack of knowledge of the status of the species or were unanticipated, such as minor drilling-mud spills. Enforcement action by NDF has been rapid and consistent, usually resulting in a "cease-and-desist" order, followed by an accounting of impacts typically in terms of individuals damaged or killed, and mitigation actions where warranted. The Service has acted in a technical advisory capacity whenever violations have occurred.

A portion of the population lies on public lands managed by the BLM, where they are accorded direct protection in compliance with the requirements of Section 9 of the Endangered Species Act. There have been no direct impacts to plants on Federal land from the development of geothermal energy production in the vicinity. Moreover, the restricted access to the industrial lands surrounding the isolated public lands has reduced the magnitude of potential threats from off-road vehicles and refuse dumping on the site to less than significant.

Most of the private lands on which the Steamboat buckwheat occurs have been held and managed by the Dorothy Towne Trust since her death. Most of the lands that support the Steamboat buckwheat are under a long-term lease from the Trust for energy production. Since the original geothermal exploration and development was conducted, ownership of the facilities and the lease itself has changed hands several times. The property is currently leased and managed by Ormat, a Delaware corporation based in Sparks, Nevada. Ormat has been conscientious about the potential effects of their operations on the conservation of the Steamboat buckwheat and has fully complied with the requirements of the NDF. Ormat also allows access to Service staff and other authorized individuals conducting research on the Steamboat buckwheat.

II.C.2.e. Other natural or manmade factors affecting its continued existence: The final rule listing the Steamboat buckwheat indicated that the narrow distribution and small population size of the Steamboat buckwheat may make it vulnerable to fire or other disturbance in its habitat, and that a loss of individuals may have adverse effects on the reproductive capacity and survival of the species. The vulnerability of the habitat to fire has been addressed above in Section II.C.1.e. in our discussion of weeds. While it appears that the sexual reproductive capacity of the plant is limited, the Steamboat buckwheat does appear to have increased slightly in total area and perhaps numbers due to the control of disturbances caused by public access. No long-term monitoring data are available to precisely evaluate the status of the species, but anecdotal evidence suggests that it has successfully established in disturbed areas where it previously was not present. In addition, areas in which ramets (a unit of clonal growth) were transplanted as mitigation for the original loss of habitat from the cooling tower facility appear to be self-maintaining. Either those ramets have been successful in maintaining individuals through asexual reproduction, or they are successfully reproducing seedlings, or both, in the mitigation areas.

II.D. Synthesis

Short-term monitoring of two subpopulations of Steamboat buckwheat, one on the Main Terrace and the other in the Central Drainage, has shown contrasting results. The number of live plants observed in 2005 decreased by 13 percent on the Main Terrace and no seedlings were observed despite a wet spring. In the Central Drainage the total number of live plants increased by 57 percent and over 401 seedlings were observed, the first documentation of sexual reproduction in the species. Weed cover remained low in both subpopulations. While these results cannot be extrapolated to determine the trend of the overall population of the species, there is substantially more habitat typical of the deeper soils of the Central Drainage than there is typical of the shallow soils on the Main Terrace; for this reason, we believe that the overall population, numbering in the tens of thousands of individuals throughout its very limited range of about 50 ac (20.2 ha), remains robust and is likely to have a stable, if not increasing trend.

Many of the threats identified in the original rule listing the Steamboat buckwheat and the Recovery Plan have either not materialized (e.g., highway widening), or have had less dire consequences than predicted. In particular, development of the geothermal resources has largely been compatible with the conservation needs of the species. Transplantation of plants from areas to be impacted by construction activities into former two-track dirt roads, while estimated to have been only 25 percent successful, has resulted in transplantation areas that appear to differ little in the abundance and cover of Steamboat buckwheat plants as compared to adjacent natural areas. Moreover, fencing of the industrial site by the geothermal company and the NDOT has controlled unauthorized access to both the private lands and the isolated parcels of public lands which provide habitat for the species. This has reduced impacts from off-road vehicles, trash dumping, and other forms of trespass to an insignificant level.

Although the formal conservation agreements called for in the Recovery Plan have not yet been accomplished, the energy company which holds the lease on much of the private land habitat has been very cooperative in conservation efforts for the species and remains interested in a more formal agreement. To date, such an agreement has been difficult to develop in part because most attempts have tried to be comprehensive and inclusive of all of the potential partners. The key element to ensuring the conservation of the species in the near term, however, remains the 12 ac (4.9 ha) parcel of private land that contains 6.7 ac (2.7 ha) (13.4 percent) of the overall population; while the owner of this parcel is interested in an outright sale of the parcel, no funding has been available, at either the Federal or State level, to pursue the purchase. Without securing this parcel, the long-term viability of the species remains in question.

As noted previously, the Recovery Plan includes criteria that cannot be met without an unlikely expansion of the species into previously unoccupied habitat. Aside from this technicality, the Steamboat buckwheat could likely be downlisted

or even delisted once satisfactory safeguards have been put in place that would protect the occupied habitat that currently exists on private land and that allow for adaptive management of the species.

In short, we conclude that once adequate provisions have been made that ensure protection from the threat of destruction or modification of the habitat of this narrowly distributed endemic, the Steamboat buckwheat may meet the criteria set forth for a "conservation-reliant species" as defined by Scott *et al*. (2005, p. 884). Specifically, the threats to its continued existence are known and manageable, pervasive, and recurrent, and render the species at risk of extinction absent ongoing conservation management. Management actions sufficient to counter threats to the species have been identified and can be implemented, and Federal, State, and local governments, in cooperation with private interests, may be capable of carrying out the necessary management actions as long as necessary. In the future, the Steamboat buckwheat may be an ideal candidate for delisting once adequate provisions to protect its habitat have been successful through the type of recovery management agreement proposed by Scott *et al*. (2005, pp. 383-389).

Based on the results of this 5-year review, we conclude that Steamboat buckwheat still meets the definition of endangered, and we recommend no change in status at this time.

III. RESULTS

III.A. Recommended Classification:

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist (*Indicate reasons for delisting per 50 CFR 424.11):*
____ *Extinction*
____ *Recovery*
____ *Original data for classification in error*
_X_ No change is needed

III.B. New Recovery Priority Number __3__

Based on the preceding analysis, the Steamboat buckwheat continues to face a high magnitude of threat due to the lack of any formal type of conservation agreement, protective easement, or other means of ensuring the conservation of its habitat on the private lands on which an estimated 66 percent of the species population occurs. Despite the high level of threat, the species' needs are relatively well understood. The threats could be easily addressed if funding were available to secure the habitat, and intensive management of the population is not likely to be necessary; the species, therefore, has a high recovery potential. Geothermal development of the site where the single population occurs was previously considered to be in conflict with the conservation needs of the species, but is now considered to have provided additional protections to the habitat that would not now be in place had the area been converted to urban/residential use rather than industrial. We conclude, therefore, that the recovery priority of the Steamboat buckwheat should be raised from its current 6C to a new recovery priority of 3 (i.e., high degree of threat and high recovery potential).

IV. RECOMMENDATIONS FOR FUTURE ACTIONS – The highest priority should be given to recovery criterion 1, i.e., securing conservation easements or fee acquisition of the estimated 66 percent of the habitat which occurs on private lands. Given the generally industrial nature of the private lands leased by the geothermal company from the Dorothy Towne Trust, the purchase of a conservation easement to secure these populations is likely to be the best option for these lands. The only other parcel of private land, roughly 12 ac (4.9 ha) in size with an estimated 7 ac (2.8 ha) of habitat, would most likely be best acquired in fee title and transferred to either Nevada Division of State Lands or the BLM, with a subsequent recovery management agreement for the entire population to be developed with the NDF or other interested entity. Once the recovery management agreement, with adequate provisions for adaptive management, is in place, the species could be proposed for delisting.

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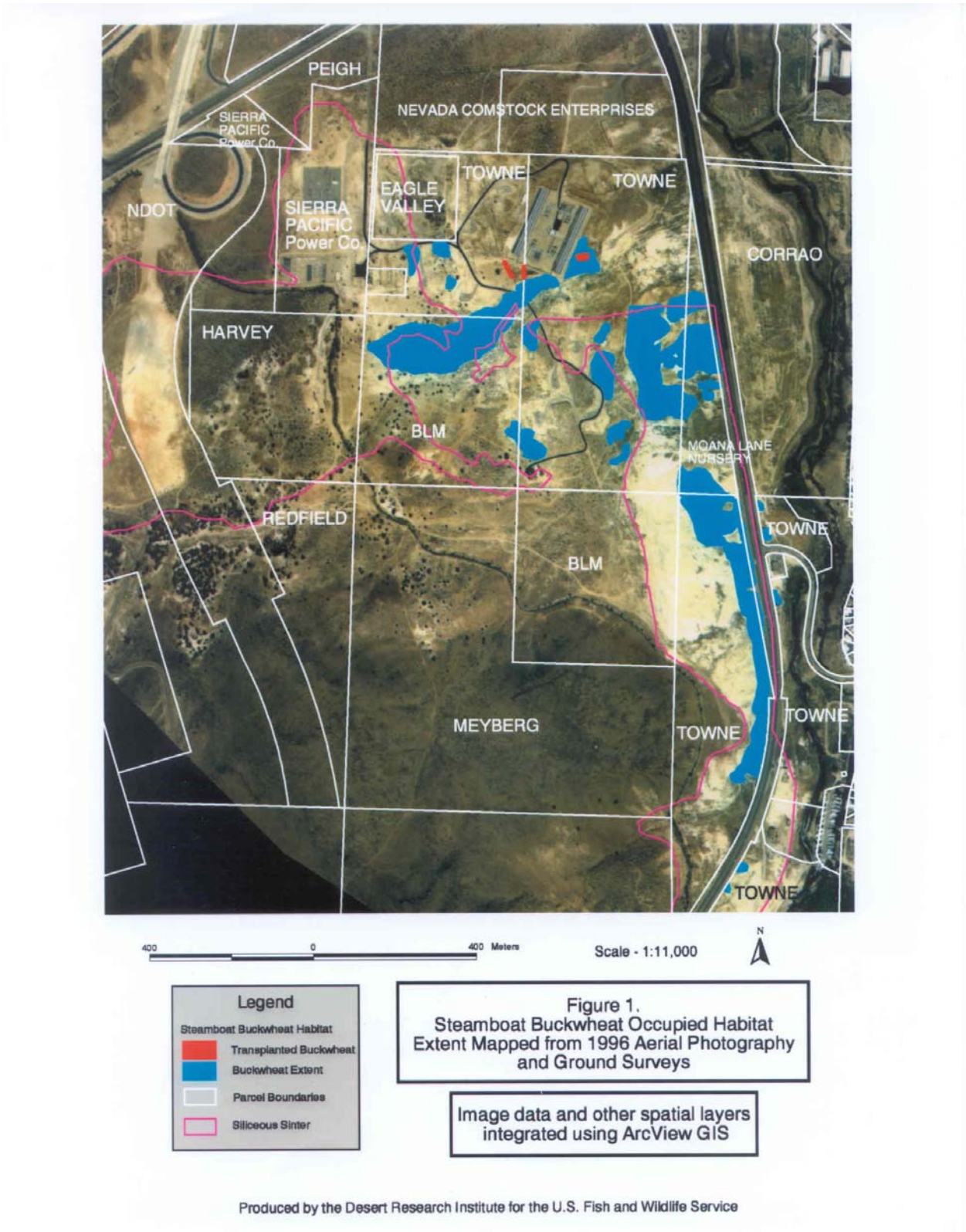

Figure 1. General distribution of *Eriogonum ovalifolium* var. *williamsiae* showing land ownership of parcels in the vicinity. The northern end of the Towne properties marks the urban boundary of Reno, Nevada; the central business district of Reno is 9.8 mi (15.7 km to the north.

U.S. FISH AND WILDLIFE SERVICE
5-YEAR REVIEW of *Eriogonum ovalifolium* var. *williamsiae*

Current Classification Endangered
Recommendation resulting from the 5-Year Review

____ Downlist to Threatened
____ Uplist to Endangered
____ Delist
__X__ No change is needed

Appropriate Listing/Reclassification Priority Number, if applicable _____

Review Conducted By Steve Caicco, Botanist, Nevada Fish and Wildlife Office, Reno

FIELD OFFICE APPROVAL:

for Lead Field Supervisor, Fish and Wildlife Service

Approve Jody E. Brown Date 1/13/09

REGIONAL OFFICE APPROVAL:

Lead Assistant Regional Director, Fish and Wildlife Service, Region 8

Approve [signature] Date 4/1/09