BEFORE THE SECRETARY OF THE INTERIOR

EMERGENCY PETITION TO THE U.S. FISH AND WILDLIFE SERVICE TO LIST TIEHM'S BUCKWHEAT (*Eriogonum tiehmii*) UNDER THE ENDANGERED SPECIES ACT AS AN ENDANGERED OR THREATENED SPECIES AND TO CONCURRENTLY DESIGNATE CRITICAL HABITAT

CENTER FOR BIOLOGICAL DIVERSITY
OCTOBER 7, 2019

Notice of Petition

David Bernhardt, Secretary
U.S. Department of the Interior
1849 C Street NW
Washington, D.C. 20240
exsec@ios.doi.gov

Margaret Everson, Principal Deputy Director
U.S. Fish and Wildlife Service
1849 C Street NW
Washington, D.C. 20240
margaret_everson@fws.gov

Paul Souza, Pacific Southwest Regional Director
U.S. Fish and Wildlife Service
Region 8 - Pacific Southwest Region
2800 Cottage Way, Room W-2606
Sacramento, CA 95825
paul_souza@fws.gov

Petitioner

Patrick Donnelly
Center for Biological Diversity
7345 S. Durango Dr., B-107 Box 217
Las Vegas, NV 89113
pdonnelly@biologicaldiversity.org

Pursuant to Section 4(b) of the Endangered Species Act ("ESA"), 16 U.S.C. § 1533(b); Section 553(e) of the Administrative Procedure Act, 5 U.S.C. § 553(e); and 50 C.F.R. § 424.14(a), the Center for Biological Diversity hereby petitions the Secretary of the Interior, through the United States Fish and Wildlife Service ("FWS," "Service"), to protect Tiehm's buckwheat (*Eriogononum tiehmii*) as endangered under the ESA. FWS has jurisdiction over this petition. This petition sets in motion a specific process, placing definite response requirements on the Service. Specifically, the Service must issue an initial finding as to whether the petition "presents substantial scientific or commercial information indicating that the petitioned action may be warranted." 16 U.S.C. § 1533(b)(3)(A). FWS must make this initial finding "[t]o the maximum extent practicable, within 90 days after receiving the petition." *Id.* Petitioner also requests that critical habitat be designated for Tiehm's buckwheat concurrently with the species being listed, pursuant to 16 U.S.C. § 1533(a)(3)(A) and 50 C.F.R. § 424.12.

We are requesting that this petition be considered on an emergency basis. BLM is allowing ongoing mineral exploration activities which are having immediate and significant impacts on this species. Further exploration activities cause a dire threat to the species, notwithstanding the broader overall threat of the mine actually being developed. Emergency protections are needed to avert extinction.

References will be sent on a flash drive to Reno FWS office, and can also be found here: https://drive.google.com/open?id=1p-QKfwSV39t_2TW_OAiFbcLEe1ROo0-y .

Petitioner the Center for Biological Diversity ("Center") is a nonprofit, public interest environmental organization dedicated to the protection of imperiled species and the habitat and climate they need to survive through science, policy, law, and creative media. The Center is supported by more than 1.6 million members and online activists throughout the country. The Center works to secure a future for all species, great and small, hovering on the brink of extinction. The Center submits this petition on its own behalf and on behalf of its members and staff with an interest in protecting Tiehm's buckwheat and its habitat.

Submitted this 7th day of October, 2019

Patrick Donnelly
Nevada State Director
Center for Biological Diversity
7345 S. Durango Dr., B-107, Box 217
Las Vegas, NV 89113
702.483.0449
pdonnelly@biologicaldiversity.org

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Executive Summary

Tiehm's buckwheat (*Eriogonum tiehmii*) is an extremely rare plant species in the buckwheat family (Polygonaceae) that grows in an isolated location in the Rhyolite Ridge area of the Silver Peak Range mountains of central Nevada. This plant grows in a highly restricted habitat type, consisting of specific substrate, within a narrow elevational band. It currently occupies fewer than ten acres of habitat spread across a three square mile area.

Tiehm's buckwheat is under immediate threat from mining exploration activity that has the potential to decimate a significant amount of this geographically sensitive plant's habitat. Already these activities are fragmenting populations. The exploration activity is a part of a plan to turn the area into an open-pit mine, likely destroying the entirety of the buckwheat's habitat. While the Bureau of Land Management ("BLM") lists Tiehm's buckwheat as a sensitive species, this has not stopped the agency from permitting exploration activities which have already impacted the buckwheat.

This emergency petition seeks Endangered Species Act protection for this nationally and globally imperiled species based on the best scientific information, in the context of the five listing factors. This petition also seeks to have the entirety of the buckwheat's known range designated as critical habitat in light of its highly restricted distribution and the severity of the threats it faces.

Figure 1: Tiehm's buckwheat flowering in its typical habitat, in population #1.
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Introduction

First named in 1985, Tiehm's buckwheat's six populations exist only in a small, isolated location in the Rhyolite Ridge area of the Silver Peak Range of Esmeralda County, Nevada. Extensive surveys indicate that the species' range is well characterized and there are no other populations of this plant. Due to the unique substrate the buckwheat grows in, the likelihood of new discoveries of additional populations is extremely low. This plant seems to be not only geographically isolated, but is a distinct species that is not known to hybridize. This limited, endemic species is vulnerable to a variety of anthropogenic factors including climate change, proliferation of invasive species, and off-road vehicle use, but mining presents the most significant and immediate threat.

Figure 2: Tiehm's buckwheat flowering. © Patrick Donnelly

I. NATURAL HISTORY

A. Description and Taxonomy

Tiehm's buckwheat (*Eriogonum tiehmii*) is a perennial herb in the wild buckwheat genus, *Eriogonum*.[1] *Eriogonium* is one of the largest genrea of vascular plants endemic to North America and is subdivided into seven subgenera: *Eucycla*, *Micrantha*, *Eriogonum*, *Oligogonum*,

[1] Reveal, 2007, p. 106.

Pterogonum, *Ganysma*, and *Oregonium*.[2] Tiehm's buckwheat is a member of subgenus *Eucycla*, which consists of perennials shrubs or herbs in the American West and Great Plains.[3] Dr. James L. Reveal first described Tiehm's buckwheat in 1985,[4] and Dr. John T. Kartesz recognized it as a valid species in *Flora of Nevada* in 1987.[5]

Kingdom	Phylum	Class	Order	Family	Genus
Plantae	Anthophyta	Dicotyledoneae	Caryophyllales	Polygonaceae	Eriogonum

Tiehm's buckwheat is a dense mounded herb that spreads low across the landscape. Its leaves are either white or gray, and the flower hue spans from white to cream to yellow.[6] Morefield (1995) provides a more detailed description:

> Perennial herb, forming low grayish clumps to 2 ft across; overall color bluish gray with pale yellow to reddish balls of flowers; leaves only at the base of the plant, upright to spreading, bluish gray in color, leaf blades longer than wide, to 1 inch long and less than 1/2 inch wide, gray hairy on both surfaces, petioles to 2/3 inch long; stems upright, unbranched, leafless, to 6 inches high, covered with hairs; flower cups bell-shaped or nearly so, l/6-l/5 inch long, narrower than long, hairy on the outside; flowers (May-June) in tight balls, light yellow to cream, aging lighter and/or turning red with age, 1/9- 1/6 inch long, flower parts 6, longer than wide, fused for 1/5-l/4 of their length, with stalked glands on the outside; stamens extending beyond flower parts, stalks about 1/6 inch long, hairy at base; seeds (May-July) light brown, about 1/6 inch long, 3-angled at tip, triangular in outline.[7]

B. Range

In the United States, Tiehm's buckwheat only exists between 5,960 and 6,200 feet elevation in the Rhyolite Ridge area of the Silver Peak Range of Esmeralda County, Nevada within the Great Basin Desert.[8] A 1995 species summary described six known occurrences, with about 20,000 plants in total, within an area less than nine hectares, or three square miles. [9] (See Figure 3 below.) A 2019 survey conducted for a mineral exploration company found eight populations, counting 43,000 plants in total, covering approximately 10 acres across a three square mile area.[10,11] Surveys for other potential sites yielded no discoveries of additional populations,[12] and

[2] *Id.* at 108.
[3] *Id.*
[4] Reveal, 1985.
[5] NNHP, 2001.
[6] Reveal, 2007.
[7] Morefield, 1995, p. 6.
[8] *Id.*
[9] *Id.*
[10] Kuyper, 2019.
[11] The 1995 Morefield paper has been the defining document for Tiehm's buckwheat for decades. While the 2019 survey found possible individuals separate from Morefield's six populations, they have not been confirmed and may or may not qualify as another population. This petition uses Morefield's population numbers throughout.

the likelihood of additional populations being discovered is very low.[13] According to BLM correspondence, extensive searches performed between 2008 and 2010 by Morefield yielded no new populations.[14]

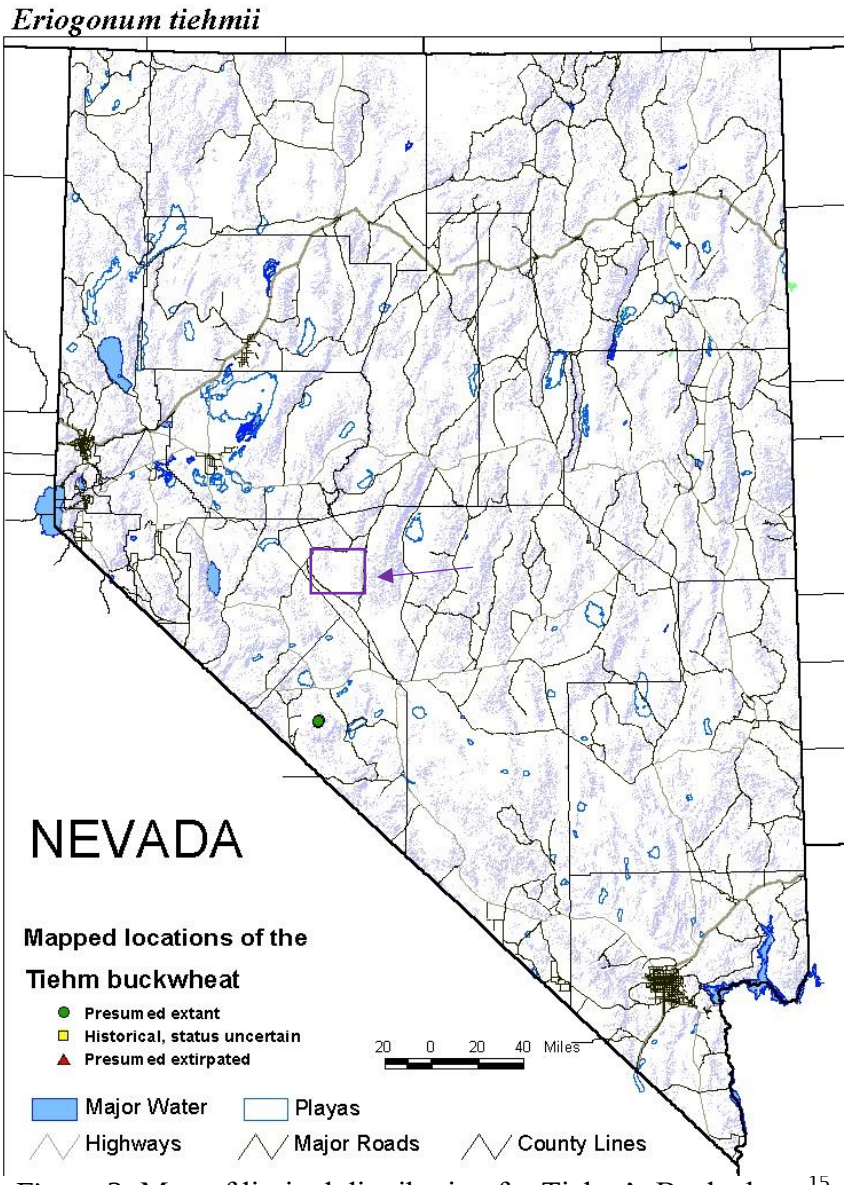

Figure 3: Map of limited distribution for Tiehm's Buckwheat.[15]

A 2019 monitoring event conducted by EM Strategies for the US Fish and Wildlife Service is likely the most comprehensive survey to date. (See Figure 4 below).

[12] Morefield, 1995, p. 14.
[13] *Id.*
[14] FOIA #1.
[15] NNHP, 2001.

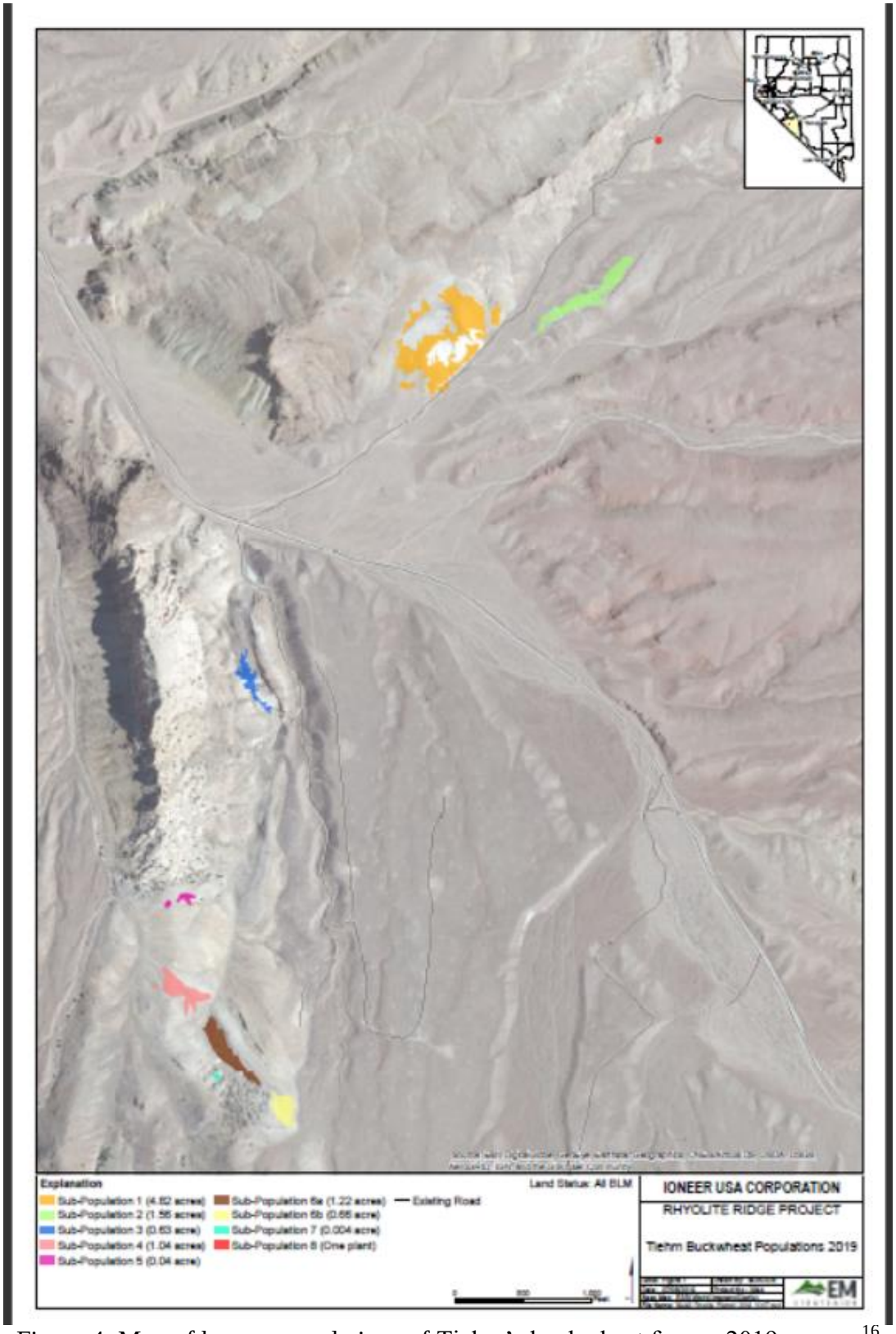

Figure 4: Map of known populations of Tiehm's buckwheat from a 2019 survey.[16]

[16] Kuyper, 2019.

C. Habitat

Tiehm's buckwheat is a locally endemic species adapted to a specialized substrate called channery soil, which consists of 15 to 35 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist.[17]The substrate consists of dry, open, barren clay soils that come from a formation of interbedded claystones, shales, and limestone local to the Rhyolite Ridge area.[18] Tiehm's buckwheat also only grows on specific soil conditions where the bedrock has either fractured, eroded, or weathered to form poor soils on upland sites.[19] Given its mere 10 acres of current occupied habitat, there are other unknown factors which determine suitable habitat, since most of the channery soil outcrops do not contain occupied habitat. Generally the area surrounding the buckwheat's habitat is Great Basin sagebrush shrubland.[20] Within the Basin, sagebrush shrubland is primarily found at elevations 3,940-5900 ft on pediments, bajadas and foothills.[21] It lives on slopes from 5,960-6,200 feet in elevation in pure stands and appears restricted to low-competition conditions with very few individuals of other associated plant species present.[22] Within its restrictive range, there is a sparse cover of shadscale saltbrush (*Atriplex confertifolia*), James' galleta (*Pleuraphis jamesii*), alkali sacaton (*Sporobolus airoides*), and a few other plant species.[23]

D. Reproduction

While Tiehm's buckwheat reproduction remains unstudied, buckwheat's in general are known to reproduce sexually.[24] Tiehm's buckwheat produces seed, and primary seed dispersal agents include gravity, wind, and water.[25] Tiehm's buckwheat flowers from May throughout June, and seeds disperse from June through July.[26] Timing may vary depending on precipitation and temperature fluctuation in the Silver Peak Range of the Great Basin.[27] In fact, low precipitation could prevent reproductive activity in its entirety.[28] Tiehm's buckwheat appears to be distinct from all related species of buckwheat and is not known to hybridize.[29]

E. Current and Historic Distribution

After thorough searches by scientists, there are only six known populations of Tiehm's buckwheat with a total of approximately 20,000-43,000 plants.[30] The overall area where the entire range of the species occurs is less than three square miles, and the total occupied habitat

[17] USDA, 2015, p. 7.
[18] Morefield, 1995, p. 10.
[19] Tiehm, 1994, p. 11-12.
[20] Wrangle, 2019.
[21] *Id.*
[22] Morefield, 1995, p. 10.
[23] NNHP 2001.
[24] Reveal, 1985.
[25] *Id.*
[26] Morefield 1995, p. 14.
[27] Tiehm, 1994.
[28] *Id.* at 13-14.
[29] Morefield 1995, p. 14.
[30] NNHP, 2001 and Kulpa, 2019.

within that area is less than 10 acres.[31] Tiehm's buckwheat is a narrow endemic that is restricted to a specific substrate, so this limits its distribution.[32] These six populations of Tiehm's buckwheat are extremely small, morphologically distinct, geographically isolated, and ecologically specialized.[33]

II. LIMITED CONSERVATION STATUS MEANS ENDANGERED SPECIES ACT PROTECTION IS WARRANTED

The ESA is a "comprehensive scheme with the 'broad purpose' of protecting endangered and threatened species." Ctr. for Biological Diversity v. U.S. Bureau of Land Mgmt., 698 F.3d 1101, 1106 (9th Cir. 2012) (quoting Babbitt v. Sweet Home, 515 U.S. 687, 698 (1995)). Congress' plain intent in enacting the ESA was "to halt and reverse the trend toward species extinction." Tenn. Valley Auth. v. Hill, 437 U.S. 153, 184 (1978). In doing so, the ESA requires that "all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of [these] purposes." 16 U.S.C. § 1531(c)(1) (2012). Endangered and threatened species are "afforded the highest of priorities." Tenn. Valley Auth., 437 U.S. at 174. Endangered species are species that are "in danger of extinction throughout all or a significant portion of its range," and threatened species, species that are "likely to become endangered species within the foreseeable future" and are listed for protection pursuant to section 4 of the ESA. 16 U.S.C. § 1532(6), 1532(20), 1533.

According to NatureServe, Tiehm's buckwheat is critically imperiled globally because of its extreme rarity, which makes it especially vulnerable to extinction.[34] It also lists it as critically imperiled in the United States for the same reasoning.[35] BLM listed Tiehm's buckwheat a sensitive species in 2017 under its mandate to "[implement] measures to conserve these species and their habitats…to promote their conservation…"[36] However, it is not a state listed species.[37]

The ESA defines an endangered species as "any species which is in danger of extinction throughout all or a significant portion of its range" and a threatened species as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." The ESA states that a species shall be determined to be endangered or threatened based on any one of five factors (16 U.S.C. § 1533 (a)(1)): 1) the present or threatened destruction, modification, or curtailment of its habitat or range; 2) overutilization for commercial, recreational, scientific, or educational purposes; 3) disease or predation; 4) the inadequacy of existing regulatory mechanisms; and 5) other natural or manmade factors affecting its continued existence.

Tiehm's buckwheat is threatened by at least three of these factors and thus qualifies for federal protection. The species is threatened by present or threatened destruction, curtailment, or

[31] *Id.*
[32] Grady, 2012, p. 127.
[33] *Id.*
[34] NatureServe. 2019.
[35] *Id.*
[36] BLM, 2017a.
[37] NNHP, 2019.

modification of habitat or range, lack of existing regulatory mechanisms to protect it from these threats, and other natural or manmade factors that affect the continued existence of the species.

III. THREATS

A. Present or Threatened Destruction, Curtailment, or Modification of Habitat or Range

Morefield (1995) noted that most sites of Tiehm's buckwheat occurrence faced impacts from past mineral exploration and extraction,[38] including leftover claims markers, trenches, and mine shafts where the plant colonized.[39] Sites where Tiehm's buckwheat exists likewise are open to mineral exploration and development.[40] The extent of Tiehm's buckwheat's range is all on public land owned by BLM in the Battle Mountain District.[41] In fact, nearly 65% of the entire sagebrush habitat ecosystem of the Great Basin occurs on federal land.[42] In Esmerelda County, approximately 98% of the land is administered by the federal government and 95% managed by BLM.[43] Habitat loss and degradation in this ecosystem is substantial and projected to accelerate.[44] One reason is mining activity. Morefield concluded that "[mining] may modify or destroy habitat in the future,"[45] and that future is occurring now.

Ioneer, formerly known as Paradigm Minerals and Global Geoscience Limited, is an Australian-based developer with plans to mine for lithium-boron deposits in Rhyolite Ridge.[46] The site layout includes an "open pit, process plant, haul roads, overburden storage, leach residue storage and salt storage."[47] The developer says the project has a total surface disturbance footprint of less than one square mile.[48] However, that one square mile is within the three square mile range the Tiehm's buckwheat, and all of the six known populations are within the project area.[49] Preliminary designs actually call for a rock quarry to entirely encompass populations #1 and #2 (as designated by Morefield). (See Figure 4 Below).

The unique soil type needed for Tiehm's buckwheat is restricted to the Rhyolite Ridge region.[50] This soil type also consists of lithium and boron, which are economically extractable.[51] Ioneer is engaged in exploration activities on two sites, Rhyolite Ridge and South Infill, that are within the isolated habitat of Tiehm's buckwheat.[52]

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[38] Morefield, 1995, p. 15.
[39] *Id.*
[40] *Id.*
[41] BLM 2017b.
[42] Wisdom, 2003.
[43] Douhan, Mandeno, and O'Brien, 2009, p. 16.
[44] Wisdom, 2003, p. 15.
[45] Morefield, 1995, p. 15.
[46] Global Geoscience, 2018a.
[47] *Id.*
[48] *Id.*
[49] EM Strategies, 2019.
[50] *Id.* at 3.
[51] Global Geoscience, 2018b.
[52] *Id.*; *see also* EM Strategies, 2019.

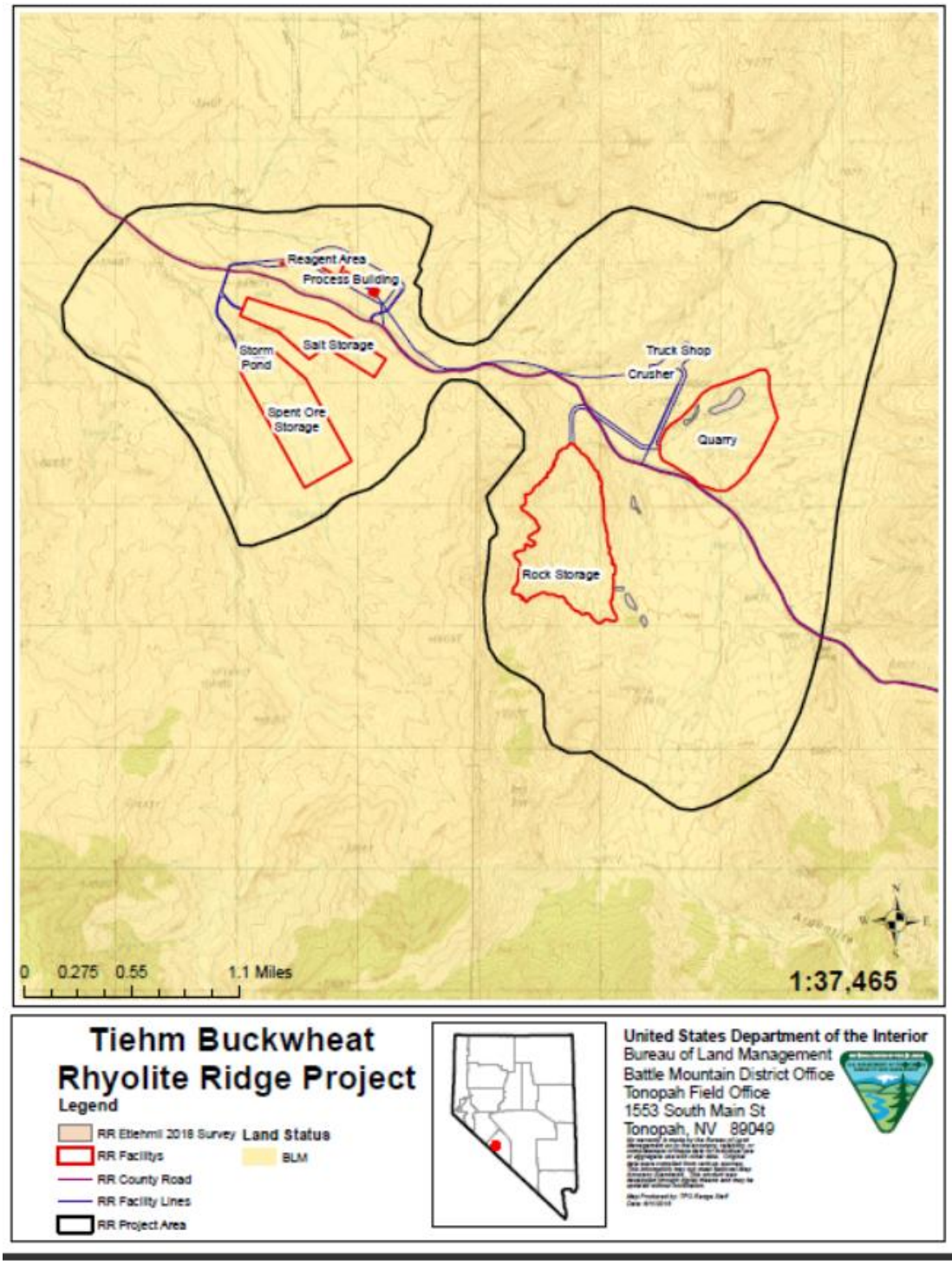


Figure 4: Map obtained through FOIA depicting the proposed project area and facilities. Tiehm's buckwheat is indicated by small pink polygons. Note that populations #1 and #2 are completely contained within the quarry area.[53]

[53] FOIA #3.

While the development of a full open-pit mine threatens the very existence of Tiehm's buckwheat, there are ongoing and future exploration activities occurring at the site which are causing grave impacts to the buckwheat right now. There are two concurrent exploration projects: Rhyolite Ridge (NVN-097202) and South Infill (NVN-097262) depicted below in Figure 5.

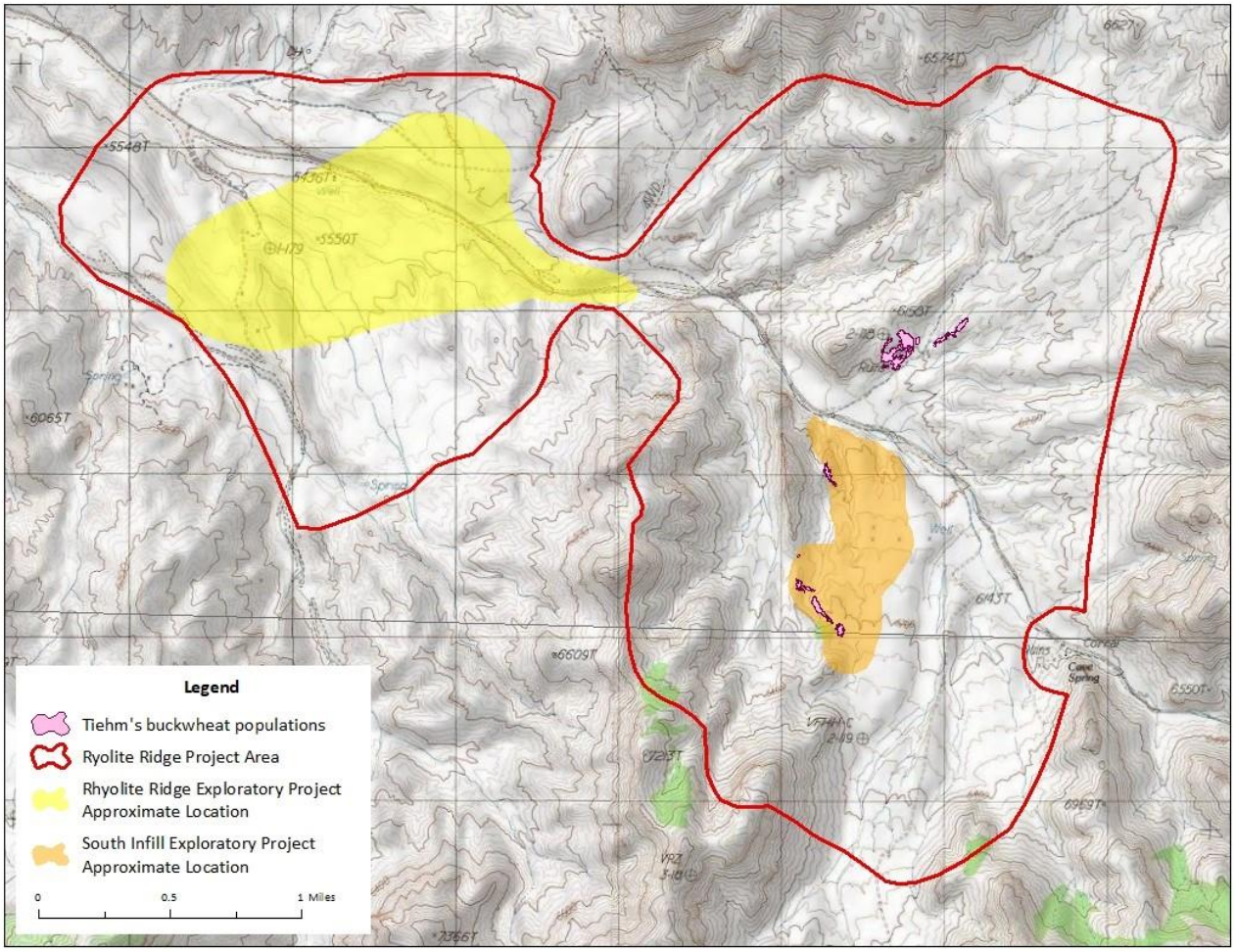


Figure 5: Locations of mining and exploration projects in relation to known populations of Tiehm's buckwheat. Note that South Infill Exploratory Project contains all of populations #3-#6 (as designated by Morefield). Map: Kara Clauser, CBD.

A site visit on June 1, 2019 revealed extensive recent impacts to the areas where Tiehm's buckwheat grows, including road grading, well pad grading and drilling, and excavation activities. In particular, one road was bladed between populations #4 and #5 (as designated by Morefield), coming within just a few feet of individual plants, and potentially irreversibly severing connectivity between the two populations. (See Figures 6 and 7 below).

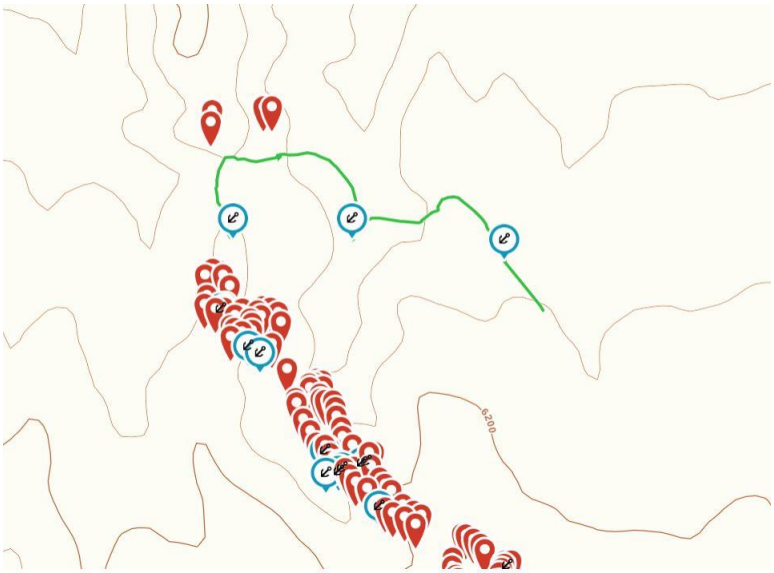


Figure 6: Map of field data collected June 1, 2019 by P Donnelly and N Fraga. Red marks indicate Tiehm's buckwheat (non-comprehensive). Population #5 (as designated by Morefield) is to the north, population #4 south of that, and population #6 trends southeast from there. Anchor marks are test pits or well pads, and the green line is the newly graded road, which impacts connectivity between populations #4 and #5.

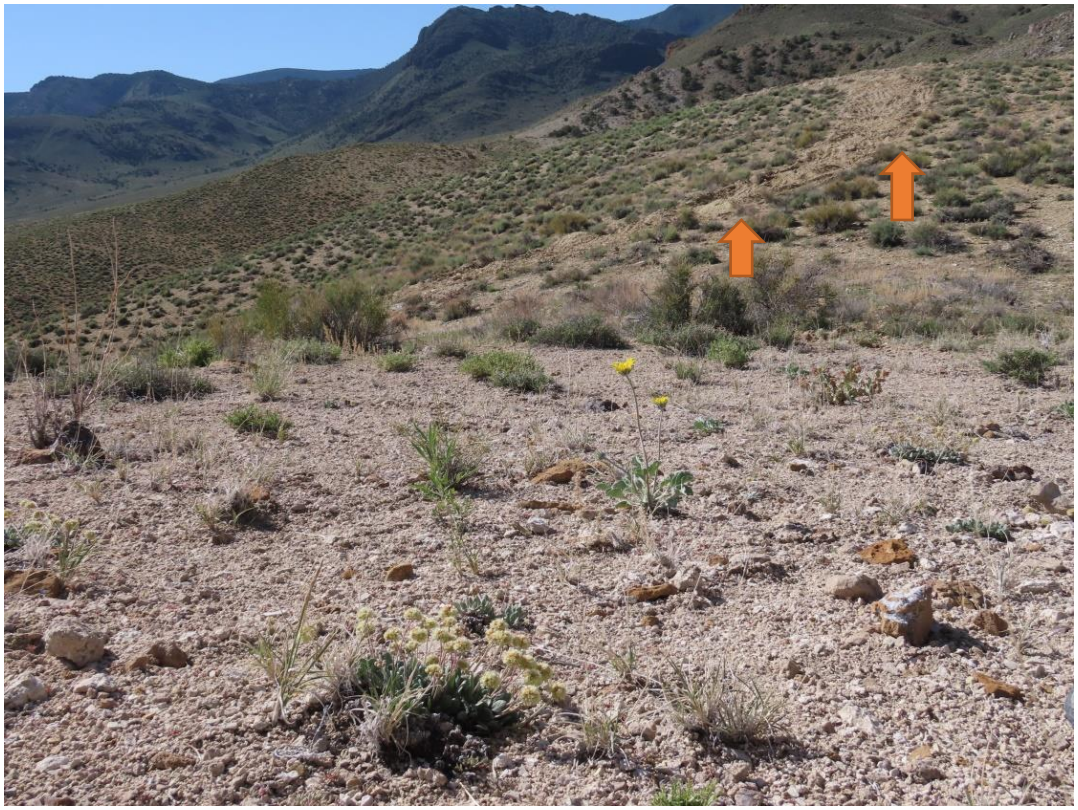


Figure 7: Newly graded road visible (upper third of photo) from within area of population #5. © Patrick Donnelly

Activities include grading roads, drilling test wells and boreholes, and digging pits.[54] The South Infill and Rhyolite Ridge project sites encompass a significant portion of the Tiehm's buckwheat habitat.[55] Tiehm noted in 1994 that due to its small area of occurrence, "any human caused disturbances would have a severe impact on the populations and the eventual existence of species." [56]Additionally, Morefield (1995) noted that exploration activities "will continue to threaten *Eriogonum tiehmii* with extinction indefinitely under present circumstances."[57]

BLM has allowed exploration activities to be conducted authorized under the 1872 Mining Act as "notice"-level projects. As can be seen in the notice document for South Infill (NVN-097262), the words Tiehm's buckwheat are not even mentioned, including in the section entitled "Measures Taken to Prevent Unnecessary or Undue Degradation."[58]

The exploration projects are particularly concerning because they have not undergone any environmental impacts analysis through the National Environmental Policy Act (NEPA). Under the 1872 Mining Act, projects are eligible as "notice"-level if they impact fewer than 5 acres. However, in this case BLM has permitted two exploration projects of just below 5 acres directly proximate to each other to be filed as separate "notices," thus preventing NEPA analysis of the project. South Infill (NVN-097262) is 4.21 acres[59] and Rhyolite Ridge (NVN-097202) is 4.98 acres,[60] for a total of 9.19 acres of impact within a single defined project area (see Figure 4 below). BLM is clearly not fulfilling any mandate it has to protect this species, due to its sensitive species status or otherwise, by allowing these exploration projects to continue without doing a NEPA analysis.

There is extensive road-building entailed in these projects: over 1.5 miles of road were built for South Infill alone (see Figure 8 below). At times, while buckwheat may be directly avoided, excavation is occurring in areas completely surrounded by occupied habitat (see Figure 9 below).

[54] Global Geoscience, 2018a.
[55] EM Strategies, 2019.
[56] Tiehm, 1994.
[57] Morefield, 1995, p. 17.
[58] FOIA #4.
[59] *Id*.
[60] FOIA #5.

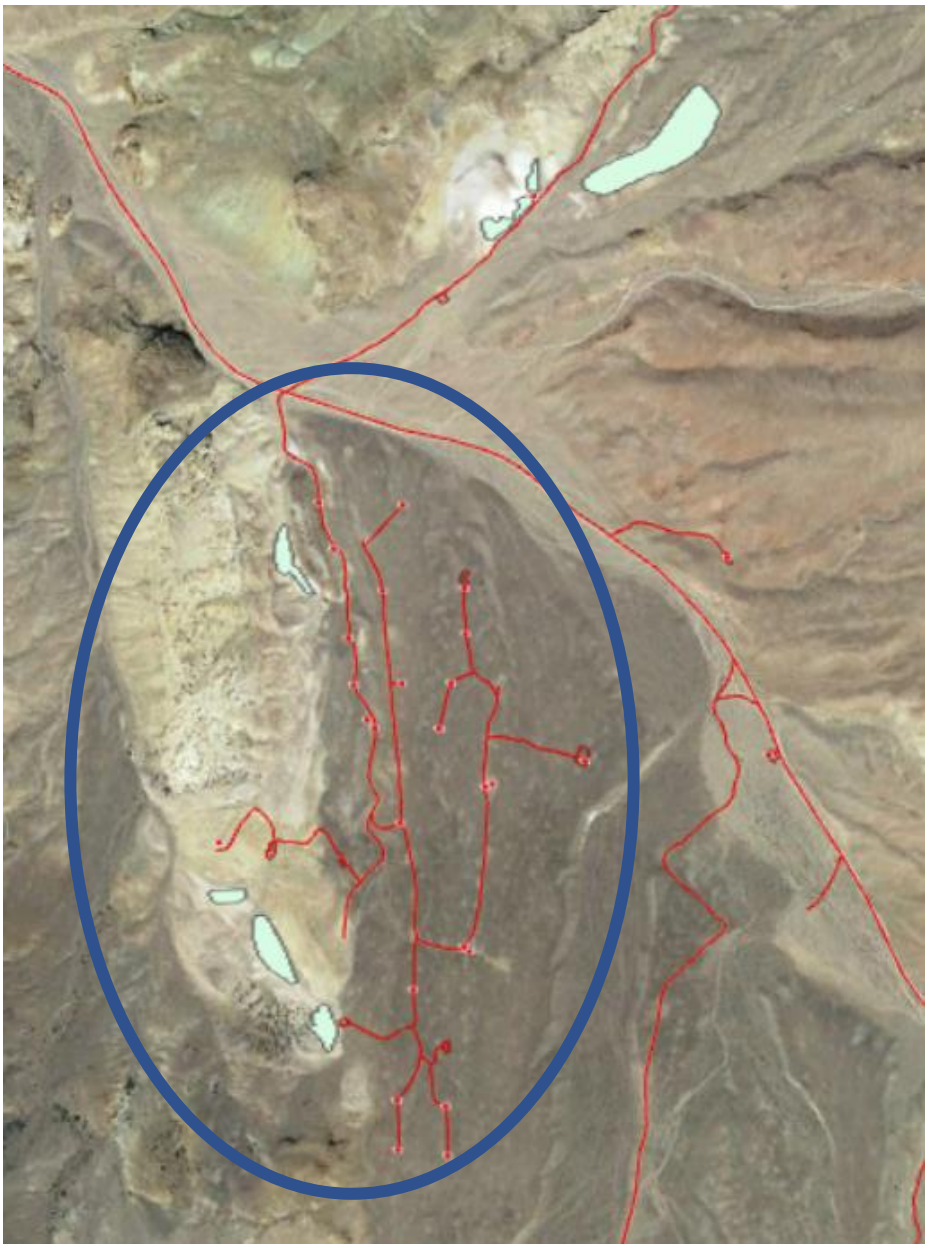


Figure 8: South Infill Project, new road construction circled in blue. Tiehm's buckwheat from a partial survey in 2018 are depicted on this map in light blue.[61] There are more populations and they are of greater extent than are depicted here using this older dataset. For more current Tiehm's buckwheat distribution data see Figure 3 above and Kuyper, 2019.

[61] Data from FOIA #6.

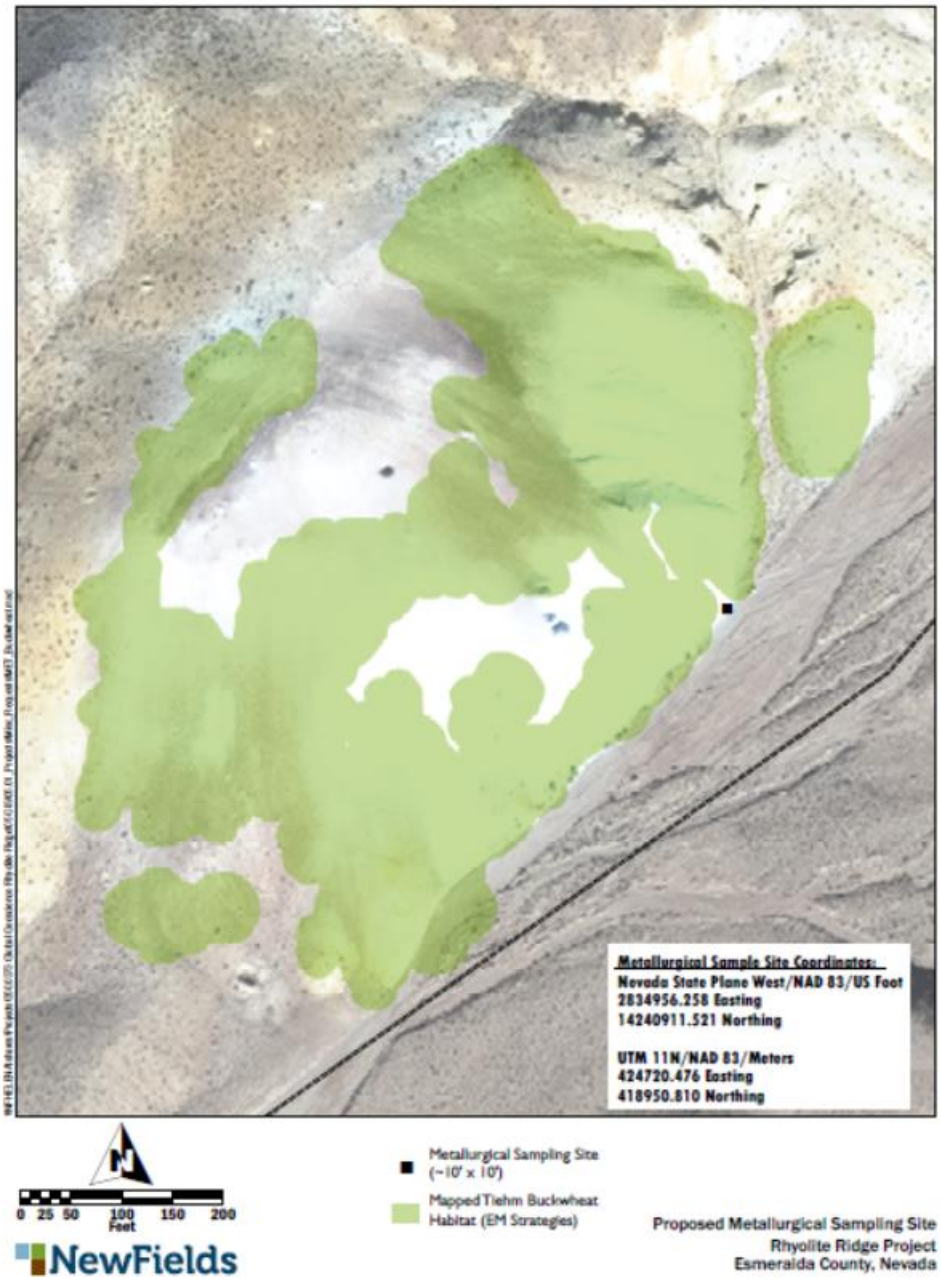


Figure 9: Map obtained through FOIA from BLM depicting an excavation site completely surrounded by occupied Tiehm's buckwheat habitat.[62]

[62] FOIA #2.

Figure 10: Mining activity including equipment and a water bladder seen adjacent to Tiehm's buckwheat in population #1. © Patrick Donnelly

Figure 11: Area of substantial new impact (road and well pad) from mineral exploration activity as seen immediately above the person in this photo, as seen from within population #6 (as designated by Morefield). © Patrick Donnelly

B. Overutilization

Overutilization is not known to pose a significant threat to *E. tiehmii*.

C. Disease and Predation

Disease and predation are not known to pose a significant threat to *E. tiehmii* at this time.

D. Inadequacy of Existing Regulatory Mechanisms

Tiehm's buckwheat lives entirely on BLM land in the Battle Mountain District.[63] Its designation as a BLM sensitive species means that it is a:

> native species found on BLM administered lands for which the BLM has the capability to significantly affect the conservation status of the species through management and…The species depends on ecological refugia or specialized or unique habitats on BLM administered lands, and there is evidence that such areas are threatened with alteration such that the continued viability of the species in that area would be at risk.[64]

However, as demonstrated above under III(A), this designation is not preventing or curtailing imipacts to Tiehm's buckwheat, leaving it vulnerable to immediate and future threats. BLM appears to be taking no special actions to conserve the species despite this designation.

There is only one known location of this plant on the planet. Though there is evidence that anthropogenic activity such as mining, cattle grazing, and off-road vehicles threaten the viability of the species, Tiehm's buckwheat has yet to gain an endangered or threatened listing designation on either the state or federal level.[65] Additionally, there are no conservation plans for Tiehm's buckwheat nor is there critical habitat designation.[66] At this time, there are no existing regulatory mechanisms that adequately protect Tiehm's buckwheat or its habitat.

[63] BLM, 2017b.
[64] BLM, 2017a.
[65] ECOS, 2019.
[66] Id.

E. Other Natural or Manmade Factors that Affect the Continued Existence of the Species

In the Great Basin Desert, the sagebrush (*Artemisia* spp.) ecosystem, which associates with Tiehm's buckwheat, faces a wide range of threats including invasive species, wildland fires, invasive plants, roads, oil and gas development, and climate change.[67] Three of the greatest threats faced directly by Tiehm's buckwheat are invasive species, off-road vehicle use, wildland fires, and climate change.

i. Invasive Species

Invasive species pose a significant threat to biodiversity worldwide and have dramatically altered landscapes across the Great Basin Desert. The primary invasive species which appears to be occurring in the immediate habitat of Tiehm's buckwheat is *Halogeton glomeratus* (saltlover).

Halogeton was accidentally introduced to the Great Basin in the early 20th century, and by mid-century had spread to all of the Intermountain and mountain west states.[68] Its invasion typically follows human disturbance, including being associated with overgrazing and road construction.[69] It is highly adapted to saline and mineralized soils, though not exclusive to them.[70] *Halogeton* has many of the characteristics common to successful invasive species.[71] It is poisonous to domestic sheep, and thus has been the subject of extensive eradication efforts for many decades.[72]

Halogeton was observed within and adjacent to all populations of Tiehm's buckwheat on June 1, 2019. However, upon revisiting on August 29, 2019, it was clear that *Halogeton* was rapidly spreading in the areas of recent disturbance from mining exploration. In the photo below, *Halogeton* can be observed colonizing a newly graded road between populations #4 and #5 (as delineated by Morefield). (See figure 12 below). Similar phenomena were observed at all graded roads and well pads.

[67] Rowland, *et al.*, 2010, p. 673.
[68] Young and Longland, 1996.
[69] Duda, *et al.*, 2003.
[70] Young, 2002.
[71] Duda, *et al*., 2003.
[72] *Id.*

Figure 12: *Halogeton* growing in the road depicted in Figure 7, three months later.
© Patrick Donnelly, 2019

Existing and ongoing disturbance from mining exploration activity presents and immediate and ongoing threat to Tiehm's buckwheat due to it opening vectors for invasive species such as *Halogeton*.

ii. Off Road Vehicles

One of several major threats in the Great Basin region is use of off-road vehicles. It is one of the fastest-growing forms of outdoor recreation, and unauthorized use of unpaved roads and trails and many acres open land leads to associated resource damage and management issues.[73] Off-road vehicle use is often connected to certain ecological challenges, including increased soil compaction and erosion, disrupted hydrologic function, damage to living plants, diminished seed germination and seedling establishment, decreased soil moisture and nutrients, increased spread of invasive plants, and increased pollution levels.[74]

Mineral exploration activities within the habitat of Tiehm's buckwheat have included grading new roads. This will encourage off-road vehicle activity in areas which did not previously have any, leading vehicular users directly into the habitat of the buckwheat. The newly graded roads, if they are through being used, have not been restored, and it's likely that off-road activity will occur, especially into the area surrounding populations #4 and #5 (as delineated by Morefield).

iii. Wildfires

Wildfires are a serious threat in the Great Basin. In fact, interactions between fire and nonnative, annual plant species represent one of the greatest threats to habitats in the Great Basin Desert, where Tiehm's buckwheat occurs.[75] During the 2007 fire season, approximately 2.7 million acres burned in the Great Basin.[76] In Nevada, about five percent of land burns per decade since 1984.[77] Wildfire spreads quickly in this area, and wildfire behavior becomes more severe when lands become invaded with exotic plants and increase in frequency with extreme wet/dry conditions.[78] This increase in extreme wildlife behavior puts firefighters and the public at risk, and that risk continues to rise.[79] Exotic annual grasses become fuel for fires in dry seasons.[80] Wildfires also contribute to weed expansion, soil erosion, and carbon loss in shrublands, where Tiehm's buckwheat lives in adjacency.[81]

iv. Climate change

Data from the past 50,000 years displays that the Great Basin is a highly sensitive indicator for climatic change.[82] Heat waves are more common throughout the southwestern United States with an earlier spring melt.[83] The state of Nevada recorded a temperature increase of two degrees

[73] Wrangle, 2019.
[74] *Id.*
[75] Sinneman, *et al.*, 2018, p. 2.
[76] Pellant, 2007.
[77] EPA, 2016.
[78] Pellant, 2007.
[79] *Id.*
[80] *Id.*
[81] *Id.*
[82] Chambers, 2016, p. 49.
[83] EPA, 2016.

Fahrenheit within the last century.[84] The effects of rapid climate change present a unique challenge to the endemic plants of this region.[85]

Endemic plants are at far greater risk of extinction, and narrow endemic plants that are restricted to specific soil types and within a narrow elevation band are the most vulnerable. Both conditions apply to Tiehm's buckwheat.[86] Additionally, climate change leads to changes in precipitation patterns and trends.[87] Currently, average temperature for the summer in the Great Basin is 83 degrees, but projections show an increase of eight to twelve degrees.[88] As snow pack shrinks and days grow warmer, the soil begins to dry out. This causes an inability to provide moisture to plants.[89] Additionally, with a growing fire threat in Nevada, trees and plants become sources for carbon emissions, which increases the global warming trend.[90] As temperatures increase, so does the likelihood for species shifts.[91] There is a high probability of localized extinctions and displacement of native species with shifts in distribution and abundance for sensitive plants species.[92] Moreover, as rain events become rarer, the risk of a "drought lasting longer than 35 years"[93] goes up by 50 percent, and "persistent drought" goes up by 30-40 percent in southern Nevada.[94] Variability in precipitation is harmful to Tiehm's buckwheat. In fact, low precipitation could prevent reproduction and recruitment of new individuals from the seed bank.[95]

v. Grazing

Like nearly all BLM-managed public lands in the Great Basin Desert, the Silver Peak Range is part of an active grazing allotment. The effects of cattle grazing on Tiehm's buckwheat are unknown. While there was evidence of cattle in the general area, direct herbivory or trampling was not observed. It should be noted that in other areas, cattle grazing has been shown to reduce the volume and average size of buckwheat plants.[96] And in general, cattle grazing has had significant impacts on the Great Basin Desert. Further study is required to know if cattle grazing poses a direct threat to the buckwheat.

[84] *Id.*
[85] Chambers, 2016, p. 49.
[86] Caicco, *et al.*, undated.
[87] Wrangle, 2019.
[88] Skelly, 2019.
[89] *Id.*
[90] *Id.*
[91] Chambers, 2008.
[92] *Id.*
[93] Skelly, 2019.
[94] *Id.*
[95] Tiehm, 1994.
[96] Cushman, 2009.

IV. CONCLUSION

Tiehm's buckwheat is a rare plant species that is dependent on a unique soil type at a certain altitude. There are only six known populations covering a total of less than ten acres within a three square mile area in southern Nevada on the Silver Peak Range. Tiehm's buckwheat warrants ESA protection because it is threatened by modification or curtailment of its habitat or range because of mining and extraction activities and other threats including off-road vehicule use, wildfires, invasive species, cattle grazing, and climate change impacts within the region. There are no existing regulatory mechanisms to prevent the plant's extinction. Tiehm's buckwheat needs ESA protection for its continued existence. Ongoing exploration and development for mining and extraction projects is a major threat to future conservation of this species. Without ESA protection, this endemic plant is at risk of extinction in the foreseeable future. We urge the Service to propose Tiehm's buckwheat for listing as endangered and to designate critical habitat to ensure that it survives for future generations.

V. REQUEST FOR CRITICAL HABITAT DESIGNATION

Critical habitat as defined by Section 3 of the ESA is: (i) the specific areas within the geographical area occupied by a species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) the specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the Secretary that such areas are essential for the conservation of the species.[97]

Congress recognized that the protection of habitat is essential to the recovery and/or survival of listed species, stating that: classifying a species as endangered or threatened is only the first step in insuring its survival. Of equal or more importance is the determination of the habitat necessary for that species' continued existence. If the protection of endangered and threatened species depends in large measure on the preservation of the species' habitat, then the ultimate effectiveness of the Endangered Species Act will depend on the designation of critical habitat.[98]

Critical habitat is an effective and important component of the ESA, without which Tiehm's buckwheat has a minimal long- term chance for survival. The Center thus requests that the Service propose critical habitat for all currently occupied Tiehm's buckwheat habitat concurrently with its proposed listing.

[97] 16 U.S.C. § 1532(5) (2018).
[98] H. Rep. No. 94-887 at 3 (1976).

VI. REFERENCES

BLM, 2017a. "Nevada Sensitive and Status Species List", U.S. Dept. of the Interior (Nov. 22, 2017), https://www.blm.gov/download/file/fid/23564.

BLM, 2017b. "Updated Bureau of Land Management (BLM) Sensitive Species List for Nevada," U.S. Dept. of the Interior (November 22, 2017) https://www.blm.gov/policy/nv-im-2018-003.

Caicco, Steve, Edwards, Fred, and Bair, Janet, undated. "Vulnerability of the rarest plants in the Great Basin of Nevada to climate change." https://www.utahrareplants.org/miscpdf/GreatBasinposter.pdf

Chambers, Jeanne C., 2008. "Climate Change and the Great Basin", U.S. Dept. of Agriculture. https://www.fs.fed.us/rm/pubs/rmrs_gtr204/rmrs_gtr204_029_032

Chambers, Jeanne C., 2016. "Great Basin Factsheet Series 2016 - Information and tools to restore and conserve Great Basin ecosystems," Great Basin Fire Science Exchange. https://www.fs.fed.us/rm/pubs_journals/2016/rmrs_2016_chambers_j003.pdf

Cushman, J. Hall, 2009. "Impacts of Cattle Grazing on the Smith's Blue Butterfly, Its Host Plant and the Surrounding Plant Community." Unpublished report.

Douhan, Carl, Mandeno, Esther, and O'Brien, Dan, 2009. "Landscape-Scale Wildland Fire Risk/Hazard/Value Assessment For Esmeralda County, Nevada." http://forestry.nv.gov/wp-content/uploads/2013/12/Esmeralda-County-Assessment-Final.pdf

Duda, Jeffrey J., Freeman, D. Carl, Emlen, John M., Belnap, Jayne, Kitchen, Stanley G., Zak, John C., 2003. "Differences in native soil ecology associated with invasion of the exotic annual chenopod, *Halogeton glomeratus*." *Biol. Fertil. Soils 38:*72-77.

ECOS, "Species Profile for Tiehm's buckwheat *(Eriogonum tiehmii)*", U.S. Fish and Wildlife Service. https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=4217

EM Strategies, 2019. "2019 Tiehm Buckwheat Survey Plan: Draft". (On file with the Bureau of Land Management, Battle Mountain District).

EPA, 2016. "What Climate Change Means for Nevada." https://19january2017snapshot.epa.gov/sites/production/files/2016-09/documents/climate-change-nv.pdf

FOIA #1. E-mail from James Morefield, Nevada Natural Heritage Program, to Brandon Crosby, BLM Tonopah (June 4, 2018, 18:23 MDT).

FOIA #2. Map attachment to e-mail from Mark Travis, Project Geologist of Newfields, to Melissa Jennings and other BLM Tonopah staff (Mar 08 2019 15:12 MST).

FOIA #3. Map attachment to e-mail from Daltry Balmer, BLM Tonopah, to various BLM and USFWS staff (June 11, 2018, 12:20 MDT).

FOIA #4. South Infill Mineral Exploration Project Notice, Case File #NVN-097262, Revision #3, from e-mail to Cayenne Engel, Nevada Division of Forestry, from Brandon Crosby, BLM Tonopah (July 01, 2019 10:59 MDT).

FOIA #5. Rhyolite Ridge Mineral Exploration Project Notice, Case File #NVN-097202, Revision #3. Obtained in-person at Tonopah Field Office on June 10, 2019.

FOIA #6. South Infill Project GIS data in a *.kmz file in an email from Melissa Jennings, Tonopah BLM to Brandon Crosby, Tonopah BLM.

Global Geoscience, 2018a. "Development Plans Unveiled for the Rhyolite Ridge Lithium-Boron Project, GLOBALNEWSWIRE.COM (June 5, 2018 21:22 PM). https://www.globenewswire.com/news-release/2018/06/06/1517387/0/en/Development-Plans-Unveiled-for-the-Rhyolite-Ridge-Lithium-Boron-Project.html

Global Geoscience, 2018b. *Updated Rhyolite Ridge Mineral Resource Statement*, GLOBALNEWSWIRE.COM (Oct. 23, 2018 04:25 PM ET). https://www.globenewswire.com/news-release/2018/10/23/1625198/0/en/Updated-Rhyolite-Ridge-Mineral-Resource-Statement.html

Grady, Ben R., 2012. FROM MOLECULAR PHYLOGENETICS TO THE EVOLUTION OF LIFE HISTORY AND EDAPHIC ENDEMISM: A COMPREHENSIVE APPRAISAL OF EVOLUTION INERIOGONUM (POLYGONACEAE) (PhD dissertation, University of Wisconsin-Madison). https://depot.library.wisc.edu/repository/fedora/1711.dl:UBCXGPM6QQG2Y8E/datastreams/REF/content

Kuyper, Kris F., 2019. "Summary of Preliminary Results of 2019 Tiehm Buckwheat Survey." Prepared for US Fish and Wildlife Service. Unpublished report.

Morefield, James D., 1995. "Current Knowledge and Conservation Statas of *Eriogonum tiehmii* Tiehm's buckwheat," NEVADA NATURAL HERITAGE PROGRAM.

NatureServe, 2019. "*Eriogonum tiehmii*", NATURESERVE EXPLORER: AN ONLINE ENCYCLOPEDIA OF LIFE, http://explorer.natureserve.org/servlet/NatureServe?searchName=Eriogonum+tiehmii.

Nevada Natural Heritage Program, 2019. "Eriogonum tiehmii", NV.GOV. http://heritage.nv.gov/taxon_detail/13844

Nevada Natural Heritage Program, 2001. "Rare Plant Fact Sheet Tiehm Buckwheat." http://heritage.nv.gov/sites/default/files/atlas/eriogtiehm.pdf

Pellant, Mike, 2007. "Environmental Threats to the Great Basin (2)," U.S. DEPARTMENT OF THE INTERIOR. https://www.doi.gov/ocl/hearings/110/ThreatToTheGreatBasin_101107Pellant.

Reveal, James L., 2007. "Eriogonum in the Garden," 65 ROCK GARDEN QUARTERLY (Spring 2007).

Reveal, James L., 1985. "New Nevada entities and combinations in Eriogonum (Polygonaceae)" 45 GREAT BASIN NATURALIST 277 (Apr. 30, 1985). https://scholarsarchive.byu.edu/gbn/vol45/iss2/6/

Rowland, Mary M., Suring, Lowell H., Wisdom, Michael J., 2010. "Assessment of habitat threats to shrublands in the Great Basin: a case study". In: Pye, John M.; Rauscher, H. Michael; Sands, Yasmeen; Lee, Danny C.; Beatty, Jerome S., tech. eds. *Advances in threat assessment and their application to forest and rangeland management.* USDA.

Sinneman, Douglas J. et.al., 2018. "A Conservation Paradox in the Great Basin—Altering Sagebrush Landscapes with Fuel Breaks to Reduce Habitat Loss from Wildfire," USGS. https://pubs.usgs.gov/of/2018/1034/ofr20181034.pdf

Skelly, Joanne, 2019. "Climate Change Impacts on Nevada", THE RECORD Courier (Jan. 16, 2019). https://www.recordcourier.com/opinion/climate-change-impacts-on-nevada/#

Tiehm, Arnold, 1994. "Status Report, *Eríogonum tiehmii*." (unpublished report, prepared for Nevada Natural Heritage Program).

USDA, 2015. "Glossary of Soil Survey Terms." https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download?cid=nrcseprd407891&ext=pdf

Wisdom, Michael J., et. al., 2003. "Procedures for regional assessment of habitats for species of conservation concern in the sagebrush ecosystem." https://www.fws.gov/greatersagegrouse/documents/Reports/SageHab_Assess_Procedures_March03.pdf

Wrangle, 2019. "North American Sagebrush Steppe," GLOBAL RANGELANDS. https://wrangle.org/ecotype/north-american-sagebrush-steppe-and-shrubland

Young, James, 2002. "*Halogeton* grazing management: historical perspective." *J. Range Manage. 55:*309-311.

Young, James A., Longland, William S., 2010. "Impact of Alien Plants on Great Basin Rangelands." *Weed Technology 10*(2): 384-391.

**Appendix A: Letter from Naomi Fraga, Ph.D.,
in support of petition from Center for Biological Diversity to protect Tiehm's buckwheat (*Eriogonum tiehmii*) under the Endangered Species Act.**

July 20, 2019

To concerned parties:

On June 1, 2019, I surveyed the entire known range of *Eriogonum tiehmii* (Tiehm's buckwheat, Polyonaceae) with Patrick Donnelly (Nevada State Director, Center for Biological Diversity). The intent of the survey was to assess the status of Tiehm's buckwheat, including population health, habitat conditions, and threats. The survey occurred during peak bloom, and shortly after the mining company, Ioneer, had installed test wells and constructed exploration roads in Tiehm's buckwheat habitat. We observed significant impacts to Tiehm's buckwheat from current mining exploration. In this letter, I outline my observations from the survey, and present an assessment of the status of Tiehm's buckwheat, including management recommendations for the Bureau of Land Management (BLM) to ensure protection of this narrowly endemic species.

Background

Eriogonum tiehmii (Tiehm's buckwheat) is a long-lived mat-forming perennial shrub in the buckwheat family (Polygonaceae); its entire range is restricted to a single location in the Silver Peak Range in Esmeralda County, Nevada. This species has an extremely limited range of approximately 21 acres and an estimated global population size of 22,500 individuals (Morefield 1995, 2001; EM Strategies 2019). Tiehm's buckwheat is associated with a distinctive clay soil that ranges in color from white to light brown and is overlain with scattered rocks. The soil parent material is diverse and includes claystones, shales, tuffaceous sandstones, rhyolite flows, and limestones (Morefield 2001; Robinson et al. 1976). Vegetation on this unusual soil type is relatively sparse when compared to the surrounding area. Associated species include: *Atriplex confertifolia* (shadscale), *Enceliopsis nudicaulis* (naked stemmed daisy), *Hilaria jamesii* (James' galleta grass), and *Sporobolus airoides* (alkali sacaton).

Eriogonum tiehmii is considered a Sensitive Species by the BLM and is regarded as Threatened by the Nevada Native Plant Society (BLM 2019; NNHP 2019). The BLM Sensitive Species designation is used for species that occur on land managed by the BLM for which BLM has the capability to significantly affect the conservation status of the species through management. The BLM Manual Section 6840 directs the BLM to manage Sensitive Species and their habitats to minimize or eliminate threats affecting the status of the species or to improve the condition of the species' habitat (BLM 2019). The entire distribution of Tiehm's buckwheat is located on land administered by the BLM in the Battle Mountain District of Nevada; as such, BLM has a

responsibility to ensure appropriate management for the long term conservation of Tiehm's buckwheat.

The small global range and population size, as well as the specific habitat requirements of Tiehm's buckwheat indicate that the species warrants special protection, management considerations, and conservation status. Species with a small global population size and a limited area of occupancy are inherently vulnerable. They are easily affected by stochastic events such as wildland fire, impacts from human activity, and climatic shifts. These events can significantly impact the long term trajectory and viability of the species (Harrison 2008; Krukeberg and Rabinowitz 1985; Morefield 1995). Any additional, external threats to known populations will only exacerbate the already tenuous status of this highly limited species. Documented threats to Tiehm's buckwheat include mining, invasion of exotic species, livestock grazing, and off highway vehicle use (Morefield 1995). Climate change is another threat to this highly restricted species, especially if precipitation amount and timing change significantly. These threats exert pressure on an already at risk species and pose a significant risk of extinction. Effective management for rare species requires protection of populations and habitats to ensure long-term population viability and conservation of the species.

The current threat of mining is the most significant and immediate threat to Tiehm's buckwheat. Recent installation of test wells and construction of exploration roads by Ioneer has had significant impact on its habitat. During the survey, I observed that newly constructed exploration roads came within a few meters of individual plants and occupied habitat. These roads have created a corridor that can facilitate the invasion of exotic species and also have the potential to interrupt pollinator services. There is evidence that past mining exploration has degraded Tiehm's buckwheat habitat by the presence of trenches and invasive species including *Halogeton glomeratus* (saltlover, Chenopodiaceae). Degradation of habitat from mining (occupied and potential) could impact the species' biology in several ways, including interruption of pollinator services, artificial reduction of the plants' ability to migrate and colonize potential habitat, and altered genetic structure and variation within and among populations. Climate change is a significant threat to Tiehm's buckwheat's because of its limited range and narrow habitat requirements. Many plant species are predicted to respond to climate change by shifting their ranges (Anacker et al. 2013; Mason et al. 2015, Still et al. 2015). Plant species such as Tiehm's buckwheat may be unable to adapt or migrate to new areas due to rapidly changing conditions because they are limited, therefore climate change presents a significant risk of extinction.

Recommendations

For most rare species, including Tiehm's buckwheat, there are no data available on genetic diversity patterns. Therefore, conservation is best approached by protecting sufficient habitat to support large enough populations to prevent inbreeding and genetic drift, thus supporting viable populations into the future (Harrison 2008). To date, surveys of potential habitat have not yielded newly documented populations, and the known range remains the same as reported in 1993

surveys (Morefield 1995). Based on past and present surveys of potential habitat, it is unlikely that additional populations will be documented outside of the known range. Therefore, management and conservation decisions should be made to ensure protection of the entire known range of the species, including potential habitat, given its highly restricted distribution. Ioneer's proposal includes all known sites of Tiehm's buckwheat. It cannot be overstated that the proposed project would have significant impact on the long term conservation of species and would place Tiehm's buckwheat at risk of extinction.

Transplanting individuals that would be directly impacted by Ioneer's proposed project has been indicated as a potential conservation strategy for Tiehm's buckwheat (EM Strategies 2019). Reintroduction or translocation as an alternative to in-situ habitat protection is not recommended as a viable conservation strategy (CPC 2019). Instead recommended first steps for species protection are to conserve all known naturally occurring populations, eliminate or reduce threats, provide habitat management, and secure ex-situ conservation seed collections. Conservation seed collections serve to secure genetic diversity offsite as a back-up, or safeguard against catastrophic events; their purpose is to support wild populations in-situ, and they should not be viewed as a replacement for onsite protection and conservation (CPC 2019).

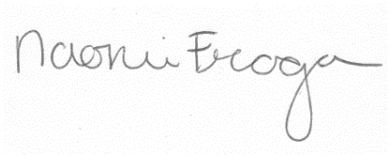
Additional conservation and recovery recommendations outlined by Morefield in 1995 remain relevant today; these include:

1. Establish monitoring of all known sites to document the demographic baseline, understand population trends, and assess impacts from habitat disturbance.
2. Eradicate invasive species to prevent their establishment and spread at known sites to avoid impacts from competition.
3. Do not permit fire suppression, reseeding, or range treatments of any kind including opening access routes.
4. Livestock animals should be prohibited from all known sites by establishing fencing.
5. Assess the role of insect pollinators in the reproductive success of Tiehm's buckwheat and avoid impacts to pollinators.
6. Pursue special land designation in the form of an Area of Critical Environmental Concern (ACEC) to include all known populations and enhance protection of Tiehm's buckwheat including mineral withdrawals.

The above mentioned recommendations were outlined in a 1995 report to USFWS. It was also suggested that USFWS enter into a formal conservation agreement with the BLM to ensure that the above recommendations would be carried out on a long term basis (Morefield 1995). In addition to the above listed recommendations, I also recommend that the BLM work with trained botanists to secure a diverse conservation seed collection for Tiehm's buckwheat. The seed collection should be stored and curated long term at a seed banking facility with appropriate freezer storage. Seed collections should follow the best practices protocol outlined by the Center for Plant Conservation (CPC 2019). Given that the above conservation recommendations that were outlined by Morefield in 1995 have not been met, and that active mining is an imminent threat, I urgently recommend that BLM stop all exploratory mining activity in Tiehm's

buckwheat habitat, and that formal listing of Tiehm's buckwheat should be pursued under the Endangered Species Act. This will be the most effective means to ensure that appropriate conservation actions are implemented to prevent extinction.

Sincerely,



Naomi S. Fraga Ph.D.

Literature Cited:

Anacker, B.L., Gogol-Prokurat, M., Leidholm, K., and Schoenig S. 2013. Climate Change Vulnerability Assessment of Rare Plants in California. *Madroño*. 60: 193-210.

Bureau of Land Management (BLM). 2019. Updated BLM Sensitive Species List for Nevada. Accessed online: https://www.blm.gov/policy/nv-im-2018-003. Date: July 7, 2019.

Center for Plant Conservation (CPC). 2019. CPC Best Plant Conservation Practices to Support Species Survival in the Wild. Accessed online: https://saveplants.org/wp-content/uploads/2019/05/CPC-Best-Practices-5.22.2019.pdf. Date: July 19, 2019

EM Strategies. 2019. 2019 Tiehm Buckwheat Survey Plan: Draft March 2019. On file with the Bureau of Land Management, Battle Mountain District, Tonopah Field Office. 1553 South Main Street. Po Box 911. Tonopah, Nevada 89049.

Harrison, S., Viers, J. H., Thorne J.H., & Grace J.B. 2008. Favorable environments and the persistence of naturally rare species. *Conservation Letters*. 1: 65-74.

Kruckeberg A.R., Rabinowitz D. 1985. Biological aspects of endemism in higher plants. Annual *Review of Ecology, Evolution, and Systematics*. 16: 447-479.

Mason S.C., Palmer, G., Fox, R., Gillings, S., Hill, J.K., Thomas, C.D., and Oliver, T.H. 2015. Geographical range margins of many taxonomic groups continue to shift polewards. *Biological Journal of the Linnean Society*. 115: 586–597.

Morefield, J.M. 2001. Rare Plant Facts Sheet: *Eriogonum tiehmii*. Accessed online: http://heritage.nv.gov/sites/default/files/atlas/eriogtiehm.pdf. Date: June 25, 2019.

Morefield, J.M. 1995. Current Knowledge and Conservation Statas of *Eriogonum tiehmii* Reveal (Polygonaceae), Tiehm buckwheat. Status report prepared for U.S. Fish and Wildlife Service, Nevada State Office.

Nevada Natural Heritage Program (NNHP). 2019. Species Information: Tiehm's buckwheat. http://heritage.nv.gov/taxon_detail/13844

Robinson, P.T., Stewart, J.H., Moiola, R.J., and Albers, J.P., 1976, Geologic map of the Rhyolite Ridge quadrangle, Esmeralda County, Nevada: U.S. Geological Survey, Geologic Quadrangle Map GQ-1325, scale 1:62,500

Still, S.M., Frances, A.L., Treher, A.C., and Oliver L. 2015. Using Two Climate Change Vulnerability Assessment Methods to Prioritize and Manage Rare Plants: A Case Study. *Natural Areas Journal*. 35: 106-121.