BEFORE THE SECRETARY OF THE INTERIOR

PETITION TO THE U.S. FISH AND WILDLIFE SERVICE TO LIST THE SODAVILLE MILKVETCH (ASTRAGALUS LENTIGINOSUS VAR. SESQUIMETRALIS) UNDER THE ENDANGERED SPECIES ACT AS A THREATENED SPECIES AND TO CONCURRENTLY DESIGNATE CRITICAL HABITAT

CENTER FOR BIOLOGICAL DIVERSITY

JULY 14, 2025

Notice of Petition

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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 the Sodaville milkvetch (*Astragalus lentiginosus* var. *sesquimetralis*) as threatened 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 the Sodaville milkvetch concurrently with the species being listed, pursuant to 16 U.S.C. § 1533(a)(3)(A) and 50 C.F.R. § 424.12.

References have been uploaded to a folder provided by the FWS listing branch, and can also be found here:

https://drive.google.com/drive/folders/1lD1fbSu50E8RipnDQrpBj9QdxT-iKnkq?usp=sharing

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 1.7 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 the Sodaville milkvetch and its habitat.

Submitted this 14th day of July, 2025:

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EXECUTIVE SUMMARY

The Sodaville milkvetch (*Astragalus lentiginosus* var. *sesquimetralis*) is a taprooted perennial herb which grows in alkali wetlands in the northern Mojave and southern Great Basin deserts. It grows prostrate on the ground with long, trailing branches and upright clusters of pink to purple flowers. The inflated fruit pods are colored with swirls of red and yellow. The Sodaville milkvetch typically flowers between April and June, and fruits in June-July; by late summer, its above ground vegetative material has largely desiccated and blown away in the wind. It grows only in areas with access to shallow groundwater and co-occurs with numerous wetland plants.

The Sodaville milkvetch occurs in six isolated populations, all of which are threatened with extirpation. Gold and lithium mining are a threat to the plant, with three of six occurrences completely claimed by mining companies. Groundwater pumping for proposed lithium and gold mines threatens to draw down the aquifers that sustain Sodaville milkvetch habitat. Similarly, groundwater pumping for agriculture is a significant threat to one population of the milkvetch. Energy development, including solar energy and transmission lines, threaten entire populations with extirpation due to surface destruction associated with development. Geothermal energy projects also pose a threat, as groundwater pumping associated with these projects is likely to alter surface water availability, potentially drying up the milkvetch's wetland habitats. Off-highway vehicle races and events also threaten the plant through direct habitat loss and dust deposition. Non-native ungulates such as cows, feral horses, and feral burros pose a threat to the plant. Development of residential, commercial, and industrial infrastructure, including a brothel, threatens one population with extirpation. Expansion of a Navy bombing range threatens another population. And, across all populations, invasive species and the specter of climate change pose additional threats.

The Sodaville milkvetch faces numerous threats from development which could directly destroy its habitat or drain the aquifers that sustain that habitat. There are no existing regulatory mechanisms that are sufficient to protect it from extinction. Thus, we seek to petition the Sodaville milkvetch to be listed as a threatened taxon under the Endangered Species Act (ESA) using the best scientific information in the context of the five listing factors specified in the statute. Listing of the Sodaville milkvetch as a threatened species and designating critical habitat under the ESA is necessary to provide critical legal protections to ensure the survival of this highly imperiled plant taxon.

I. INTRODUCTION

The Sodaville milkvetch (*Astragalus lentiginosus* var. *sesquimetralis*) is a perennial herb in the pea family (Fabaceae) that generally flowers from April through June and fruits from June through July. It is restricted to saline, alkaline wetlands in proximity to springs, seeps, and shallow groundwater in the northern Mojave and Great Basin desert ecoregions, at elevations ranging from approximately 975 m at Big Sand Spring in Inyo County, CA, to 1450 m in Big Smoky Valley, Esmeralda County, NV. Occurrences generally occupy the lowest elevations of their respective endorheic basins, with a shallow groundwater table and often perennial surface water expression at springs fed by groundwater aquifers.

Sodaville milkvetch is known from six global occurrences, with one occurring in California and the remaining five in Nevada**:** (1) the type locality at Sodaville, Mineral County, NV (private), (2) Cold Springs, Nye County, NV (private), (3) Big Sand Spring, Inyo County, CA (Death Valley National Park (DVNP), (4) Sarcobatus Flat, Nye County, NV (Bureau of Land Management; BLM), (5) Fish Lake Valley Salt Marsh, Esmeralda County, NV (BLM), and (6) Big Smoky Valley Playa, Esmeralda County, NV (BLM). Occurrences are separated by a minimum of 36 and up to 66 air km with little suitable habitat between them.

The Sodaville milkvetch is a habitat specialist restricted to saline, alkaline wetlands in proximity to springs, seeps, and shallow groundwater in the northern Mojave and Great Basin desert ecoregions. It is wholly dependent on the maintenance of fragile alkaline wetland ecosystems and the groundwater aquifers that sustain them. Populations of Sodaville milkvetch and its unique habitat face numerous threats across its narrow range including groundwater depletion, mining, geothermal, solar energy development, cattle and federal horse grazing, and off highway vehicle use, leaving it vulnerable to extinction without the intervention of federal Endangered Species Act protections.

II. NATURAL HISTORY

A. Taxon Description

Astragalus lentiginosus var. *sesquimetralis* is a taprooted perennial herb with a prostrate, radially sprawling habit and stems spreading up to 0.8–1.2 m, branching (or not) below the middle (**Fig. 1**). Plants are generally pallid to bluish green with variable vestiture: stems generally strigulose to strigose, often reddish; leaves generally strigulose to hirsute, at least abaxially; calyces densely strigulose; and fruit pods generally sparsely strigulose (**Fig. 3**). The compound, terminally pinnate leaves are composed of 9–17 (most often 11–13) oblanceolate leaflets, each measuring 6–18 mm long and usually loosely folded (**Fig. 2**).[1] The leaves are subsessile with short petioles, and are generally shorter than the internodes between them.[2] [3] The inflorescence is a short raceme of 6–12 flowers from calyces 7–8 mm long with teeth incised 2.2–2.5 mm (Fig. 2, 3). The papilionaceous flowers are purple, with banners to 14.5 mm long and 6.5 mm wide, wings 11–12 mm long, and keel to 9.5 mm. The fruit is a moderately inflated, coriaceous, red-mottled, bilocular, narrowly ovoid legume to 2.5 cm long with an incurved 4–8 mm beak, containing 12–20 ovules (Fig. 2, 3).[4] [5]

The taxon is distinguished from morphologically similar conspecific varieties *A. lentiginosus* var. *piscinensis* and *A. lentiginosus* var. *albifolius*, both of which occupy similar habitat in alkali meadows and wetlands, by its number of leaflets, flower color, fruit pod shape, and flower size. While similar in habit and flower color and size, variety *piscinensis* has only 3-5 leaflets, and the terminal leaflet is often notably longer (14-30 mm long) than in var. *sesquimetralis* (7-15 mm long).[6] [7] [8] In the variety *albifolius,* the beak of the fruit pod is declined (vs. incurved), the flowers are smaller, to 11.5 mm in overall length, and are generally white with variable purple or pink veins.[9] [10]

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[1] Barneby 1964 p. 928.
[2] Rydberg 1929 p. 414.
[3] Welsh 2007 p. 298.
[4] Barneby 1964 p. 928.
[5] Barneby 1945 p. 78, 116.
[6] Welsh 2007 p. 290-291, 298.
[7] Wojciechowski and Spellenberg 2023.
[8] Barneby 1964 p. 928.
[9] Welsh 2007 p. 290-291.
[10] Wojciechowski and Spellenberg 2023.

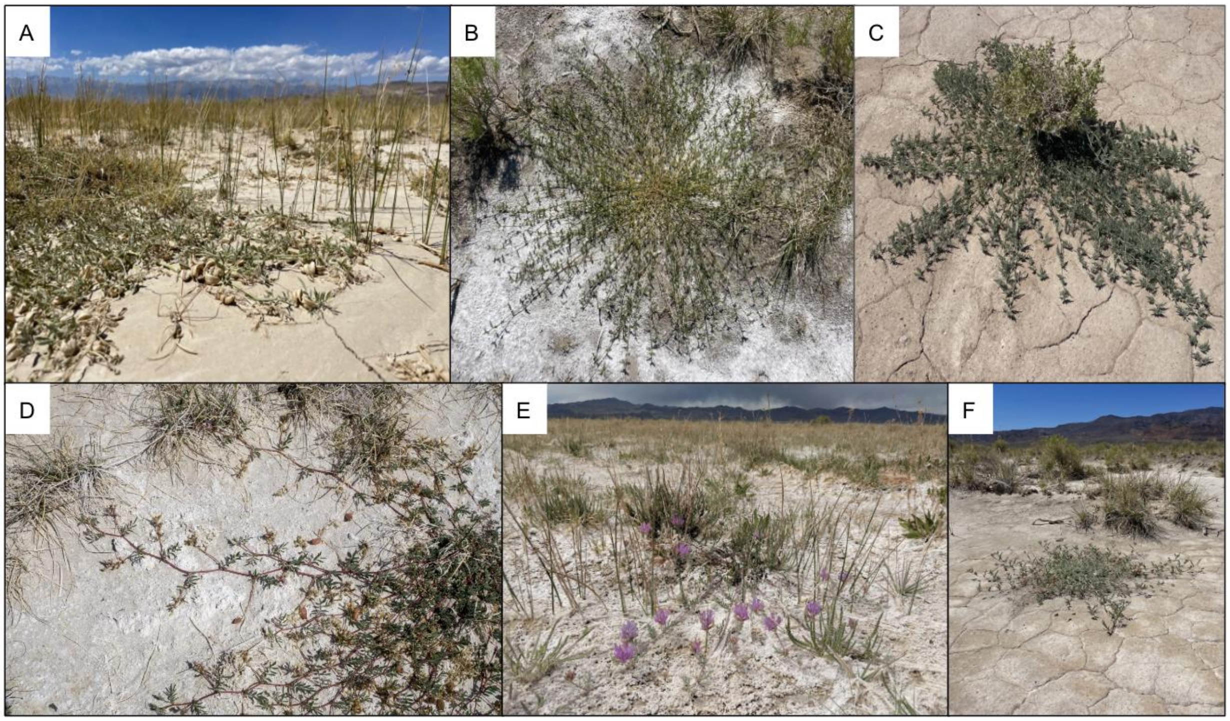

Fig. 1. Plant habit, *Astragalus lentiginosus* var. *sesquimetralis.* — A. Fish Lake Valley, Esmeralda County NV. August 2023. — B. Big Smoky Valley playa, Esmeralda County, NV. May 2024. — C. Sarcobatus Flat, Nye County, NV. May 2024. — D. Big Sand Spring, Death Valley National Park, Inyo County, CA. Photo by M. Berger, April 2024. — E. Cold Springs, Nye County, NV. Photo by M. Cloud-Hughes, May 2019. — Big Smoky Valley playa, Esmeralda County, NV. May 2024.

Fig. 2. Scientific illustration of *Astragalus lentiginosus* var. *sesquimetralis* by Louise Fleurs.

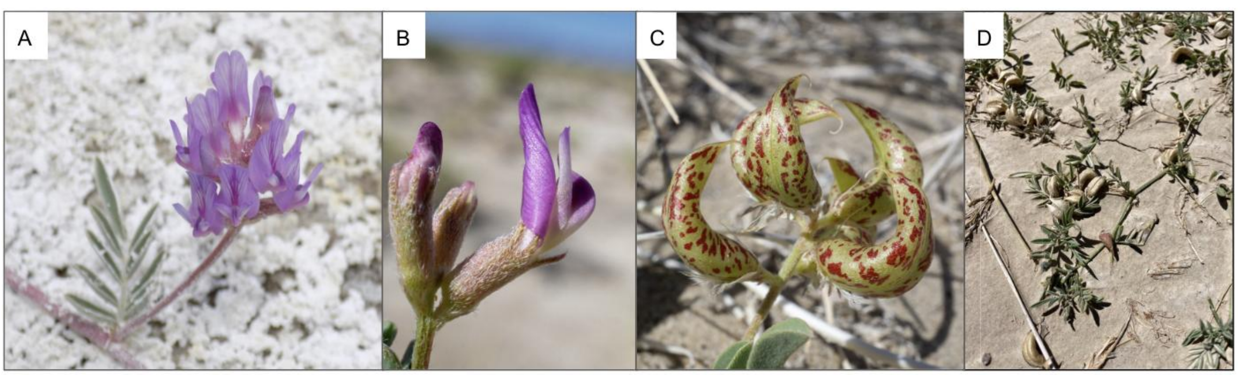

Fig. 3. Flowers and fruit, *Astragalus lentiginosus* var. *sesquimetralis*. — A. flowers at Cold Springs in May 2019, photo by M. Cloud-Hughes. — B. Flower and calyx detail, Big Smoky Valley, May 2024, photo by M. Berger. — C. Fruit detail, Big Smoky Valley, May 2024, photo by M. Berger. — D. Mature and dehisced fruit, Fish Lake Valley, August 2023.

B. Biology and Ecology

Astragalus lentiginosus var. *sesquimetralis* generally flowers from April through June, with a majority of flowering observations and herbarium specimens collected in May, though there are notable outlier observations and collections of plants flowering in August and in January.[11] [12] [13] [14] [15] Fruit development by early May has been observed, and can continue throughout a prolonged period of successive flowering along nodes proximal to the stem apex, presumably enabled by the shallow groundwater table characteristic of its habitat.[16] The fruits are noted to be stiffer and more leathery relative to other varieties of *A. lentiginosus,*[17] [18] and senescent fruits have been observed in proximity to putative maternal plants both during and beyond the growing and reproductive season, suggesting that longer distance seed dispersal may be limited relative to the more readily wind-dispersed pods of some *A. lentiginosus* varieties.[19] [20] Like other *Astragalus* taxa, the seeds of *Astragalus lentiginosus* var. *sesquimetralis* most likely undergo some period of physical dormancy relating to their hard seed coat, with germination requiring either scarification, stratification, or both.[21] [22] [23] [24]

After fruiting, plants typically enter a dormant phase in late summer or early fall, possibly varying according to seasonal precipitation patterns.[25] In dormancy, above ground tissues senesce and often disarticulate such that plants are not detectable outside of the growing season.[26] While the lifespan range of individual plants is not presently known, the presence of large taproots[27] and observation of senesced and fallen fruits among very large (> 2 m diameter mats) individual plants in flower suggests that lifespans upwards of several years are possible, as has been observed in the ecologically similar conspecific *A. lentiginosus* var. *piscinensis*.[28]

While no studies specifically addressing the reproductive biology, life history or ecology of *Astragalus lentiginosus* var. *sesquimetralis* have been published to date, it is reasonable to

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[11] iNaturalist 2025.
[12] *Amelia Ryan pers. comm.*
[13] Pipkin and Novak 2701 RSA.
[14] *Novak pers. obs. August 2024*.
[15] Freeman 175 RENO.
[16] Welsh 2007 p. 298.
[17] Barneby 1945 p. 116.
[18] Barneby 1964 p. 928.
[19] *Novak per. obs. August 2023-June 2025*.
[20] *Cf.* USFWS 2005, Harrison et al. 2019, Knaus 2010, Thomas 2023.
[21] Soltani et al. 2021 p. 74, 77.
[22] Harrison et al. 2019 p. 261.
[23] USFWS 2009 p. 1, 9.
[24] USFWS 2021 p. 9.
[25] Morefield 1993 p. 11-12; *Novak field observations 2023-2024*.
[26] *Ibid.;* Kane 2003.
[27] E.g. Tiehm 17443 UTC (Intermountain Regional Herbarium Network Portal 2025)
[28] *Novak field observations 2023-2025*; *cf.* Harrison et al. 2019.

extrapolate testable hypotheses from studies of closely related taxa and those that occupy similar habitats, including the Fish Slough endemic *Astragalus lentiginosus* var. *piscinensis* and the Ash Meadows endemic *Astragalus phoenix.* A study of the pollination biology of *A. phoenix* determined that it was xenogamous and most likely pollinated by the bee *Anthophora porterae*.[29] Studies of *A. lentiginosus* var. *piscinensis* have found it rarely self-pollinates, while *Astragalus lentiginosus* taxa generally are likely bee pollinated.[30] [31] Field observations of *Astragalus lentiginosus* var. *sesquimetralis* have documented visitation by several species of bee (clade Anthophila) including *Bombus* spp., Lycaenid and Hesperiid butterflies, and Bombyliid flies.[32]

Other observed interactions include evidence of seed predation, likely due to bean weevils in the genus *Acanthoscelides*.[33] [34] Evidence of herbivory (defoliation), likely due to native rodents or lagomorphs, has been observed on vegetative plants (Fig. 6), and is recognized as a significant threat to both *A. phoenix* and *A. lentiginosus* var. *piscinensis*.[35] [36] Additionally, it can be inferred that *A. lentiginosus* var. *sesquimetralis* likely hosts symbiotic rhizobia bacteria in root nodules, a trait shared by a majority of the Fabaceae and documented in its conspecific relatives,[37] as well as endophytic fungal symbionts.[38] These relationships may be especially important in alkali wetland habitats where nitrogen availability is often limited.[39]

C. Distribution

Astragalus lentiginosus var. *sesquimetralis* is known from six global occurrences, with one occurring in California and the remaining five in Nevada (Map 1). They are distributed along a north-south oriented series of valleys belonging to the Lahontan Trough, a physiographic designation that describes a low-elevation corridor along the southwestern edge of the Great Basin geomorphic province hypothesized to be an important dispersal route for climate-associated migrations since the Pleistocene epoch.[40] [41] Within these valleys, populations of Sodaville milkvetch generally occupy the lowest elevations of endorheic basins with high water

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[29] Tanner *et al.* 2013 p. 377.
[30] USFWS 2009 p. 6.
[31] Harrison *et al.* 2019 p. 261.
[32] *Novak field observations, May 2024-June 2025.*
[33] Johnson 1970 p. 84-86.
[34] Soltani et al. 2021 p. 69.
[35] USFWS 2020.
[36] Tanner et al. 2013 p. 377.
[37] Zahran 1999.
[38] Harrison et al. 2018.
[39] USFWS 2009 p. 7.
[40] Reveal 1979 p. 12.
[41] Morefield 1993 p. 15.

tables and often perennial surface water expression at springs, and/or seasonal accumulation of precipitation.[42] [43] [44]

The entire known population occupies an area of occupancy approximately 48 km^2, distributed among six widely spaced occurrences over an extent of approximately 6,623 km^2 and isolated by both distance and physiographic features, including mountain ranges and hydrographic basins (**Fig. 4**).[45] Known occurrences include the following localities, summarized in Table 1: (1) the type locality at Sodaville, Mineral County, NV; (2) Cold Springs, Nye County, NV; (3) Big Sand Spring, Inyo County, CA; (4) Sarcobatus Flat, Nye County, NV; (5) Fish Lake Valley Salt Marsh, Esmeralda County, NV; and (6) Big Smoky Valley Playa, Esmeralda County, NV (**Table 1**).

Occurrences are separated by a minimum of 36 and up to 66 air kilometers with generally little suitable habitat between them (**Fig. 4**). In 2024 and 2025, surveys of potentially suitable habitat in areas outside the known occurrence localities were conducted in several locations identified via high resolution satellite imagery, available climate and vegetation data, and appropriate soil moisture indices detected on multispectral Sentinel-2 shortwave infrared (SWIR) satellite imagery.[46] [47] These surveys yielded the first documentation of the occurrence at Big Smoky Valley in Esmeralda County in May of 2024, but no additional Sodaville milkvetch occurrences were detected in the potentially suitable habitat areas surveyed, including Rhodes Salt Marsh, Teels Salt Marsh, and Columbus Salt Marsh.[48] Similar surveys were conducted in the early 1990s and summarized in a taxon status report prepared by the Nevada Natural Heritage Program in 1993, which concluded:

> "Its absence from numerous natural sites apparently containing much suitable habitat suggests either that population losses may already have occurred, or that the taxon has a narrow set of edaphic and or environmental tolerances which limit its ability to spread to additional sites." [49]

Surveys led by the California Botanic Garden and Nevada Division of Natural Heritage in 2024 and 2025 contributed data on the area of occupancy, habitat characteristics, and estimated population size for the four occurrences on Bureau of Land Management land in Nevada (NV-02, NV-03, NV-04, NV-05; Table 1).[50] The privately owned occurrence NV-01 has

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[42] *Ibid.* p. 9.
[43] Kane 2003.
[44] Grayson 2011 p. 16.
[45] Geospatial analyses, including the taxon's extent of occurrence (EOO) and area of occupancy (AOO), were calculated using Kew's Geospatial Conservation Assessment Tool (GeoCAT) with data derived from CNDDB, NDNH and DVNP. Kew GeoCAT 2024.
[46] Liu et al. 2021.
[47] Yue et al.. 2019.
[48] NDNH 2025.
[49] Morefield 1993 p. 14.
[50] NDNH 2025

not been verified or surveyed since 2002, and detailed survey data for occurrence CA-01 are only current through 2007.[51] [52] Using the most generous estimates recorded for each occurrence at any historical point, the total global population could number up to approximately 5,000 individuals; however using the most recent data available for all occurrences, the global abundance estimate is closer to 690-1520 individuals (**Table 1**).

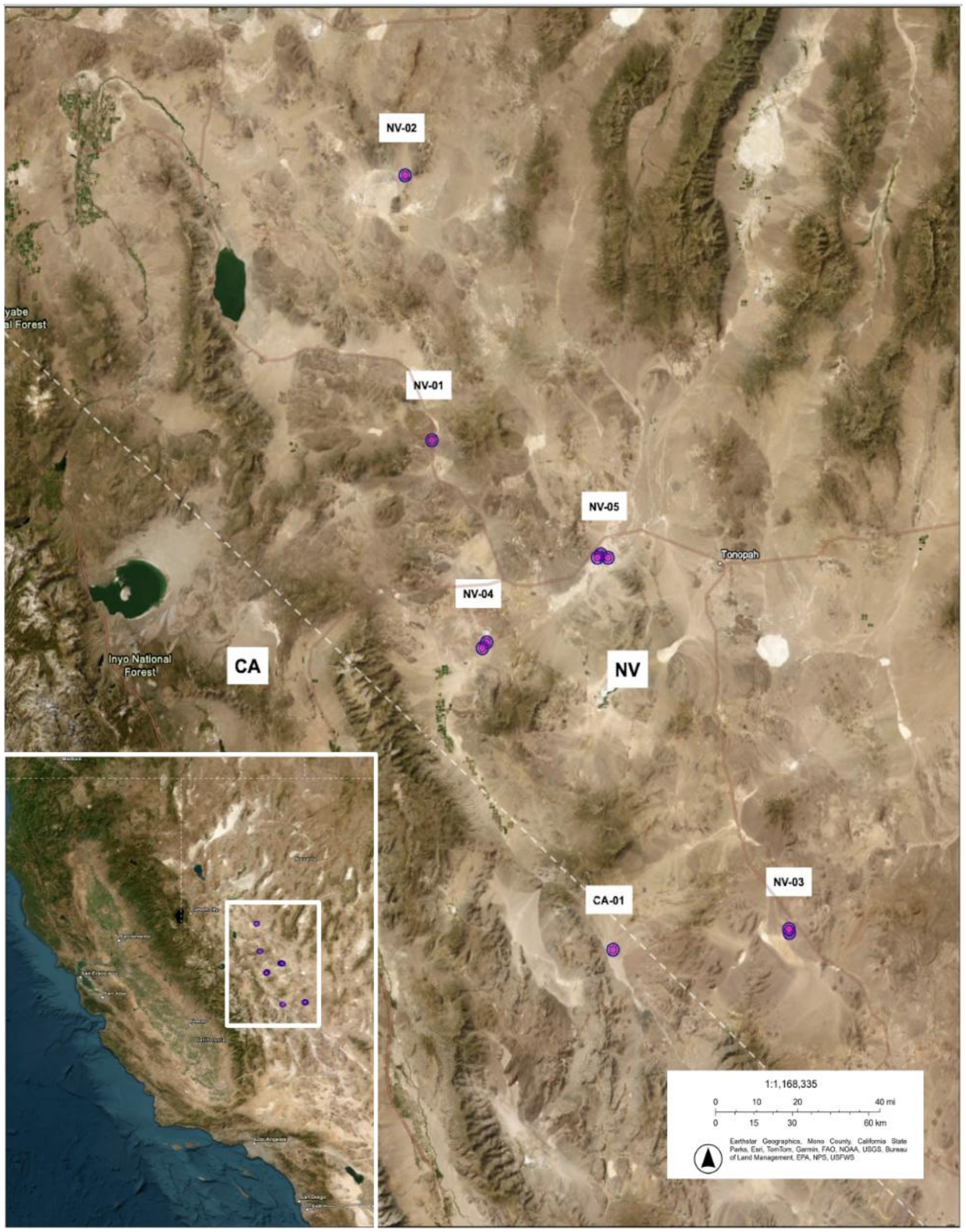

Fig. 4. *Astragalus lentiginosus* var. *sesquimetralis* occurrences known as of June 2025.

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[51] CNDDB 2024

[52] Kane 2003, entire.

Locality	EO #	Land Owner/ Manager	Low population estimate [date of count]	High population estimate [date of count]	Year last observed	Threats
Sodaville, Mineral County, NV	NV-01	Private	50 [2002]	500 [1992]	2002	Grazing, hydrological alteration, surface developments, OHVs
Cold Springs, Nye County, NV	NV-02	Private, BLM Carson City District	100 [2019]	350 [2025]	2025	Habitat alteration, OHVs, grazing, invasive plants
Sarcobatus Flat, Nye County, NV	NV-03	BLM Battle Mountain District	190 [2024]	470 [2025]	2025	Solar, mining, transmission lines, OHVs, grazing, herbivory
Fish Lake Valley, Esmeralda County, NV	NV-04	BLM Battle Mountain District	100 [2025]	200 [2024]	2025	Solar, mining, geothermal, agriculture, grazing, OHVs
Big Smoky Valley, Esmeralda County, NV	NV-05	BLM Battle Mountain District	200 [2024]	500 [2025]	2025	Solar, mining, geothermal, grazing
Big Sand Spring, Death Valley NP, Inyo County, CA	CA-01	National Park Service, Death Valley NP	50 [2022]	3003 [1998]	2024	Grazing/feral ungulate activity

Table 1. Occurrences of *Astragalus lentiginosus* var. *sesquimetralis* and summarized data. Element occurrence numbers are assigned here for the purpose of reference within this document and may not reflect element occurrence identities recognized within organizations and agencies, which were not included in any of the data reviewed. (Abbreviations: EO = element occurrence,

NV = Nevada, OHV = off-highway vehicle, BLM = Bureau of Land Management, CA = California, NP = National Park).[53] [54] [55] [56] [57] [58]

D. Habitat Characteristics

Astragalus lentiginosus var. *sesquimetralis* is restricted to saline, alkaline wetlands in proximity to springs, seeps, and shallow groundwater in the northern Mojave and Great Basin desert ecoregions (**Fig. 5**), at elevations ranging from approximately 975 m at Big Sand Spring in Inyo County, CA, to 1450 m in Big Smoky Valley, Esmeralda County, NV.[59] [60] The Sodaville, Cold Springs, and Big Sand Spring populations occur in close proximity to cold springs, while the Big Smoky Valley, Fish Lake Valley, and Sarcobatus Flat populations occur along playa margins in areas with perennially to seasonally moist soils. Occurrences generally occupy the lowest elevations of their respective endorheic basins, with high water tables and often perennial surface water expression at springs fed by ancient groundwater aquifers.[61] [62] [63]

Climatic conditions experienced by *Astragalus lentiginosus* var. *sesquimetralis* are fairly similar across the six known occurrences, and are characteristic of the Great Basin and northern Mojave deserts with very low precipitation, hot dry summers, and cold dry winters. Precipitation tends to be highest in winter through early spring, from January through May, and averages 12.4 cm per year across all sites during the 30-year period from 1990-2020 (Table 2).[64] Minimum and maximum temperatures typically occur in December and July, respectively, but are somewhat more variable than precipitation between sites, with notably higher average temperature values observed in the lowest elevation occurrence at Big Sand Spring (**Table 2**).[65]

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[53] NDNH 2025
[54] Morefield 1993
[55] CNDDB 2024
[56] Kane 2003
[57] *J. Lovera pers. comm.*
[58] *A. Ryan pers. comm.*
[59] Welsh & Welsh 21536 CAS-BOT-BC
[60] NDNH 2025
[61] Morefield 1993 p. 9
[62] Kane 2003
[63] Grayson 2011 p. 16
[64] PRISM 2025
[65] *Ibid.*

Element Occurrence Number and Locality Name	Elevation (m)	Average maximum monthly temperature (July 1990-2020)	Average minimum monthly temperature (December 1990-2020)	Average annual precipitation (1990-2020)
NV-01, Sodaville, Mineral County, NV	1420 m	35.4 C	-5.5 C	13.5 cm
NV-02, Cold Springs, Nye County, NV	1262 m	35.0 C	-6.8 C	12.4 cm
NV-03, Sarcobatus Flat, Nye County, NV	1205 m	36.5 C	-4.3 C	12.5 cm
NV-04, Fish Lake Valley, Esmeralda County, NV	1430 m	35.4 C	-5.5 C	13.5 cm
NV-05, Big Smoky Valley, Esmeralda County, NV	1450 m	34.9 C	-6.4 C	12.3 cm
CA-01, Big Sand Spring, Inyo County, CA	975 m	38.7 C	-0.4 C	11.5 cm

Table 2. Climate data for the six occurrence localities of *Astragalus lentiginosus* var. *sesquimetralis,* averaged over the 30-year period from 1990 through 2020. Data for each locality represent values for 800 m grid cells in the central portion of the mapped occurrence. At all sites, lowest minimum monthly temperatures occurred in December and highest maximum monthly temperatures occurred in July.[66] Elevation values are derived from the National Elevation Dataset.[67] Element occurrence (E.O.) numbers are assigned here for the purpose of reference within this document and may not reflect element occurrence identities recognized within organizations and agencies, which were not included in any of the data reviewed.

Within the spring-fed alkali wetland and playa complexes that occur in these basins, the taxon is further restricted to clayey to sandy, seasonally to perennially moist, generally evaporite-encrusted soils among sparse vegetation including *Atriplex parryi* (Parry's saltbush), *Cirsium mohavense* (Mohave thistle), *Distichlis spicata* (saltgrass), *Ericameria albida* (white flowered rabbitbrush), *Ivesia kingii* var. *kingii* (alkali ivesia), *Juncus balticus* (baltic rush),

[66] PRISM 2025

[67] Gesch et al. 2002

Muhlenbergia asperifolia (scratchgrass), *Phragmites australis* (common reed) and *Sporobolus airoides* (alkali sacaton).[68] [69] [70] [71] Vegetation immediately adjacent to and surrounding the open claypan areas that *Astragalus lentiginosus* var. *sesquimetralis* typically occupies is predominantly composed of desert alkali-saline marsh and shadscale scrub, with *Allenrolfea occidentalis* (iodine bush), *Atriplex canescens* (fourwing saltbush), *Atriplex confertifolia* (shadscale saltbush), *Leymus cinereus* (Great Basin wild rye), *Sarcobatus vermiculatus* (greasewood), and *Suaeda nigra* (bush seepweed).[72] [73] [74] [75] Associated plant taxa vary somewhat between and within occurrences, but consistently include *Distichlis spicata, Ericameria albida, Sporobolus airoides,* and *Atriplex* spp.

Microtopography of the habitat varies between sites but generally is characterized by low hummocks separated by drainage channels and depressions over a relatively level aspect, with vegetation composition and density likely covarying with surface and subsurface water availability.[76] [77] [78] [79] [80] The hummocks are typically stabilized by clumping stands of *Atriplex* spp., *Distichlis spicata, Ericameria albida, Phragmites australis* and/or *Sporobolus airoides* (**Fig. 5**). These habitat characteristics closely parallel those of *Astragalus lentiginosus* var. *piscinensis*, a distinct variety that occurs only in Mono and Inyo counties, California.[81] [82]

The predictive success of a novel habitat detection method utilizing multispectral remote sensing imagery analysis suggests that specific subsurface soil moisture properties, correlated with particular short wave infrared (SWIR) wavelengths rendered by Sentinel-2 satellite imagery, may be a critical dimension of the habitat requirements for *Astragalus lentiginosus* var. *sesquimetralis*.[83] [84] [85]

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[68] NDNH 2025
[69] Bell et al. 2021 p. 27
[70] Welsh 2007 p. 298
[71] Novak and Fraga 2025
[72] NDNH 2025
[73] Bell et al. 2021 p. 27
[74] Pipkin 2024 p. 58
[75] Faber-Langendoen 2010-2019
[76] Novak and Fraga 2025 entire
[77] Morefield 1993 p. 9
[78] Tiehm 19338 RENO, Intermountain Herbarium Network Portal 2025
[79] Kittel 2015 entire
[80] Shukla et al. 2023 p.7-8
[81] USFWS 2009 p. 10
[82] Harrison 2019 p. 261
[83] Liu et al. 2021 p. 7454
[84] Yue et al. 2019 p. 222
[85] Novak and Fraga 2025

Like many of its rare congeners, *Astragalus lentiginosus* var. *sesquimetralis* is restricted to habitat and edaphic conditions that are themselves rare;[86] [87] namely, desert alkaline wetlands.[88] [89] [90] These are generally characterized as harsh and limiting environments for plant growth due to their high salinity and pH and relatively low nutrient availability, and adaptations to these conditions may confer competitive advantages to specialized plants like *A. lentiginosus* var. *sesquimetralis* over taxa that might otherwise outcompete them on more broadly hospitable substrates.[91] [92] [93]

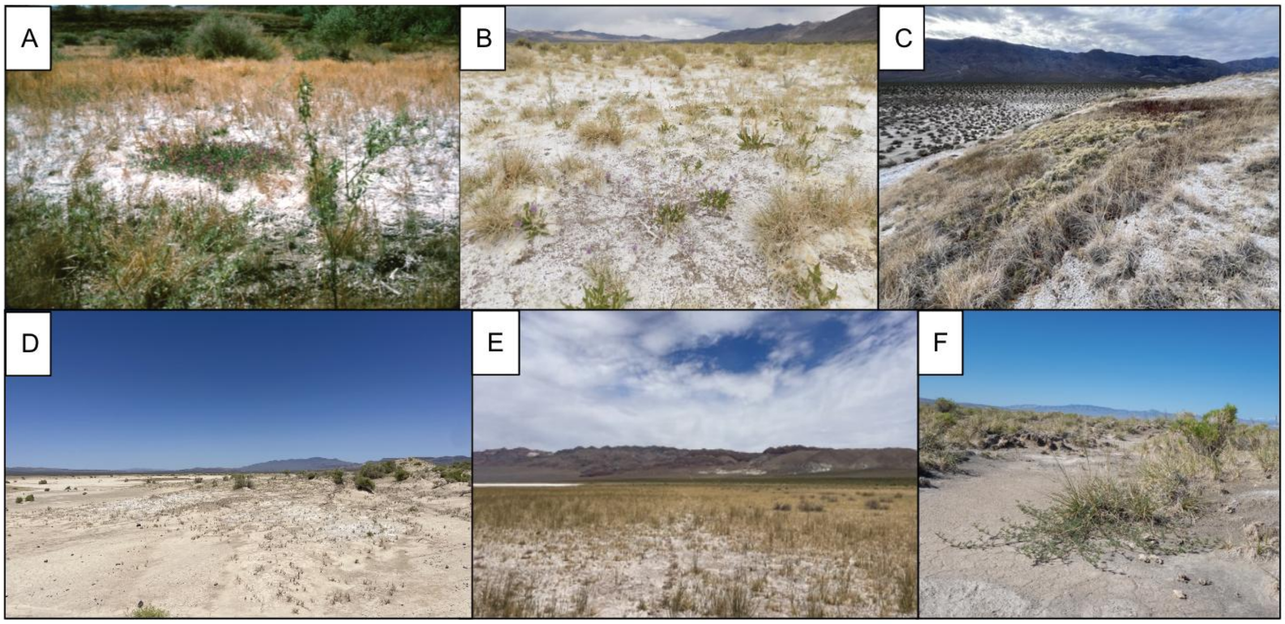

Fig. 5. Habitat of *A. lentiginosus* var. *sesquimetralis*. — A. Sodaville, NV (NV-01). Photo by James D. Morefield (Morefield 1993). — B. Cold Springs, NV (NV-02). Photo by M. Cloud-Hughes, May 2019. — C. Big Sand Spring in Death Valley National Park, CA (CA-01). Photo by A. Ryan, January 2024. — D. Sarcobatus Flat, NV (NV-03), 26 May 2024. — E. Fish Lake Valley, NV (NV-04), 24 May 2024. — F. Big Smoky Valley playa, NV (NV-05). Photo by M. Berger, 26 May 2024.

[86] Statwick 2016.
[87] Rundel et al. 2015 p. 114.
[88] Morefield 1993 p. 9.
[89] CNDDB 2024.
[90] Rundel et al. 2015 p. 118.
[91] Rundel et al. 2015 p. 114.
[92] Ding et al. 2021.
[93] Jones et al. 2021 p. 1416

E. Taxonomy

With approximately 3,000 species distributed across temperate arid regions of Eurasia, the Americas, and Africa, *Astragalus* is broadly accepted as the most species-rich genus of terrestrial plants,[94] within one of the largest plant families, Fabaceae. First described in 1753 by Carl Linnaeus in volume 2 of his *Species Plantarum,*[95] the genus has received numerous taxonomic treatments and revisions in proportion with its size, the majority of which have focused on regional and subgeneric groupings. Molecular studies over the last several decades have supported the monophyly of the genus,[96] [97] [98] however, and phylogeographic analyses have proposed infrageneric clades aligned with biogeographic patterns of radiation and diversification.[99] [100] [101] With some 450 accepted species, Western North America has been recognized as a center of diversity for the genus.[102] [103]

Significant treatments of *Astragalus* species in Western North America began in the 19th century with the description of 29 species in William Jackson Hooker's *Flora Boreali-Americana*,[104] including the first published description of *A. lentiginosus* contributed by David Douglas. The most important treatment from this early period was Asa Gray's 1864 *Revision of the North American Species of Astragalus and Oxytropis* which has remained a foundational reference for North American *Astragalus* taxonomy.[105] Further influential revisions were made by Sereno Watson (1871), and prolific contributions by Marcus E. Jones (1923) yielded some 417 taxa.[106] Contemporaneously with Jones, Per Axel Rydberg took a very different taxonomic approach and would eventually publish 27 genera as segregates from the genus *Astragalus*. Under this schema, Rydberg reclassified the previously described varieties of *Astragalus lentiginosus* as full species in the genus *Cystium,* to which he added twelve newly described taxa.[107] Among these additions was *Cystium sesquimetrale,* based upon the type collection made by William H. Shockley at Soda Springs, Nevada, on June 11, 1882.[108] In his description, Rydberg notes the habit as "making mats 1.5 m in diameter," which can be inferred as the

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[94] Folk et al. 2024a p. 1
[95] Linne 1753 p. 755
[96] *Ibid.*
[97] Zarre 2013 p. 3
[98] Wojciechowski 2005 p. 382.
[99] Scherson 2008 p. 1034-1036.
[100] Folk et al. 2024a p. 11.
[101] Folk et al. 2024b p. 1213.
[102] Chaudhary et al. 2008 p. 338.
[103] Folk et al 2024a p. 11-12.
[104] Hooker 1829.
[105] Gray 1864.
[106] Jones 1923.
[107] Rydberg 1929.
[108] Shockley 278 GH.

character to which the name "sesquimetralis," i.e. "one-and-a-half" (sesqui-) + "meters" (metralis), refers.[109]

Rydberg's classifications were eclipsed by a comprehensive revision of *Astragalus* undertaken by Rupert Barneby in the mid-20th century, culminating in his 1964 *Atlas of North American Astragalus* which has remained largely authoritative to the present. In an earlier treatment of *Astragalus* section *Diplocystium*,[110] Barneby dispensed with Rydberg's proliferation of genera and reinstated *Astragalus lentiginosus* as a single species with 40 varieties—the most infraspecific-taxa of any species in the United States flora.[111] In this treatment, Rydberg's *Cystium sesquimetrale* was included as a variety of *Astragalus lentiginosus* for the first time. Notably, in this treatment Barneby comments that the taxon "appears to be a remarkable race, one which in another section of *Astragalus* would deserve, in fact, specific status: more collections, however, are needed".[112] His later treatment of the variety published in his *Atlas* does not resume this discussion of a possibly warranted elevation to species rank, and instead comments on uncertainty regarding the type locality, noting that attempts to relocate the population had been unsuccessful.[113] Thus, all published descriptions of the plant to that date were based solely on the type collection. In 1977, Barneby published an account of the plant's rediscovery at Sodaville by Margaret Williams, as well as her documentation of a second population at Big Sand Spring in Inyo County, California, noting minor morphological differences in the latter material.[114] Several new infraspecific taxa under *A. lentiginosus* were added by Stanley Welsh in his 2007 *North American Species of* Astragalus *Linnaeus (Leguminosae): A Taxonomic Revision,* with much of Barneby's system of classification and the position of *A. lentiginosus* var. *sesquimetralis* preserved.[115]

[109] Rydberg 1929 p. 414.
[110] Barneby 1945.
[111] Knaus 2010 p. 1816.
[112] Barneby 1945 p. 116.
[113] Barneby 1964 p. 928.
[114] Barneby 1977 p. 380-381.
[115] Welsh 2007.

III. STATUS OF THE SODAVILLE MILKVETCH

The Endangered Species Act (ESA) was enacted to preserve biodiversity by ensuring that imperiled species are afforded necessary protections.[116] The ESA established 5 factors that the Secretary of Interior must consider when determining whether a species should be listed as threatened or endangered.[117] Those factors are: (1) 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.[118] In evaluating the factors listed above to determine whether a species warrants listing, the Service must use only the best scientific and commercial data available.[119] If a species is found to warrant listing, the ESA requires that the Secretary designate critical habitat "concurrently" with the listing determination.[120]

Sodaville milkvetch is threatened throughout its range by at least three of the above factors and thus warrants federal protection under the ESA. Each of its six populations face a combination of threats due to groundwater drawdown for agriculture, mining, solar and geothermal energy development, non-native ungulate grazing and trampling, off-highway vehicles, and invasive species (**Table 3**). Climate change is an additional threat to all populations.

Occurrence	Agriculture	Mining	Geothermal	Solar	OHVs	Grazing
NV-01 Sodaville			**X**			**X**
NV-02 Cold Springs	**X**	**X**				**X**
NV-03 Sarcobatus Flat		**X**	**X**	**X**	**X**	**X**
NV-04 Fish Lake Valley	**X**	**X**	**X**	**X**	**X**	**X**
NV-05 Big Smoky Valley		**X**	**X**	**X**	**X**	**X**
CA-01 Big Sand Spring						**X**

Table 3. Sodaville milkvetch occurrences and threats.

[116] 16 U.S.C § 1531(b)
[117] *Id.* at § 1533(a)(1)
[118] *Ibid.*
[119] *Ibid.*
[120] *Id.* at § 1533(b)(2)

Sodaville milkvetch is listed as critically endangered by both the state of Nevada and the state of California.[121] [122] In California it is ranked 1B.1 under the California Native Plant Society's California Rare Plant Rank system, indicating that it is rare, threatened or endangered in California and elsewhere, and seriously threatened in California.[123] NatureServe ranks the taxon globally G5T1, and S1 subnationally in both California and Nevada.[124] In Nevada, it is also listed on the Bureau of Land Management's list of Sensitive Species.[125]

In 1992, Sodaville milkvetch was proposed as a candidate for listing as threatened under the federal ESA among a group of "seven desert milk-vetch taxa from California and Nevada."[126] At the time, the Sodaville milkvetch was known from only three occurrences (NV–01, NV-02, and CA-01), and the proposed rule noted only the following brief account of the relevant threats as they were understood at the time: "habitat alteration and destruction resulting from off-road vehicle activity, and commercial development and associated roadside activity" in reference to E.O. # NV-01 and E.O. # NV-02, "habitat alteration and predation resulting from grazing by feral burros and livestock" in reference to E.O. # CA-01, and "stochastic extinction due to small population size and numbers of individuals" overall.[127] In 1998, the agency withdrew its proposed rule to list *A. lentiginosus* var. *sesquimetralis* because as of 1994, E.O. # CA-01 had been "transferred to wilderness under management of the National Park Service at Death Valley National Park."[128] Given the agency's recognition that stochastic extinction was a threat to the taxon in 1992, the decision to withdraw it from candidacy for listing on the grounds that one out of three then-known occurrences had been afforded some protections was arguably dubious at the time.[129] Today, improved knowledge of the taxon, its distribution, and the proliferation of unprecedented and pervasive threats throughout its range, urgently warrant its reconsideration for federal protection under the ESA.

Due to the pervasiveness of the threats the Sodaville milkvetch faces across its range, it is threatened with becoming endangered, thus qualifying for protection as a threatened species under the Endangered Species Act.

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[121] CNDDB 2025
[122] Nevada Division of Forestry p. 1
[123] CNPS 2025
[124] NatureServe 2020
[125] BLM 2023 p. 25
[126] USFWS 1992 p. 19845-19846
[127] *Ibid.*
[128] USFWS 1998 p. 53631-53632
[129] Roberson 2001 p. 6

IV. THREATS

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

1. Threats Common to All Populations

a. Groundwater Drawdown

The Sodaville milkvetch is reliant on shallow groundwater to sustain its alkali wetland habitat. Its specialized habitat is thus vulnerable to groundwater depletion, deterioration of water quality, and climatic changes that alter recharge rates.[130] Perturbations to the hydrologic systems which feed the shallow groundwater the milkvetch needs for survival are cause for great concern. Overpumping due to agriculture and is already causing groundwater drawdown in or near the Sodaville milkvetch's habitat.[131] Emerging threats like geothermal energy, gold and lithium mining will place additional pressures on already over-taxed aquifers. A continuation of current pumping trends would result in a significant risk of extinction for the milkvetch. Any increase in pumping will only exacerbate this problem and potentially hasten the milkvetch's demise.

Fig. 6 conceptualizes how springs may be affected by groundwater pumping, with the potential for impact ultimately depending on the proximity of the pumping, the hydraulic characteristics of the aquifer and the magnitude and duration of pumping.[132] Prior to pumping (A), the flow from recharge areas over the mountains balance the discharge areas along the valley axis or out of the basin via underflow and springs occur where the water table intercepts the land surface. With the onset and continuation of pumping (B-E), water levels are lowered around the pump, causing a hydraulic gradient that induces radial flow towards the pump. A cone of depression develops around the pump and grows until the recharge rates are in balance with the pumping rate. The drawdown may intercept water that would otherwise be discharged at springs.[133]

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[130] Rohde *et al.* 2020, p. 4.
[131] Esmeralda County 2024, p. 50.
[132] Nye County 2004, p. 23.
[133] *Id.*, p. 25.

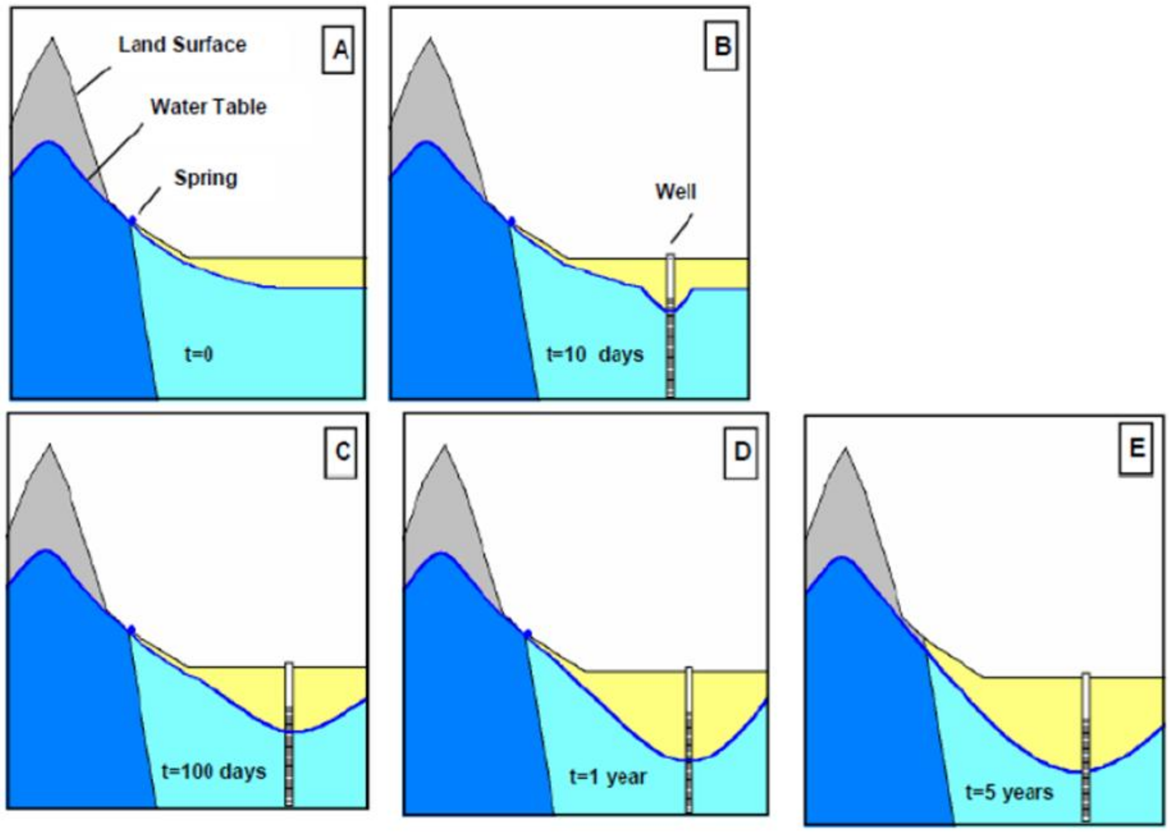

Fig. 6: Potential effects of groundwater withdrawals on spring discharge rates: (A) Natural hydrologic system is in balance; (B) Water levels are lowered in the vicinity of the production wells; (C) The area of decline expands outward from the pumping well or wells; (D) Wells' area of influence approaches the edges of the valley-fill aquifer or the geologic structure controlling the spring and discharge rates may begin to decline; (E) Effects may expand beyond the valley-fill aquifer and eliminate the natural discharge of springs.[134]

The Sodaville milkvetch is entirely reliant on sustained availability of shallow groundwater. A decline in groundwater levels in the areas supporting the known populations, resulting from either declines in spring discharge or an overall lowering of the water table, would decrease the quality and/or area of the milkvetch habitat, up to and including localized extirpation.

With the onset of groundwater pumping, water levels around pumping locations will begin to decline, causing hydraulic gradients that induce radial flow towards the pumping wells. Cones of depression will develop around the wells and grow until the recharge rates are in balance with the pumping rates. The drawdown may intercept water that would otherwise be discharged at

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[134] Adapted from Nye County 2004, p. 25.

springs,[135] or support groundwater dependent vegetation. Once the pumping ceases, water will continue to flow towards the wells but start to replenish the drawdown cones created by the pumping. The top of the cones will continue to expand even as the tip of the cones recover because gradients toward the wells are still required to drive the flows. Water levels at the wells initially recover quickly because there is little volume at the tip of the cones but in the long term, the remainder of the cones recover slowly because the flow gradients will have decreased so that fluxes toward the cones decrease.[136] Thus, groundwater dependent ecosystems may continue to be affected by the mining projects long after mining has ceased.

Even a small amount of drawdown may potentially dry up lower flowing springs or increase the amount of time a spring stays dry due to natural variability.[137] As noted by Currell in examining drawdown of springs due to mine development in Australia:[138]

> *It is quite possible for a spring (or a gaining stream) to experience minimal drawdown, but for the flow of water from the aquifer to the surface to decrease or even cease entirely. For this reason, by the time 20cm of drawdown has been noticed at the Doongmabulla Springs – which are located about 8 kilometres from the mine site – it is likely that the flow directions and water budget will have been fundamentally changed, and possible that the springs may ultimately cease to flow, as has occurred in many other parts of the Great Artesian Basin.*

Even modest amounts of drawdown could dry up Sodaville milkvetch habitats, especially over the long term. Capture is a term that refers to the loss of discharge from an aquifer, through surface expression or evapotranspiration, due to groundwater drawdown. While initial response to pumping occur through depletions to aquifer storage, over the long term, up to 85% of groundwater depletion expresses through capture of surface discharge.[139] As pumping occurs, surface discharge and evapotranspiration are captured, resulting in the desiccation of moist soils and mortality of phreatophytic vegetation.[140] Declines in groundwater levels of one foot would result in a linear reduction in evapotranspiration from phreatophytes.[141] During monitoring elsewhere in the Amargosa Basin, groundwater levels at a monitoring well in Chicago Valley decreased 1.6 feet over a 6 year period,[142] which coincided with the adjacent Twelvemile Spring going functionally dry.[143]

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[135] Nye County 2004, p. 25.
[136] Myers 2011, p. 11.
[137] Myers 2011, p. 7.
[138] Currell 2016a, p. 3.
[139] Konikow & Leake 2014, p. 8.
[140] Bredehoeft 2011, p. 809.
[141] Bredehoeft and Durbin 2009, p. 4.
[142] Zdon 2020, p. 41.
[143] *P. Donnelly, personal observation.*

There is the additional issue of groundwater flux as it pertains to pumping or dewatering. In some cases, groundwater monitoring for drawdown is not necessarily a good indicator of the propensity of a pumping scenario to contribute to capture.[144] There can be a delay between pumping and the impacts of such pumping as drawdown propagates through a system.[145] After pumping commences and reductions in aquifer storage result, it creates a cone of depression which will induce flow of groundwater towards its bottom.[146] This will in turn draw water away from discharging at springs and wetlands, even when groundwater levels at those springs and wetlands have only decreased minimally.[147] "Only very minor drawdown need occur at this point for the flow direction to reverse, depriving springs or streams of flux,"[148] (**Fig. 7**).

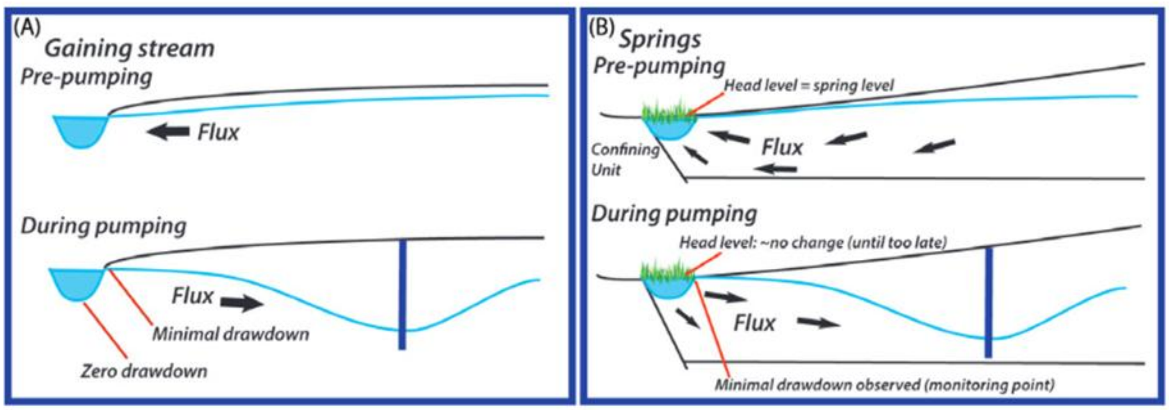

Fig. 7. Conceptual model illustrating the impacts of groundwater pumping on flux as it pertains to (A) gaining streams and (B) springs. Pumping induces flow away from surface discharge and toward the cone of depression, even when groundwater levels at the source of discharge decrease minimally.[149]

Proposed adaptive management measures to mitigate the harms of groundwater pumping on Sodaville milkvetch habitat are unlikely to succeed in preventing groundwater drawdown and decreases in spring discharge. Groundwater drawdown can propagate slowly across the landscape, and there can be a significant delay between when pumping commences and when impacts of pumping materialize in nearby surface water sources.[150] It may take years for a

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[144] Currell 2016b, p. 620.
[145] Bredehoeft 2011, p. 810.
[146] Currell 2016b, p. 620.
[147] *Ibid.*
[148] *Ibid.*
[149] Currell 2016b, p. 620.
[150] Barlow and Leake 2012, p. 73.

drawdown signal to propagate to a spring or other surface water source; and due to this lag, even when adaptive management or other reasons cause pumping to decrease or cease, the drawdown can continue to increase as the cone of depression spreads outward.[151] Even as pumping ceases, capture of surface discharge and evapotranspiration may persist "over a longer time period than the immediate (and often temporary) loss of storage."[152] Therefore, adaptive management regimes using triggers and other signals to manage pumping levels are unlikely to prevent degradation of Sodaville milkvetch habitats due to groundwater pumping. Because groundwater flows and basin systems are complex and span large areas that may not be coextensive with surface physiography, pumping of groundwater even at a removed distance can impact occurrences of groundwater-dependent taxa like the Sodaville milkvetch.[153] [154]

b. Mining

i. Dewatering and Pit Lakes

Open pit mining that extends below the groundwater table captures groundwater and can drastically change groundwater relations.[155] At mines in northern Nevada, groundwater levels near open pit mines have decreased as much as 500 m and drawdown has extended 80 km from the pit.[156] Substantial drawdown due to mine dewatering has been extensively documented at mines in northeastern Nevada. For example, groundwater levels at the Goldstrike Pit on the Carlin Trend have declined as much as 1,600 feet in some places by 2003 in response to the removal of about 1.125 million acre-feet of groundwater.[157] Lowered groundwater levels and drawdown due to mine dewatering can capture water that would otherwise discharge at springs. Dewatering may be the largest stress that an aquifer can be subjected to due to the area, depth, and volume of the pits which must be kept dry.[158]

Once dewatering ceases, groundwater impacts continue due to the deficit created in the groundwater system. Groundwater returns to the dewatered pits, causing the water table to recover and leading to the formation of a pit lake. Pit lakes experience evaporative loss, continuing to pull water from the aquifer to replenish as water evaporates off.[159] Natural pit lake recovery leading to a long-term relatively steady state level can range from decades to 500 years

[151] Bredehoeft 2011, p. 812.
[152] Currell 2016b, p. 620.
[153] Hasselquist and Allen 2009, p. 623.
[154] Elmore *et al.* 2006, p. 776-777.
[155] Myers 2016, p. 1.
[156] *Ibid.*
[157] Plume 2005, p. 1 & 4.
[158] *Id.*, p. 3.
[159] McCullough *et al.* 2012, p. 168.

due to the need to also return water to the empty pores of the surrounding dewatered overburden, the increasing evaporation as the pit lake grows and expands, and the increase in lake volume per unit depth increase.[160] [161]

Open pit mine dewatering is required when a mine's pit extends below the water table in order to keep the mine dry. Once the dewatering ceases, groundwater around the mine will start to recover and as this happens, the mine pit will fill with water, creating a pit lake.[162] Because the volume of the pit below the water table was mostly rock prior to mining, the pit lake represents a substantial water deficit. Evaporation from the surface of the pit lake is another source of water loss.[163] Whether or not a pit lake is backfilled, and the prevailing climate conditions, thus partly control the amount of water that is lost from the system, as well as the rate and extent of groundwater level recovery at the mine site.[164] Groundwater level recovery occurs until the net flux into the pit equals the evaporative loss from the pit lake.[165] In arid climates, evaporation can greatly exceed precipitation, causing unfilled mine pits to become terminal sinks for groundwater.[166] In the study by Bozan et al. 2022, equilibrium lake levels simulated for moderately transmissive aquifer conditions varied between 15–30 m below the premining groundwater table for net evaporation rates of 1,000 and 3,000 mm/year, respectively. The situation was exaggerated if less permeable aquifer conditions were assumed.[167] Based on technical comments submitted by Nevada's Bureau of Mining Regulation and Reclamation, net evaporation rates at mines in Nevada range between 508 mm/year and 1473 mm/year.[168]

ii. Dust

Mining activities can result in a significant increase in ambient dust, due to construction activities, blasting, quarrying, and significantly increased vehicular traffic on dirt roads. Dust deposition can impact plant health by limiting reproduction, reducing light availability, CO_2 assimilation, and thus reducing photosynthetic capacity.[169] It can also reduce transpiration leading to higher leaf temperatures and reduced water use efficiency.[170] [171] Ambient dust has also been correlated with plant stress symptoms such as water stress, plant die-back, and smaller leaf

[160] Myers 2016, p. 3.
[161] Plume 2005, p. 13.
[162] Bozan et al., 2022, p. 1822, 1825-1826.
[163] Myers 2014, p. 1.
[164] Bozan et al., 2022, p. 1826.
[165] *Ibid.*
[166] *Ibid.*
[167] *Id.*, p. 1830.
[168] BMRR 2021, p. 1-3.
[169] Wijayratne *et al.* 2009, p. 82.
[170] Sharifi et al. 1997, p. 842-843.
[171] USFWS 2022a, p. 45.

size.[172] Dust can also affect pollinators, impeding their ability to provide reproductive services for plants.[173] Ambient dust has been shown to negatively affect the ability of plants to set fruit, and also affects the number of seeds per plant and mean seed weight, meaning that dust has widespread effects on plant reproduction.[174] Appreciable changes to the species composition of shrubland communities have been associated with significant dust deposition.[175]

One study found plants growing within 400 m of mining disturbance, including unprotected stockpiles, occurred in habitats that were degraded due to dust deposition.[176] Plants further away, but in areas that are exposed to prevailing winds were also negatively impacted by dust deposition.[177] Dust deposition at the studied mine site had "a significant effect on photosynthesis and gas exchange," under both high and low dust deposition regimes.[178]

Dust mitigation efforts may not prevent impacts to nearby plants. One prominent mitigation effort includes the use of chemical dust suppressants (e.g. MgCl mixed in water). A prior study found that $MgCl_2$ based products can migrate from treated roads into adjacent soils through precipitation.[179] Chloride (Cl^-) and magnesium (Mg^{+2}) are essential nutrients that are important for normal plant growth, but an excess of either nutrient could be toxic to plants or change water relations such that the plant cannot easily accumulate water and nutrients. This could have a significant impact on rare wetland plants and associated vegetation in and around the Sodaville milkvetch habitat.

iii. Lithium Mining

Traditional lithium production involves pumping lithium-laden brines from groundwater aquifers and evaporating the water out in pools to extract the salts therein. Lithium is then extracted from the salts and processed into lithium carbonate, which is used for batteries. The only current large-scale lithium production in the United States occurs at Silver Peak, Nevada in Clayton Valley, one valley east of Fish Lake Valley. This facility, owned by Albemarle, consumes between 10,000 and 20,000 acre-feet of water annually. This lithium production is already causing significant impacts to aquifers in Clayton Valley. "The Clayton Valley hydrographic basin is permanently losing storage because of withdrawals of groundwater."[180] It is likely that some of

[172] Talley & Holyoak 2006, p. 651.
[173] Waser et al. 2017, p. 90-91.
[174] Lewis et al. 2017, p. 430.
[175] Farmer 1993, p. 72.
[176] Padgett et al. 2007, p. 284.
[177] *Ibid.*
[178] *Id.*, p. 281.
[179] Goodrich et al. 2009, p. 2379.
[180] Esmeralda County 2024, p. 59.

this loss in storage may be permanent: "The impact of the groundwater withdrawals for mineral concentration by evaporation will take decades for the water levels to recover and the loss of groundwater storage will never be regained."[181]

Newer technologies which attempt to minimize consumption of groundwater brines are generally referred to as "direct lithium extraction" or "DLE." DLE technologies use physical, chemical, or electrical processes to selectively extract lithium ions from brine. The spent brine is then able to be reinjected into the aquifer, potentially eliminating the significant declines in groundwater levels associated with lithium brine evaporation projects, as described above. Some DLE technologies require significant inputs of freshwater.[182] The amount of brine required for DLE may be enormous – one company in Nevada has applied for 70,000 gallons per minute, which is approximately 113,000 acre-feet per year.[183] Given that groundwater flow paths are controlled by faulting and pressure gradients, huge amounts of brine pumping for DLE could alter aquifer flow dynamics, potentially inducing flow from freshwater aquifers.[184] [185] [186] While DLE may be a way of producing lithium while reducing overall groundwater consumption by obviating the need for evaporation, much remains unknown about the overall effects on the groundwater system.

In addition to lithium brine production, there is a substantial emerging lithium claystone mining sector. This involves traditional hardrock mining methods – open pit strip mining with on-site processing. This type of mining is typically targeting clays rich in lithium, boron, and other minerals. Ore processing is conducted using a sulfuric acid leaching process.[187] [188] While data is quite limited, both of the claystone mines currently in permitting or construction in Nevada, Thacker Pass and Rhyolite Ridge, will consume significant groundwater. Thacker Pass will consume as much as 5,200 acre-feet per year during Phase 2 of the mine, in a basin that is already severely overallocated.[189] The impacts of Rhyolite Ridge's proposed groundwater use are discussed below in Section IV(A)(2)(c)(ii).

In general, open pit mines for lithium claystone will be permitted under lode mining claims, while lithium brine operations will be permitted under placer mining claims.

[181] *Ibid.*
[182] Vera et al. 2023, p. 157.
[183] USFWS 2021a, p. 2.
[184] Vera *et al.*, p. 153 & 156.
[185] Clifford *et al.*, p. 11.
[186] Saftner *et al.*, p. 19.
[187] BLM 2020, p. 29.
[188] BLM 2024b at 2-4.
[189] BLM 2020, p. 33.

In many cases, brine and freshwater aquifers may be interconnected, and thus drawdown in one may affect the other.[190] [191] For example, an analysis of spring discharge in Railroad Valley, site of a proposed lithium brine project, found 240 parts per million lithium in springs supporting an endangered fish.[192] In order to minimize impacts of lithium brine projects, it is recommended to survey not just springs and water features within a project boundary but, "Surface waters that are hydraulically connected to groundwaters, both up and downgradient, in the project area should be considered."[193]

Lithium production in the Atacama Desert has caused severe water conflicts with mining companies, including with local communities, indigenous communities, and the government of Chile itself.[194] Local communities have received just 3.25% of the overall water rights granted in the Atacama basin, with mining companies taking the remaining 96.76%.[195] The government of Chile sued lithium miner Albemarle for their overuse of the aquifer, as conditions have degraded there to a point of "ecological exhaustion." [196]

Nevada may be approaching a crisis point with lithium. An analysis from 2024 found that 97,639 acres of wetlands in Nevada, including Sodaville milkvetch habitat, have been claimed for lithium production.[197] 20 critically imperiled species, ranked G1/T1 or G1/S1 occur in proposed lithium projects in California and Nevada, including the Sodaville milkvetch, 85% of which are groundwater-dependent taxa. Species such as the Sodaville milkvetch which are restricted to groundwater-dependent ecosystems may be especially vulnerable to all forms of lithium extraction, as none are free from impacts to groundwater.[198]

iv. Gold Mining

Gold mines require a significant amount of water for construction, operations and closure. The exact amount of water required largely depends on the processing method and the amount of material to be mined,[199] with water uses such as dust suppression common across mines. Another important factor is the extent of water reuse.

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[190] Vera *et al.*, p. 152.
[191] Saftner *et al.* 2023, p. 21.
[192] USFWS 2021a, p. 2-3.
[193] Saftner *et al.* 2023, p. 17.
[194] Blair *et al.* 2024, p. 267.
[195] *Ibid.*
[196] Jamasmie 2022, *entire*.
[197] Clifford *et al.* 2024, p. 7.
[198] Parker *et al.* 2024, p. 6.
[199] University of Arizona 2024, p. 2.

Most, if not all, gold mining operations in Nevada will involve a heap leaching operation. Water at the various mines will also likely be supplied through a combination of production wells and dewatering wells (collectively "pumping wells") as open pit mining is planned for most projects and a portion of the pits will likely extend below the water table.

There are various mine components, described in more detail below, that can become a source of contamination to surface and/or groundwater due to leaks and spills. Among the chemicals that may be released are cyanide, heavy metals and sulfuric acid.[200] The latter is formed when sulfide minerals present in the ore are exposed to air and water. The acid leaches minerals from the surrounding rock,[201] forming a highly toxic solution.

- **Overburden storage areas.** Overburden corresponds to all of the unwanted or low value material located between the surface and the targeted ore. It sometimes includes the first layer of soil and vegetation on the surface. Once removed, it is stored in heaps around the site, which can produce dust, and if dust is suppressed with watering, leachate.[202] The latter may run off the waste rock pile, or percolate through the pile, infiltrating groundwater. Leachate may also be produced as a result of rain falling atop the overburden material.

- **Heap leach pads.** These large, engineered structures are used to process lower grade ore using surface irrigation with a sodium cyanide solution. The latter infiltrates through the ore, picking up gold and other metals in the process.[203]

- **Ponds and tanks** used to collect, store and process solutions and mill tailings. Also liable to spills and leaks are pipelines and surface conveyors.

- **Trucks.** The transport of chemicals to the mining site, and waste off-site is another potential source of contamination, as is the long-term storage of waste on-site.

A final source of contamination is pit lakes formed by groundwater seeping back into open pits after mining ceases. Since most open pit gold mines occur in areas of high evaporation, the flow of water is typically into the open pit. However, if outflow occurs, the surrounding groundwater may be contaminated as the outflowing pit lake water is usually of poorer quality.[204] The backfilling of open pits, although preferable from a groundwater recovery standpoint, also poses a risk to groundwater quality. Unlike in the presence of a pit lake, there will be no evaporation once the pit is backfilled, which means groundwater will flow into the backfill and out. As the

[200] *Id.*, p. 5.
[201] Gestring and Hadder 2017, p. 5-6.
[202] BTL Liners 2024, p. 1.
[203] Gestring and Hadder 2017, p. 5.
[204] Gestring and Hadder 2017, p. 6.

groundwater infiltrates into the backfill, potential toxins can be leached and transported out of the pit, into surrounding groundwater.[205]

There are numerous examples of leaks and spills associated with gold mines. Gestring and Hadder found that 27 out of the 27 (i.e. 100%) mining operations reviewed in their report (representing 93% of U.S. gold output in 2013) had experienced at least one pipeline spill or other accidental release, including cyanide solution, mine tailings, diesel fuel and ore concentrate.[206] Meanwhile, 20 out of the 27 (i.e. 74%) mining operations were reported to have failed to capture or control contaminated mine seepage. The seepage of cyanide solution was one of the more common impacts.[207]

b. Geothermal Energy

Geothermal energy production has a long track record of drying up thermal water features or otherwise altering hydrologic systems so as to change surface water availability. There is abundant peer-reviewed literature documenting this, and the U.S. Fish and Wildlife Service has previously recognized this phenomenon in its emergency listing of the Dixie Valley toad[208] and supporting documentation.[209]

In general, geothermal energy production involves pumping hot water to the surface, and utilizing its heat or steam to spin a turbine and generate energy. In older geothermal energy systems, water would generally evaporate off as steam, resulting in a net loss to the groundwater aquifer. In more modern systems, called closed-loop binary cycle systems, the hot water is used to heat a thermal transfer medium, frequently pentane, which is then used to create energy. The hot water can then be reinjected into the aquifer, theoretically avoiding the problems with water loss from the older technologies. However, as will be discussed, just because groundwater is not being directly consumed, does not mean there will not be changes to surface water features.

Myers,[210] writing about the Dixie Meadows Geothermal Project but speaking about general concepts, describes some of the mechanisms through which geothermal energy production may affect groundwater flow and surface water discharge:

> *Production wells [c]ould pull water from the natural discharges to the springs because pumping causes a drawdown in the potentiometric surface (a pressure gradient).*

[205] Great Basin Resource Watch 2023, p. 8.
[206] Gestring and Hadder 2017, p. 7-8.
[207] *Id.*, p. 8.
[208] USFWS 2022, *entire*.
[209] USFWS 2023, *entire.*
[210] Myers 2017, p. 7-8.

> *Injection would create zones of pressure that would be higher than the background, as necessary to assure fluids flow into the fractures. Much of the injected flow would follow similar pathways as occurred before development because those pathways are most transmissive, but the limitation of the existing fractures would require higher pressure to force the fluid through the fractures. This would result in a substantial amount leaking off into other fractures or the bulk media, which would cause a net loss of flow. It is also possible that reinjection would not occur into the same fracture zones as the water removed for geothermal development. As described above, the most permeable fractures are few, and due to heterogeneity, there is no certainty that permeable fractures in the injection wells would intersect the permeable fractures in the collection wells. This would cause reinjected water to be lost to the circulation, especially if reinjection reaches fractures that are transverse to the general fracture trend found in the fault system. Therefore, there are two ways that recirculation could lose water – by leaking off into bulk media or by reinjection to fractures not connected to the collection wells.*

Pumping from the geothermal reservoir would alter the aquifer's natural pressure gradients. Water would be pulled from natural discharge zones due to depressurization at the pumping sites while high pressure would be experienced in areas near injection wells. The reinjection wells would almost certainly not replace water in the same exact locales that it was pumped from. Permeable fractures in the injection wells would not necessarily intersect the permeable features. For more discussion on this, see supporting documentation from the Dixie Valley toad listing.[211]

Reinjected water might be lost to the circulation, particularly if reinjection reaches fractures transversal to the general fracture trend found in the fault system.[212] Reinjection can also cause deformation and shattering of substrate, potentially offering new pathways for gas and water circulation and therein altering the hydrology of the adjacent surface features.[213]

Numerous analyses of the environmental impacts of geothermal energy have cited changes to surface manifestations of geothermal waters as inherent in geothermal energy production technology.[214] [215] [216] "Historical evidence shows that natural thermal features have been affected, often severely, during the development and initial production stages of most high-temperature

[211] USFWS 2023, p. 41-44.
[212] Myers 2017, p. 8.
[213] Rissman et al. 2012, p. 232.
[214] Kristmannsdottir & Armannsson 2003, p. 454-455.
[215] Bayer et al. 2015, p.374.
[216] Maochang 2001, p. 99.

geothermal systems."[217] "Changes in surficial features and land elevations accompanying geothermal development should be viewed as the rule, rather than the exception."[218]

There are many examples of geothermal energy projects in the Great Basin drying up or significantly altering nearby hot springs. These include at Brady's Hot Springs, where thermal hot springs sufficient to host a resort and spa (at a minimum flow of 21 gallons per minute) completely dried up upon the drilling and pumping of geothermal wells.[219] Upwards of 27 geysers at Beowawe, Nevada used to shoot thermal water 8 meters into the air,[220] however upon commencement of geothermal drilling and pumping, the geysers ceased to flow, and groundwater levels fell 65 to 130 meters.[221] The geysers have never resumed their flow.

In some cases, geothermal pumping has caused changes to groundwater hydrology sufficient to imperil rare biodiversity. Steamboat Hot Springs, near Reno, experienced a significant decline of surface discharge from geysers and springs including a reduction of thermal water discharge to Steamboat Creek by 40%.[222] The Steamboat buckwheat, a rare plant living at the hot springs, is now listed under the Endangered Species Act, with its sinter habitat gradually drying up and eroding away, with the geophysical processes which are necessary to replace it having ceased.[223]

Geothermal pumping in Long Valley Caldera near Mammoth, California has resulted in springs drying up and declines in pressure in the geothermal aquifer.[224] This has also resulted in a 30-40% reduction in thermal water content in the springs at Hot Creek Fish Hatchery.[225] Notably, the literature shows impacts from the geothermal energy production in this area extending many kilometers away from the points of diversion.[226] The US Fish and Wildlife Service acknowledged the impacts of this in their proposed rule to list the Long Valley speckled dace (*Rhinichthys nevadensis caldera*) as an endangered species, concluding that, "Changes in surface-expressed water temperature and flow from geothermal production areas have been documented within the Long Valley Caldera at historical localities where Long Valley speckled dace previously occurred…" including at two specific springs nearby.[227]

The ways geothermal energy may impact adjacent groundwater dependent ecosystems can be paradoxical. For instance, the North Dixie Valley geothermal project, a 56-megawatt project that

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217 Hunt 2001, p. 99.
218 Sorey 2000, p. 708.
219 Lund 1982, p. 14.
220 White 1992, p. 1.
221 *Id.*, p. 12.
222 Sorey 2000, p. 707.
223 USFWS 2022b, p. 2.
224 Sorey 2000, p. 707.
225 *Id.*
226 *Id.*
227 USFWS 2024, p. 64859.

has been in production since 1985, has experienced land subsidence as a result of their pumping.[228] [229] In order to counteract land subsidence issues, the operator began pumping cold basin fill aquifer water and reinjecting it above the hot geothermal reservoir.[230] This misguided mitigation effort may have contributed to the groundwater table decreasing some 2.5-3 meters from 2009-2011.[231] Significant changes to vegetative composition in the area of the geothermal power plant were evident when pumping of the basin-fill aquifer began.[232]

A notable recent entry in the ledger of geothermal energy projects drying up surface water features is the example at Jersey Valley, Nevada. There, Ormat commenced production at a geothermal power plant in 2011. The nearby Jersey Valley Hot Springs, which flowed regularly at between 0.08-0.17 cfs, began to decline immediately, and ceased flow altogether by 2014 (**Fig. 8**). It has never resumed its flow.[233] Field observations from 2021-2023 reveal an area of dead emergent vegetation and dead phreatophytes in the area of Jersey Valley Hot Springs (**Fig. 9**). BLM has permitted Ormat to conduct a mitigation project to refill the spring pool using produced geothermal water from the power plant,[234] but as of 2024, the mitigation project had not yet been executed.[235]

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[228] Sorey 2000, p. 708.
[229] Huntington et al. 2014, p. 5.
[230] Huntington et al. 2014, p. 5.
[231] Albano et al. 2021, p. 79.
[232] *Id.*, p. 80.
[233] NDWR 2025d, *entire.*
[234] BLM 2022b, p. 1.
[235] *P. Donnelly, personal observation.*

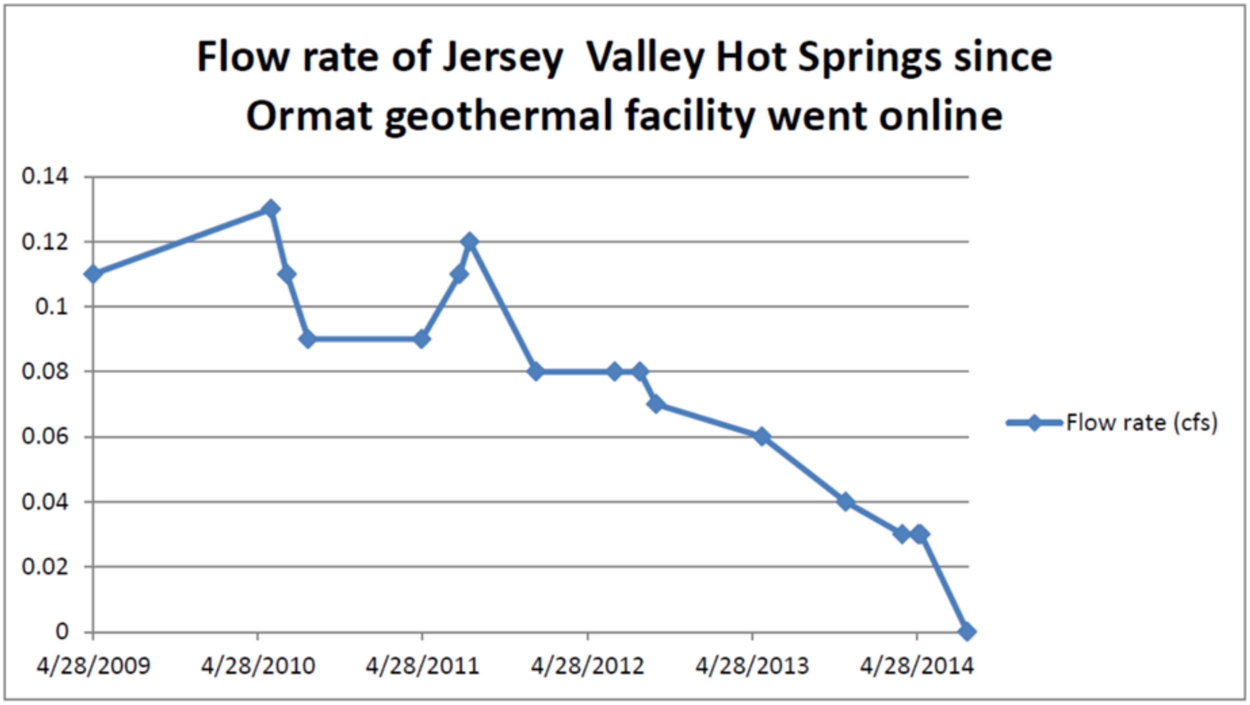

Fig. 8. Spring flow data at Jersey Valley Hot Springs, per NDWR's website.[236]

Fig. 9: A dried-up Jersey Valley Hot Spring. Photo taken on July 28, 2023 at 40.17692, -117.59657.

[236] Adapted from NDWR 2025d.

In recognition of the threats posed by geothermal energy production to adjacent surface water features and the rare flora and fauna that call them home, the U.S. Fish and Wildlife Service added the Dixie Valley toad to the list of endangered species in December of 2022.[237] The final listing rule cited many of the same examples cited in this petition. The final listing rule also included a Species Status Assessment (SSA), which featured an expert knowledge elicitation, in which expert hydrogeologists, most previously familiar with Dixie Valley, were presented with evidence and questioned on their thoughts on the likely outcomes from building the Dixie Meadows Geothermal Project.[238] The experts found it likely that the springs at Dixie Meadows would respond quickly, with a median estimated response time of 4 years, and a 90% chance that the largest magnitude changes would occur within 10 years.[239] The median confidence of the experts for Ormat's monitoring plan to detect changes to the spring system was 38%, and the median confidence for the impacts to then be adequately mitigated was 29%.[240] All of the experts agreed there would likely be some changes in spring discharge quantity and temperature once geothermal production commenced.[241] Despite the proposed Dixie Meadows Geothermal Project using the latest binary cycle technology, experts still thought it would substantially alter the groundwater flow system and spring discharge there.

The Sodaville milkvetch grows in areas of shallow groundwater, which creates the moist soil conditions that the plant favors. The exact impact of geothermal energy production on the Sodaville milkvetch is unknown at this time. Variables which would be important in determining this impact would include the portion of localized groundwater sourced from geothermal aquifers versus shallow alluvial aquifers; the connectivity between shallow and deeper aquifers; and the transmissivity of the bedrock layers.

Geothermal springs and thermal systems often create habitats for unique flora and fauna that have evolved specifically to the unique conditions present in geothermal systems.[242] Spring systems with thermal features across the Great Basin harbor endemic species, such as those in Railroad Valley, Dixie Valley, Steptoe Valley, and the Amargosa River Basin. Changes to habitats created by thermal water features due to geothermal energy production can result in a loss of local biodiversity.[243] [244]

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[237] USFWS 2022c, *entire.*
[238] USFWS 2023, *entire.*
[239] *Id.*, p. 41.
[240] *Id.*, p. 42.
[241] *Id.*, p. 43-44.
[242] Boothroyd 2009, p. 203.
[243] Yurchenko 2005, p. 496.
[244] Waikato Regional Council 2012 p. 14.

c. Solar Energy Development

Under the BLM's recently released Western Solar Plan, all five Nevada occurrences of *Astragalus lentiginosus* var. *sesquimetralis* coincide with the designation, "Lands Available for Application" (**Fig. 10**).[245] Given their proximity to planned or existing transmission lines, these localities have a high likelihood of being prioritized by solar industry planners. Development of utility-scale solar projects poses both direct and indirect threats to *Astragalus lentiginosus* var. *sesquimetralis* occurrences within or in proximity to project boundaries, with a range of potential impacts including direct destruction or disturbance of habitat, fugitive dust deposition, chemical herbicide contamination, disruption of pollinator habitat, and introduction of invasive species.[246] [247] [248]

Large solar installations are a threat to the Sodaville milkvetch as construction (primarily dust suppression) and operation consumes water, with recent reports linking drying of local wells to solar plants in California's Colorado Desert.[249] [250] Recent solar plans for nearby Pahrump Valley cite requirements of 1,200 acre-feet for construction of one project, mostly going to dust suppression.[251] Future solar energy development is thus highly likely to increase pressure on the aquifers which sustain Sodaville milkvetch habitats as a whole due to increased groundwater withdrawals.

Inasmuch as the Western Solar Plan revision may result in solar development directly adjacent to or on top of Sodaville milkvetch habitat, site-specific impacts must also be considered. Land clearing associated with solar development is also a concern as it may destroy milkvetch habitat, increase sedimentation and promote invasion of exotic plants.[252] Road construction for access to the sites increase dust.[253] "Proximity impacts result from the fragmentation and degradation of land near and between protected areas," due to solar development.[254] Broadly, renewable energy development, in particular solar, is the leading cause of observed conservation value declines in the Mojave Desert.[255]

[245] BLM 2024i.
[246] Karban *et al.* 2024 p. 10.
[247] Grodsky *et al.* 2021, p. 5-6.
[248] Hernandez *et al.* 2015, p. 13581-13582.
[249] Myskow 2023, *entire.*
[250] Wainwright 2023, *entire.*
[251] BLM 2020a at 3-95.
[252] Glicksman 2011, p. 114
[253] Mulvaney 2017, p. 505
[254] Hernandez et al. 2015, p. 13581
[255] Parker *et al.* 2018, p. 10-11.

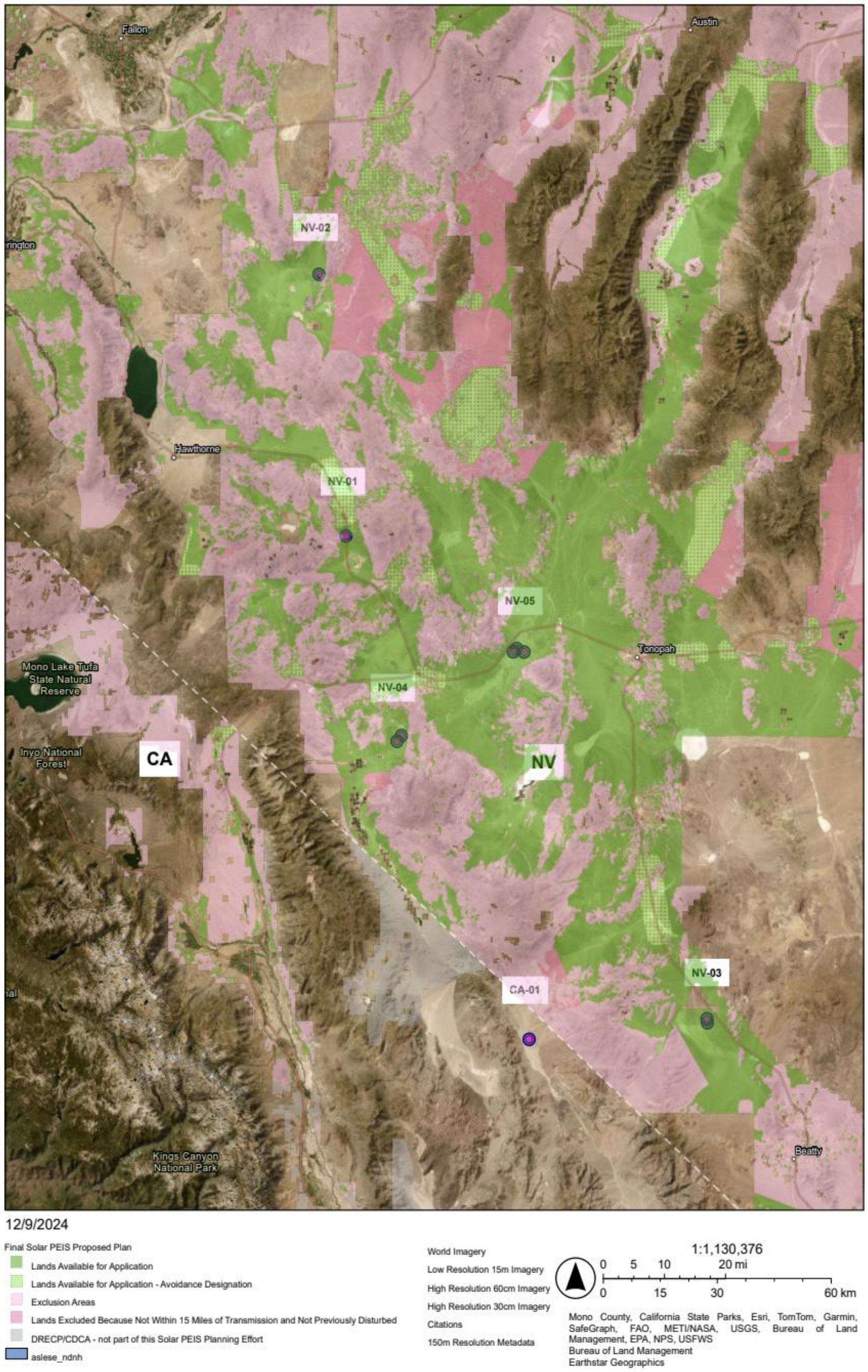

Fig. 10. Map of *Astragalus lentiginosus* var. *sesquimetralis* occurrences overlain by the Bureau of Land Management's Western Solar Plan per the final Programmatic Environmental Impact Statement finalized 29 August 2024.[256] All Nevada occurrences fall under or are immediately adjacent to "Lands Available for Application," indicating priority for solar development.

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[256] BLM 2024i.

d. Cattle and Feral Horse/Burro grazing

Livestock grazing is one of the most widespread land use practices in western North America and it has been associated with a wide range of negative impacts on habitats where it occurs.[257] Livestock grazing can increase soil compaction, decrease infiltration rates, increase runoff, decrease riparian vegetation, increase stream sedimentation and water temperature, contaminate water through excrement and promote invasive species, among other changes.[258] [259] These changes are significant as even small deviations in water quantity and quality could potentially negatively impact the Sodaville milkvetch.

Grazing in arid desert lands has been shown to have "dramatic effects on species composition of plant communities."[260] Grazing also "destabilizes plant communities" by spreading invasive species including through dispersing seeds in fur and dung, creating disturbance which allows invasive species to thrive, and reducing competition by native plants through herbivory.[261] Cattle grazing can also cause deterioration of soil stability, increasing erosion and compaction.[262] This could have significant impacts on the Sodaville milkvetch by preventing germination and eliminating habitat.

Grazing has been shown to negatively correlate with perennial forb cover, and positively correlate with an increase in exotic annual plants, including *Bromus tectorum*.[263] The effects of grazing on plant communities and individual species can be greatly magnified during drought conditions.[264] [265] This has important ramifications for the Sodaville milkvetch, as the Great Basin Desert has been under long-term drought conditions for many years.[266]

There is relatively little literature on the effects of cattle grazing on rare plants in deserts. A recent study examined dormant season grazing in the habitat of *Astragalus holmgrenorium* and found that mortality during dormancy dramatically increased following grazing.[267] Reduction in survival in this study was "directly linked to trampling disturbance" from cattle.[268] Livestock

[257] Fleischner 1994, p. 636.
[258] Batchelor et al. 2015, p. 931.
[259] Kimball & Schiffman 2003 as cited in Filazzola et al. 2020.
[260] Fleischner 1994, p. 631.
[261] *Id.*, p. 633.
[262] *Id.*, p. 634.
[263] Loeser, *et al*. 2007, p. 91.
[264] *Id.*, p. 93-94.
[265] Souther, *et al.* 2020, p. 12.
[266] Williams et al. 2022, p. 23.
[267] Searle and Meyer 2020, p. 6.
[268] *Ibid.*

activity can also impact local hydrology, by mechanisms including ground compaction and streambank and channel erosion.[269]

Wild burros are an invasive species in North America and invasive species are known to be one of the most widespread and serious threats to the integrity of native wildlife populations due to the habitat degradation they cause in native ecosystems.[270] Large herbivores such as burros disturb landscapes by trampling soils and vegetation, selectively grazing palatable plants, and altering the distribution of nutrients in the ecosystem. Burros and horses ingest more forage per unit of body mass than any other large-bodied grazer in western North America.[271] Research in the Great Basin has also found that areas with feral horses have fewer plant species and less grass, shrub, and overall plant cover than areas without, and more invasive plant species and weeds such as cheatgrass, which degrades wildlife habitat. Riparian and wetland areas may furthermore be impacted by burros through soil compaction and increased erosion.[272]

e. Off-highway vehicles

OHV use can harm plant species in arid environments by disturbing the soil, and crushing or uprooting individual plants, and increasing soil loss.[273] [274] OHV recreation is also a vector for exotic and invasive species.[275] OHV use can cause soil compaction, potentially inhibiting recruitment.[276] By altering the hydrologic regime, soil compaction can also promote invasive species and discourage establishment of deep-rooted annuals.[277] Even a single pass from an OHV in wet loamy sand, or twenty passes in dry loamy sand, can cause a reduction in desert annual plant cover due to a reduction in plant size.[278]

Fugitive dust created by OHV traffic can also impact plants, potentially affecting processes such as photosynthesis, respiration, and transpiration because the dust may block stomata.[279] [280] [281]

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269 Eldridge *et al.* 2022, p. 1786-1787.
270 Wildlife Society 2014, p. 1.
271 *Id.*, p. 1-2.
272 *Id.*, p. 1.
273 Switalski 2019, p. 89.
274 Ploughe and Fraser 2022, p. 9.
275 *Ibid.*
276 Ouren *et al.* 2007, p. 11.
277 *Id.*, p. 12.
278 *Id.*, p. 11.
279 Ouren *et al.* 2007, p. 13.
280 Spellerberg and Morrison 1998, p. 16.
281 Ploughe and Fraser 2022, p. 10-11.

This may in turn result in reduced plant growth, size, productivity, or survivorship.[282] A recent study found a 12% decrease in local PM10 levels when a nearby OHV recreation area temporarily shut down.[283] Once soils have been disturbed by OHVs, wind can exacerbate debris flow and increase fugitive dust.[284] Please see the discussion about the impacts of dust on rare plants in the above mining section of this petition.

While the effects of OHV use on the Sodaville milkvetch has not been specifically studied, there have been intensive studies on the effects of another rare plant, Pierson's milkvetch (*Astragalus magdalenae* var. *piersonii*), which grows in the Algodones Dunes, a popular OHV area in Imperial County, CA. One study found that areas with OHV use had 4-5 times fewer Pierson's milkvetch plants than areas legally closed to OHVs.[285] High levels of vegetation destruction have been found in areas of the Algodones Dunes open to OHVs, both through direct destruction of above-ground vegetative matter, but also through damage to the root systems of psammophytes.[286] Groom *et al.* suggest that seed pod production by Pierson's milkvetch is likely one fifth as much in areas used by OHVs as opposed to those closed.[287] One mechanism through which OHVs may harm the overall population of Pierson's milkvetch is by reducing small plant survival, which was found to be reduced by 33% in areas open to OHVs.[288]

2. Population Specific Threats

a. Sodaville (type locality)

The type locality E.O.# NV-01 at Sodaville in Mineral County, NV, occurs in Nevada Division of Water Resources (NDWR) Groundwater Basin 121A, which includes the small towns of Mina and Luning. This groundwater basin is badly over appropriated, with a perennial yield of 600 acre-feet per year but total commitments of 3,414 acre-feet per year.[289] If pumping is exceeding recharge by such a vast amount, it is likely that the groundwater basin is in overdraft and surface discharge is being captured by pumping. In a Groundwater Basin Status Assessment performed by NDWR in 2023, this basin was rated in the second-highest of 5 assessment categories indicating high vulnerability to groundwater shortage.[290]

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[282] Ouren *et al.* 2007, p. 13.
[283] Gillies et al. 2022, p. 1.
[284] Lovich & Bainbridge 1999, p. 316.
[285] Groom *et al*. 2007, p. 130.
[286] Luckenbach and Bury 1983, p. 275.
[287] Groom *et al.* 2007, p. 130.
[288] *Id.*, p. 132.
[289] NDWR 2025b.
[290] NDWR 2023.

i. Habitat Alteration

Habitat at the Sodaville milkvetch's type locality in Sodaville, Nevada has been substantially altered (**Fig. 11**, **Fig. 12**). The occurrence and surrounding springs and wetlands that comprise its habitat are privately owned and historically supported industrial mining operations, a railroad station, and even a "desert lobster" (Australian red claw crawfish) farm.[291] [292] [293] Currently, the property appears to be covered with derelict vehicles and other debris, a gravel pit, numerous trailers, and a brothel called the Wild Cat, which has opened and closed at various times over the years.[294] Water has been diverted from the spring into several artificial ponds. Parts of the wetlands appear desiccated on satellite imagery. The private parcels in this basin are surrounded by BLM land on which hundreds of placer and lode mining claims are filed for mineral resources including lithium, all of which would likely entail significant water usage if developed.[295]

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[291] Morefield 1993, p. 13.
[292] Moreno 2021, p. 1.
[293] Walton 2024, p. 1-2.
[294] https://www.thewildcatbrothel.com/
[295] NDOM 2025b.

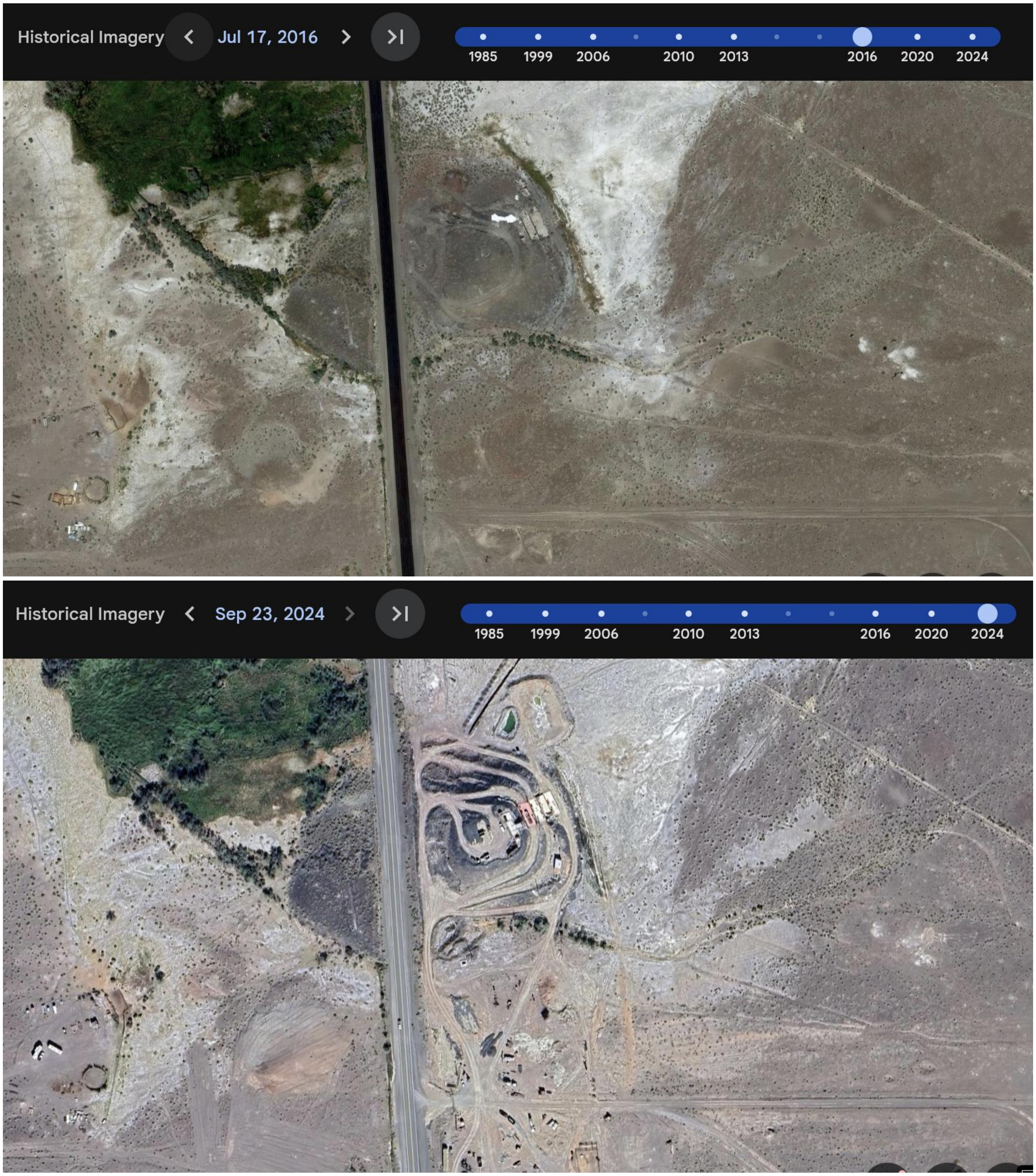

Fig. 11. Habitat alteration between 2016 and 2024 visible from satellite imagery in southern Sodaville. Google Earth, accessed 11 July 2025.

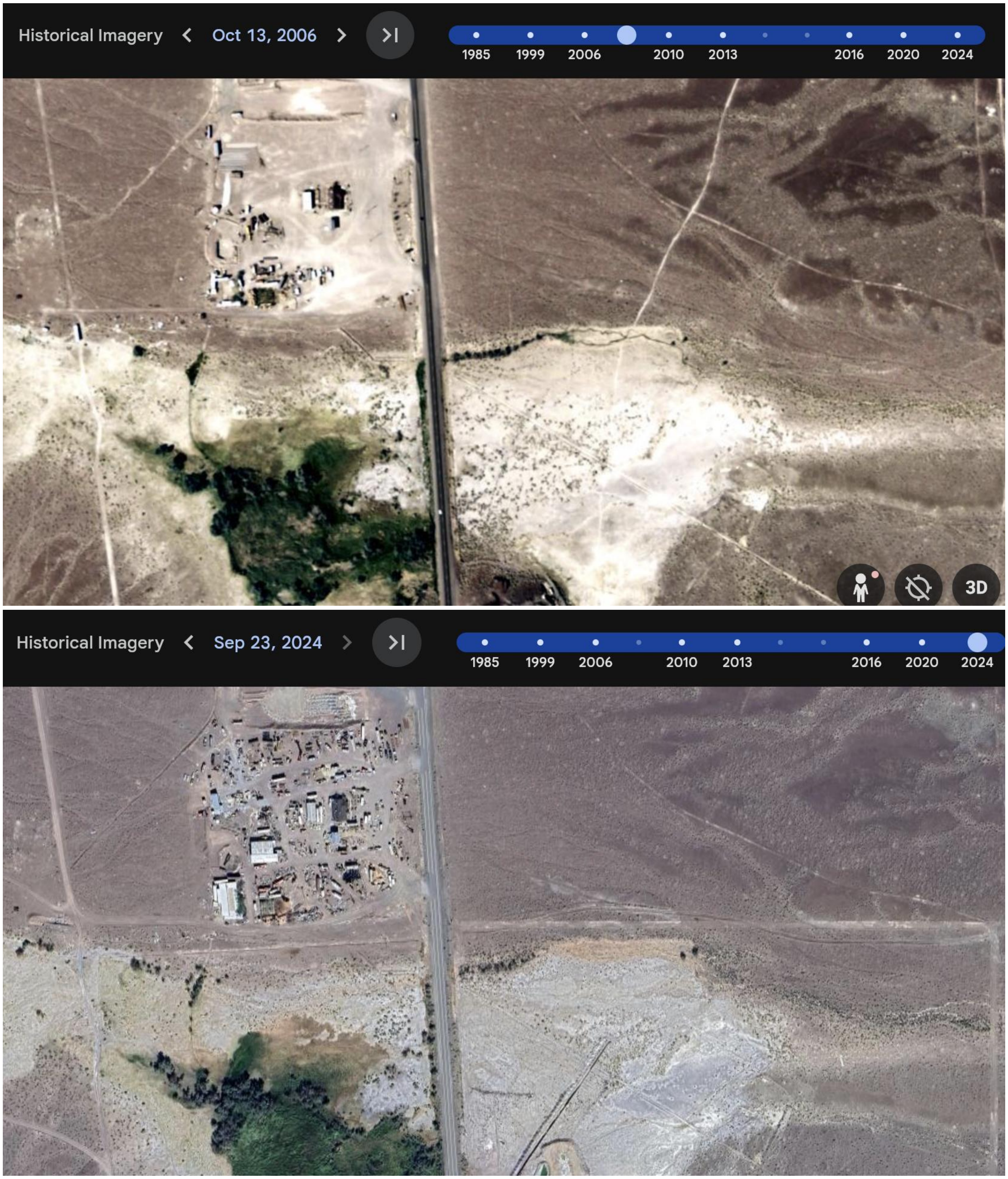

Fig. 12. Habitat alteration of wet channel between 2006 and 2024 visible from satellite imagery. Google Earth, accessed 11 July 2025.

ii. Geothermal Energy

There is geothermal energy development activity on the east side of Rhodes Salt Marsh, approximately three miles away from Sodaville. Geothermal company Ormat has active leases there, and has applied for exploratory well drilling permits from the Nevada Division of Minerals for their “Excelsior Project,” which is located in Township 5N Range 35E Sections 12 & 13, and Township 5N 36E Sections 7 & 18, Mount Diablo Baseline and Meridian.[296] Additionally, BLM is offering more parcels adjacent to Rhodes Salt Marsh in their October 2025 geothermal lease sale.[297]

Sodaville’s springs are known to be warm - historically it was used as a bathing resort by locals.[298] Thus the surface waters there are connected in some way to a warm water aquifer. Development of the geothermal resource at Rhodes Salt Marsh could theoretically impact surface discharge at Sodaville.

b. Cold Springs

i. Bombing Range Expansion

Cold Springs is within an area Congress has allocated for the expansion of a U.S. Navy bombing range.[299] Specifically, it is within the expansion area of the B-17 bombing range at Naval Air Station-Fallon. Surveys during the preparation of the Legislative Environmental Impact Statement for the proposed land transfer found 25 Sodaville milkvetch plants at Cold Springs within the B-17 expansion area.[300] The EIS notes, “The potential for wildfires from current training activities within the proposed range expansion areas is the primary concern with respect to potential impacts on vegetation.”[301] Fires may be lit by exploding ordnance or other activities.[302] In addition to the potential impacts of fire, there is also the threat of direct destruction due to explosion of ordnance. “The resources within the withdrawal areas associated with the proposed range expansion areas would be subject to physical disturbance from ordnance expenditures and construction activities.”[303] The Navy plans to acquire the private land at Cold

[296] Ormat 2025, *entire*.
[297] BLM 2025a, p. 16.
[298] Moreno 2021, p. 1.
[299] Churchill County 2022.
[300] US Navy 2020 at 3.10-40.
[301] *Id.* at 3.10-123.
[302] *Ibid.*
[303] *Id.* at 3.10-143.

Springs and eventually also take in the BLM land there.[304] Once it is in Navy ownership, the public will be shut out. As of now it's not clear that the Navy has any plans for special management or stewardship of the sensitive habitats at Cold Springs.

ii. Groundwater Drawdown

Cold Springs is part of the Gabbs Valley hydrographic basin. Per the Nevada State Engineer, this basin has a perennial yield of 5,000 acre-feet per year.[305] However, the basin is badly over appropriated. There are a total of 18,411 acre-feet of water rights that have been issued in the basin, including 9,118 acre-feet for mining; 7,712 acre-feet for irrigation; and 996 acre-feet for commercial use.[306] This basin was rated by NDWR in the category of "high" vulnerability to groundwater shortage.[307] While some of these uses, like the mining, occur relatively far away from Cold Springs, some of the uses, like the irrigation for agriculture, occur within a few miles of Cold Springs. Additionally, since Gabbs Valley is a closed basin, the cumulative effects of overdraft of the groundwater aquifer could have impacts basin-wide.

Additionally, there is an existing geothermal power plant in Gabbs Valley, about 10 miles away from Cold Springs. It has a nameplate capacity of 39 Megawatts.[308] Comparable binary cycle geothermal projects will pump and reinject approximately 30,000 acre-feet per year. While this is theoretically a non-consumptive use, the huge flux in groundwater flows combined with the effects of massive overdraft of the aquifer could lead to serious consequences for groundwater dependent ecosystems such as Cold Springs.

iii. Gold Mining

The Black Hills are a compact mountain range approximately 3 miles south of Cold Spring. They are densely covered in mining claims, with some 640-acre section of land containing as many as 195 mining claims (**Fig. 13**).[309] They are all lode mining claims.

Historically there was some amount of gold and silver production in the Black Hills from the Lithia Mine (BLM mineral resources assessment) and copper production at the Rita Mine (BLM mineral resource assessment). Historic notice data from BLM shows several closed mineral

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304 US Navy 2025.
305 NDWR 2025, *entire.*
306 *Ibid.*
307 NDWR 2023.
308 Ormat 2021, p. 3.
309 NDOM 2025b.

exploration notices for Gold Ridge Resources, Inc., which shut down in 1995.[310] Notice data shows exploration notices labeled "interim" as of 2022 for a company named Gold 50 Inc.[311]

The primary company involved with the current claims is Hightest Resources LLC. They have a webpage packaging the claims as "the Spitfire property."[312] While their current noticed or permitted activities are unknown, some activity has been observed at the Lithia Mine site, possibly related to exploration.[313]

If these mining claims were developed for an open-pit gold mine, it could intersect the water table that sustains Cold Springs and impact the Sodaville milkvetch population there.

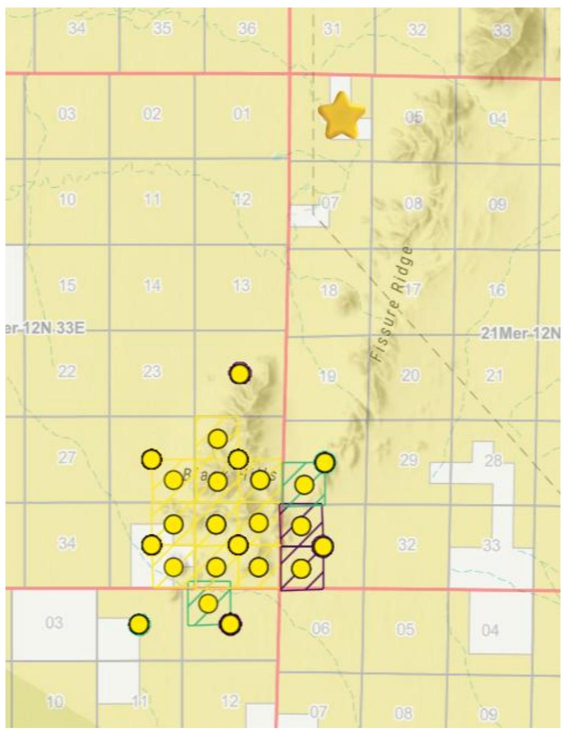

Fig. 13. Dense markers of lode mining claims in the Black Hills, approximately 3 miles south of the Cold Springs population, indicated with a star. [314]

[310] *Ibid.*
[311] *Ibid.*
[312] Hightest 2022.
[313] *P. Donnelly, personal observation*.
[314] Adapted from NDOM 2025b.

iv. Grazing

Cattle and wild horses appear to be a significant problem at Cold Springs. A portion of the population at Cold Springs is on private land and is likely leased for cattle grazing because it has surface water, which is essential for survival. The public lands portion of the population is totally within the Phillips Well grazing allotment,[315] which is permitted for 17,400 AUMs (animal unit months) across 79,717 acres. There is widespread evidence of trampling and habitat degradation due to cattle at Cold Springs (**Fig. 14**). There is also some evidence of wild horses being present.

Fig. 14. Sodaville milkvetch growing around cow feces at Cold Spring.

c. Fish Lake Valley

i. Agriculture

While it was estimated in 1973 that much greater utilization of the water resources of Fish Lake Valley was hydrologically possible,[316] the basin is now experiencing irreparable damage from

[315] PEER 2024, *entire.*
[316] Rush and Katzer 1973, p. 51.

water production that exceeds annual recharge.[317] Water levels in Fish Lake Valley have declined up to 2.5 feet per year, causing more than 75 feet of cumulative drawdown.[318] Historic groundwater levels are shown in **Fig. 15**. This overdraft is causing aquifer storage to collapse, with the exact amount depending on the type of materials that comprise the local aquifers. This decrease in pore space reduces the aquifer's ability to store groundwater and cannot be reversed in the future.[319]

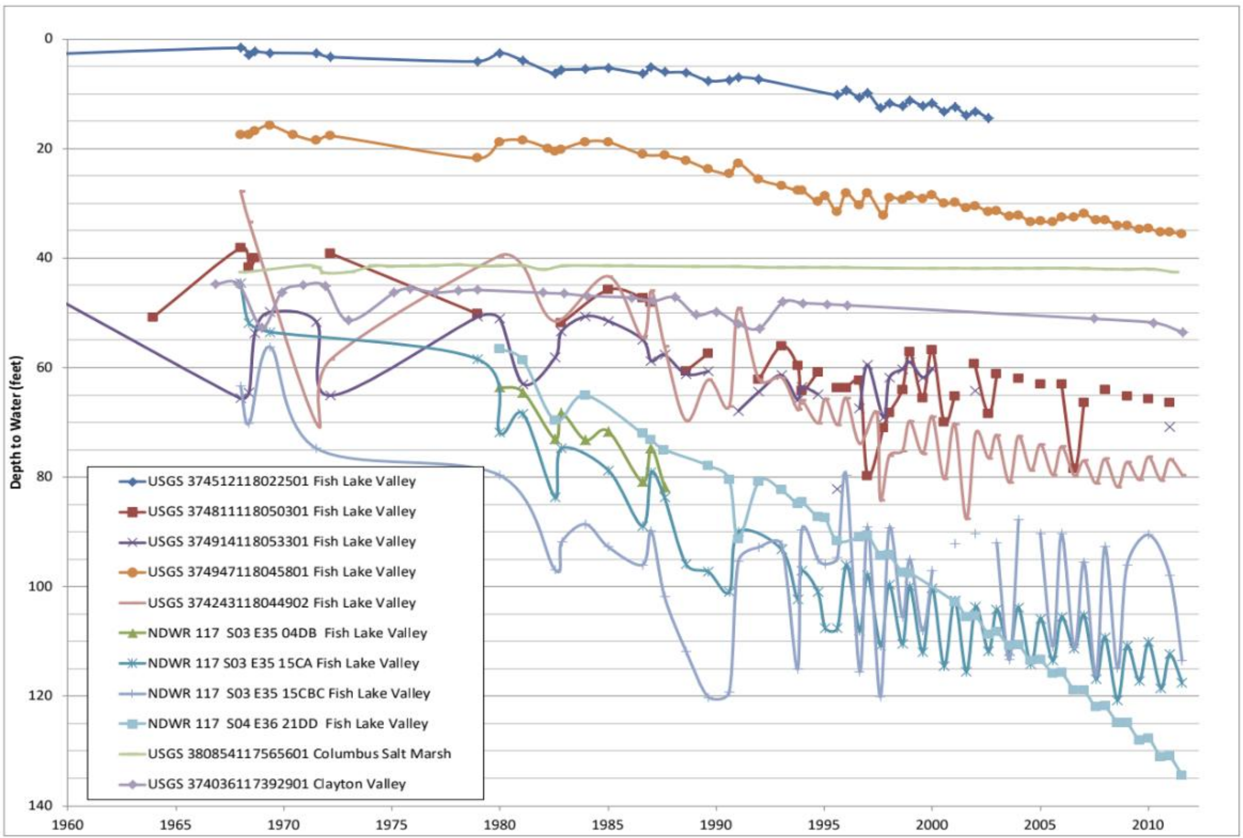

Fig. 15. Selected groundwater levels in Fish Lake Valley from 1960 to 2011.[320]

Recent groundwater pumpage by manner of use is shown in **Fig. 16**. From this figure it can be seen that the vast majority of groundwater is extracted for irrigation, and indeed Esmeralda County notes that stabilizing the Fish Lake Valley groundwater resource will require a combination of increasing agricultural efficiency and decreasing the irrigable area within the

317 Esmeralda County 2024, p. 50.

318 *Id.*, p. 1.

319 *Ibid*, p. 38.

320 Esmeralda County 2024, p. 53.

basin.[321] Other measures mentioned are preventing artesian flows from wells and limiting groundwater withdrawals from California.

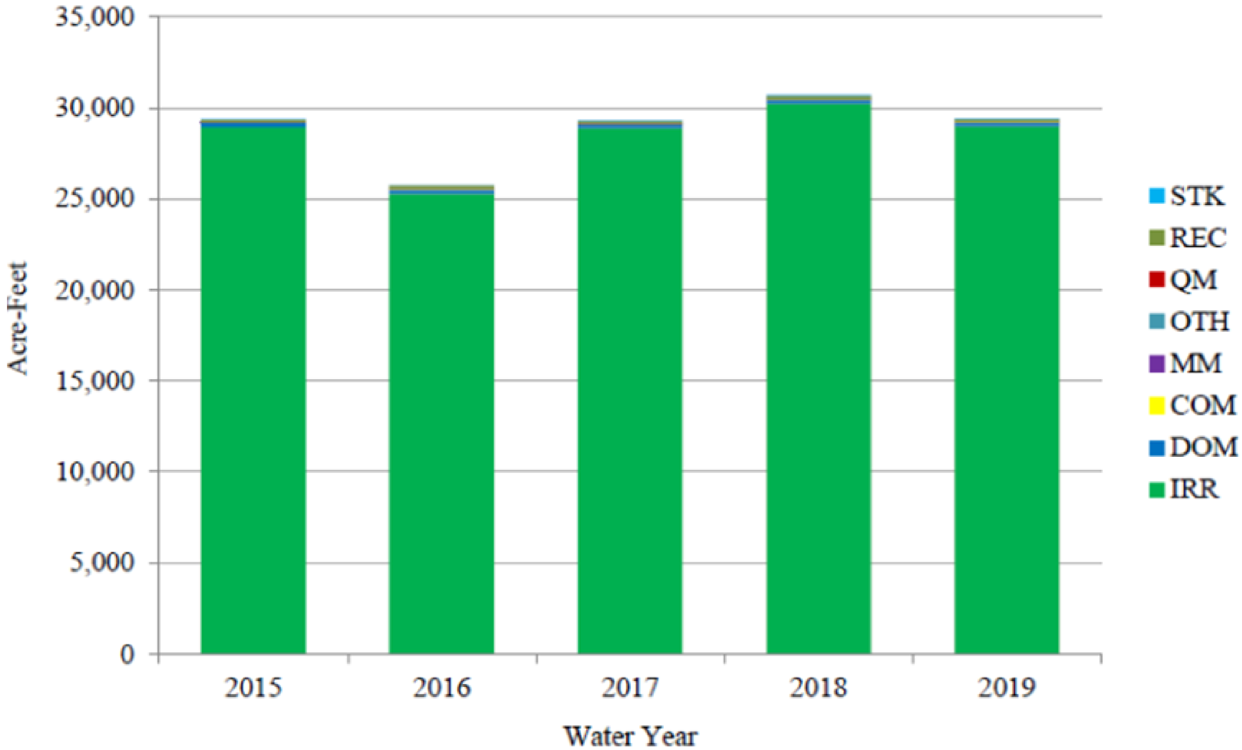

Fig. 16. Fish Lake Valley historical pumpage by manner of use.[322]

The two main irrigation water uses are alfalfa and pasture. Fish Lake Valley "has long been a place for alfalfa farms along with cattle and horse ranches and some fruit trees."[323] It is the primary area for agricultural production in Esmeralda County. In 2000-2001, 58% of the county's sales came from alfalfa hay, while the second largest contributor was cattle and calves (40% of agricultural sales).[324]

In addition to increased groundwater withdrawal, groundwater recharge from runoff may be declining and contributing to the groundwater decline. Surface water flows are an important source of irrigation water in the agricultural areas of Fish Lake Valley, with surface water diversions for agriculture from Chiatovich, Leidy, Busher, Perry-Aiken, and McAfee Creek drainages.[325] The consumptive use of run-off for agriculture is estimated to be between 15 and

[321] Esmeralda County 2024, p. 52.
[322] NDWR 2019, p. 8.
[323] Esmeralda County 2011, p. 14.
[324] Suverly 2000, p. 4.
[325] Esmeralda County 2024, p. 27.

26% based on Eakin's calculations,[326] but the acreage under irrigation is certainly higher now. **Fig. 17** shows land under alfalfa cultivation and pasture/grass in Fish Lake Valley, in 2009 and 2019. Within the red boundary shown in Figure 15, we estimate that the amount of land used to grow alfalfa has increased by about 3290 acres. This increase is also evident from the figure itself. Grass/pasture has conversely decreased by ~1938 acres but practically all of the conversion was due to alfalfa cultivation. The amount of shrubland converted to grass/pasture over this time period is ~540 acres.

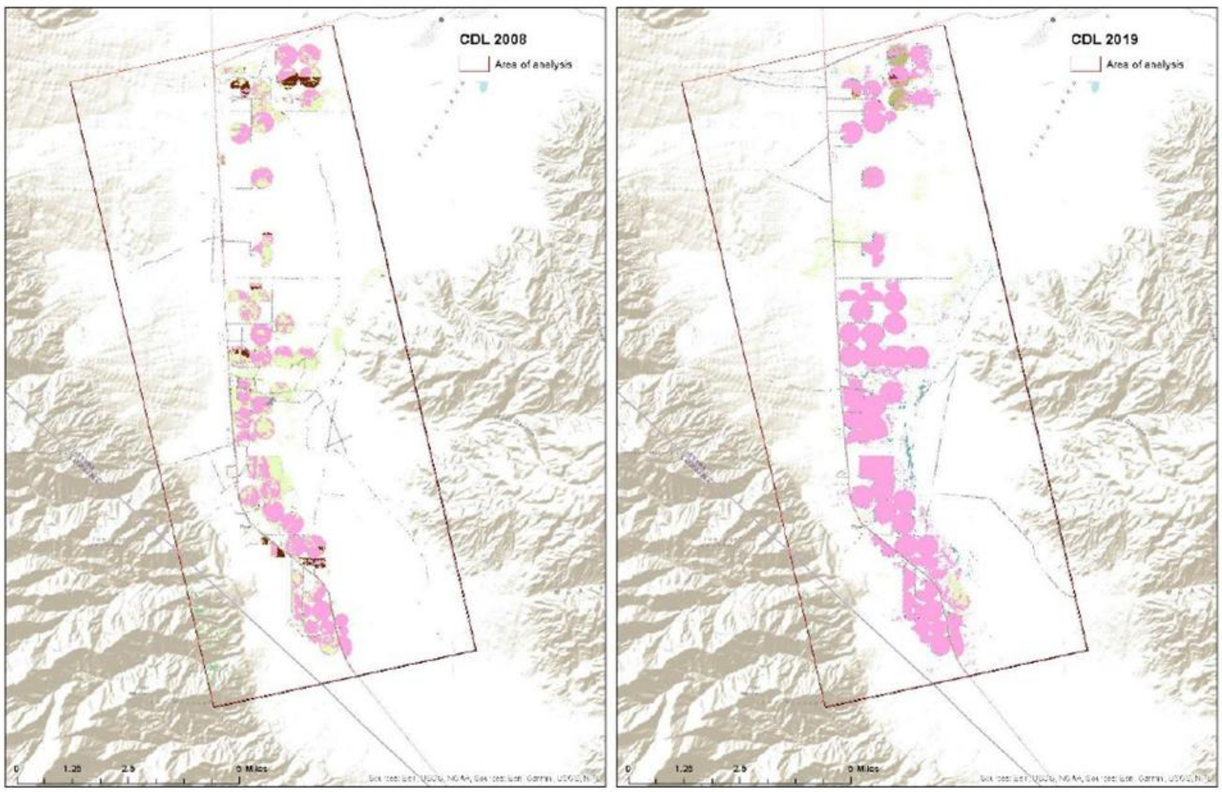

Fig. 17. Agricultural land in Fish Lake Valley in (a) 2009 and (b) 2019. Alfalfa is shown in pink and grass/pasture in light green.[327]

The springs in the Valley are here inferred to predominantly be gravity springs, where: (1) water either moves from the water table aquifer through permeable materials to the land surface, or (2) issues from the intersection between the water table and the land surface.[328] The springs are likely also a combination of the two mechanisms, with (2) mostly involving fracture or tabular springs which form when water emerges from fractures or joints in rock, from solution channels

[326] Eakin 1950, p. 20.
[327] National Croplands Database 2020.
[328] USDA 2012, p. 5.

in limestone or gypsum, or from natural tunnels in volcanic rock.[329] In addition to gravity springs, water may flow from springs that are under "artesian pressure"- i.e. water is introduced from a higher elevation to a water bearing bed confined between relatively impervious strata.[330]

The complex hydrologic system which forms the Sodaville milkvetch's habitat has been altered by agricultural use of groundwater for many years. "...streamflow beyond the areas of irrigation pumpage has been reduced, depriving the large playa in the northeast part of the valley of some streamflow that would pond on the playa under native conditions."[331]

Groundwater monitoring wells near the Sodaville milkvetch's habitat are illustrative of the peril it faces. Nevada DWR monitoring site 117 S01 E35 24DB 1 shows a decline of nearly 7 feet, from a peak groundwater elevation of 4786.24 in 2005 to its current level at 4779.55 as of March 15, 2022 (**Fig. 18**).[332] This well is the closest monitoring site to the Sodaville milkvetch's habitat. It is located approximately 3 miles west-southwest of McNett Ranch and directly on the groundwater flowpath from Chiatovich Creek and the White Mountains to the Sodaville milkvetch's habitat.

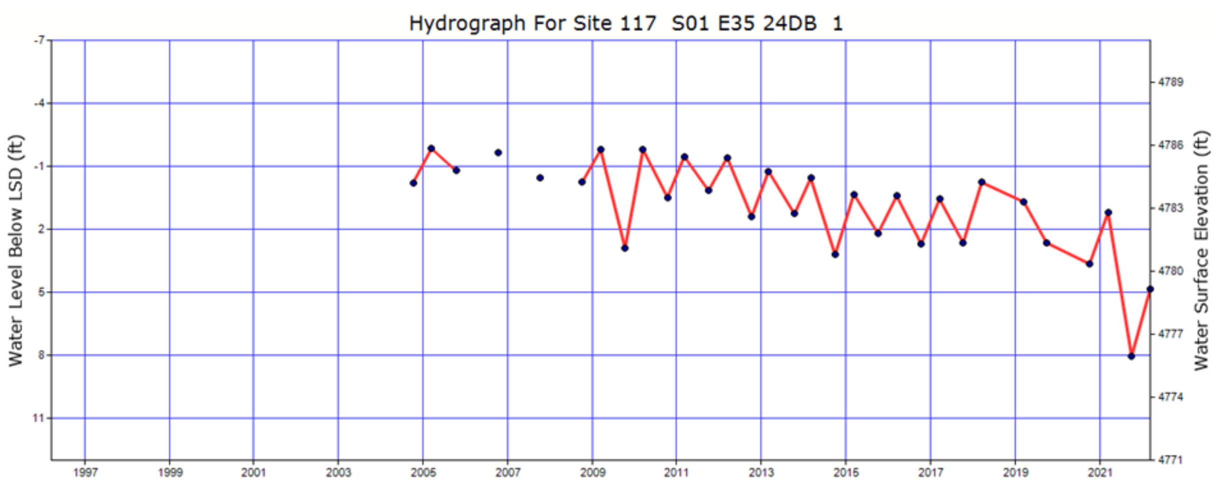

Fig. 18. Hydrograph for NDWR monitoring site 117 S01 E35 24DB 1, showing a significant decline over time.[333]

Nevada DWR monitoring site 117 S01 E35 35CC 1 shows a decline of just over 23 feet, from a starting groundwater elevation of 4823.77 in 1968 to its current level at 4800.72 as of March 15,

[329] *Ibid.*
[330] *Id.*, p. 8.
[331] Rush & Katzer 1973, p. 49.
[332] NDWR 2023a, *entire*.
[333] NDWR 2023a.

2022 (**Fig. 19**).[334] This well is located southwest of site 117 S01 E35 24DB 1 by approximately 3 miles.

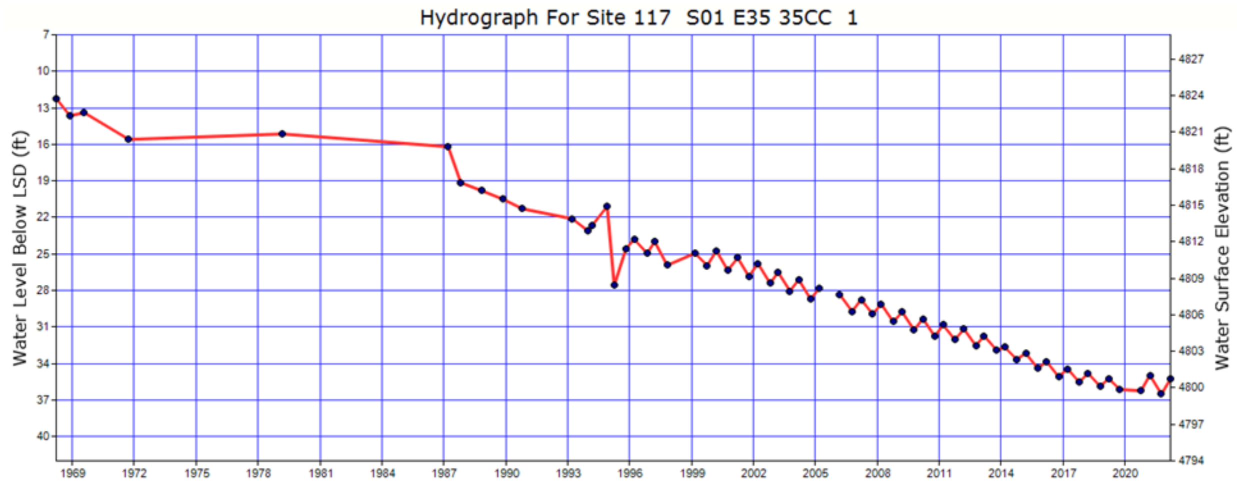

Fig. 19. Hydrograph for NDWR monitoring site 117 S01 E35 35CC 1, showing a significant decline over time.[335]

While there are many more monitoring wells across the Valley declining, the final we will highlight here is Nevada DWR monitoring site 117 S01 E35 13DC 1 at Old Dyer Ranch. This well is on the groundwater flow path toward the Fish Lake Valley playa from the south, near the former Fish Lake. It also shows a decline of just over 23 feet, from a starting groundwater elevation of 4768.68 in 1968 to its current level at 4745.38 as of March 15, 2022 (**Fig. 20**).[336] This well is located south-southwest of McNett Ranch by approximately 7 miles. Declines here indicate that multiple groundwater flowpaths to the Sodaville milkvetch's habitat are experiencing declining groundwater levels.

334 NDWR 2023b, *entire*.
335 *Ibid.*
336 NDWR 2023c, *entire.*

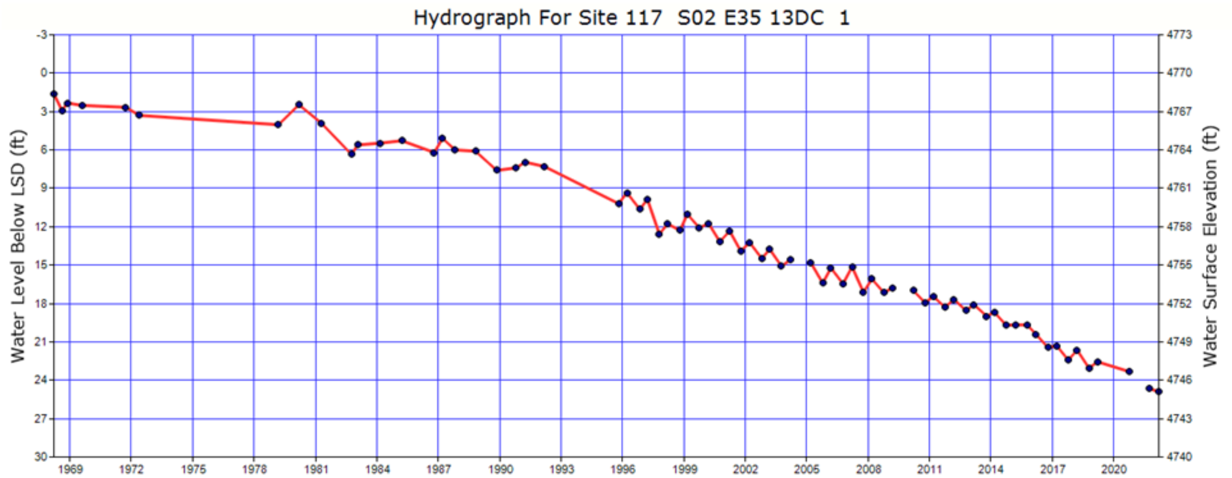

Fig. 20. Hydrograph for NDWR monitoring site 117 S01 E35 13DC 1, showing a significant decline over time.[337]

ii. Rhyolite Ridge Mine

The Rhyolite Ridge Mine is a proposed open-pit lithium-boron mine in the Silver Peak Range, above the Fish Lake Valley Salt Marsh. The mine would include a 960-foot deep,[338] 202 acre open-pit surrounded by over 1,300 acres of waste rock dumps.[339] It would consume 4,043 acre-feet of water per year for operations and minerals refining,[340] and an additional estimated 2,324 acre-feet per year of water for dust suppression.[341]

During construction, the water would be sourced from on-site production wells. During mining and processing, Ioneer will move pumping operations down to Fish Lake Valley where they will water currently in use as irrigation water, and pump it through a pipeline up to Rhyolite Ridge.[342] This will cause a new cone of depression, particularly if the pumping is with water rights that are not currently being exercised.

This groundwater pumping plan for the Rhyolite Ridge Mine poses risks to the Sodaville milkvetch. Groundwater flows from the Silver Peak Range down Cave Springs Wash to the Fish Lake Valley Salt Marsh and is a source of shallow groundwater for the milkvetch. Aquifer

337 *Ibid.*
338 BLM 2024a, p. 6.
339 BLM 2024b at 2-19.
340 BLM 2024b at 2-9 (citing 2,500 gallons per minute, roughly 4,043 acre-feet per year).
341 McCarthy 2024, p. 10 (citing 2,069,566 gallons per day for 95% dust control efficiency, roughly 2,324 acre-feet per year).
342 BLM 2024b at 2-9.

drawdown and the perpetual consumptive water use of a pit lake will negatively impact this flow path and could reduce groundwater levels in Sodaville milkvetch habitat. And while the pumping proposed in Fish Lake Valley is said to be converted from alfalfa irrigation, it will change the nature of the pumping which could have impacts on the hydrology of the system. Some amount of the irrigation water currently pumped is returned to the system through infiltration after it is irrigated. While this is likely a small amount, it is a reduction in shallow alluvial flow upgradient from the Sodaville milkvetch's habitat. Additionally, the pumping for Rhyolite Ridge Mine in the valley would be year-round, whereas currently irrigation pumping only occurs during the growing season - roughly April to October. A consistent pumping regime would allow less time for the aquifer to recover during the winter months, potentially exacerbating problems with groundwater drawdown in the area.

The Project will result in the formation of a pit lake. The pit lake will be approximately 260 feet deep and cover 66 acres once it is fully filled.[343] Evaporation from the pit lake, which will continue to draw down groundwater resources for decades. This will be a continuing draw on the groundwater flow system which helps feed the Sodaville milkvetch's habitat in Fish Lake Valley.

The mine will also result in a significant increase in vehicular traffic on the dirt roads which surround the Sodaville milkvetch population in Fish Lake Valley. This could result in a dramatic increase in the amount of dust in the milkvetch's habitat. See above for a discussion of the impacts of ambient dust on rare plants.

The Rhyolite Ridge Mine received a positive Record of Decision from the Bureau of Land Management on October 24, 2024. The Environmental Impact Statement ("EIS") upon which the ROD was based did not mention the Sodaville milkvetch. Additionally, the EIS did not analyze the impacts of groundwater pumping from the mine on the plant community at the Fish Lake Valley Salt Marsh, concluding that these sensitive groundwater dependent ecosystems were outside their area of analysis. Litigation against the BLM over approval of the EIS cites this oversight as a key point of contention. The fate of the Rhyolite Ridge Mine may hinge on the outcome of that litigation, but in the meantime it poses a key threat to the Fish Lake Valley population of the Sodaville milkvetch.

iii. Grazing

The Fish Lake Valley population of Sodaville milkvetch occurs entirely within the Red Spring grazing allotment, which is permitted for 15,120 AUMs on 149,125 acres. Cattle and cattle sign are observed frequently within the plant's habitat.

[343] BLM 2024b at 2-20.

iv. Off-Highway Vehicles

At least three organized, permitted off-highway vehicle race competitions occur in Fish Lake Valley: Rebelle Rally, Best in the Desert, and Legacy Racing Baja Nevada.

The Rebelle Rally is a women's cross-country navigation competition, and they utilize roads near the Sodaville milkvetch habitat in Esmeralda County, including camping at the Hot Well in 2022.[344] In recent years, BLM has been approving the competition using a Categorical Exclusion (CX), meaning there is no environmental impacts analysis conducted for this event. Per the documentation, no special measures are taken to avoid sensitive species, including the Sodaville milkvetch, and no mitigation occurs to compensate the habitats for the impacts of bringing hundreds of vehicles through in a competition setting.[345]

Best in the Desert is a large-scale off-road race from southern Nevada to northern Nevada, involving hundreds of racers and thousands of ancillary vehicles and spectators. At times in the past, including in 2021, it has passed through Fish Lake Valley near the Sodaville milkvetch habitat. In 2021, the route came over Emigrant Pass, down to The Crossing, and then north along the west side of the Fish Lake Valley playa (**Fig. 21**).[346]

Fig. 21. Zoom of map of Best In the Desert 2021, showing race route in red coming into Fish Lake Valley and around the playa near Sodaville milkvetch habitat (circled in purple).[347]

[344] BLM 2022, p. 2.

[345] *Id.*, *entire.*

[346] Best In the Desert 2021, *entire*.

[347] adapted from Best In the Desert 2021.

Another OHV race through Fish Lake Valley is the Legacy Racing Baja Nevada. In 2022, the Baja Nevada race ran along the east side of Fish Lake Valley and along the east side of the playa through Sodaville milkvetch habitat (**Fig. 22**).[348] A subsequent post on Twitter in 2023 depicted the race running near the playa (**Fig. 23**).[349]

Fig. 22. Zoom of map of Baja Nevada 2022, showing race route in black going through Sodaville milkvetch habitat (circled in purple).[350]

348 Legacy Racing 2022, p. 2.
349 Twitter 2023, entire.
350 Adapted from Legacy Racing 2022, p. 2.

Fig. 23. Screen grab of Twitter post depicting the Legacy Baja Nevada 2023 race with the Fish Lake Valley playa clearly visible, dated May 13, 2023.[351]

v. Lithium

Numerous mining interests are operating and developing prospects in Fish Lake Valley. Figure 24 depicts the hundreds or likely thousands of mining claims across the habitat of the Sodaville milkvetch in Fish Lake Valley.[352] As can be seen, the entirety of the Sodaville milkvetch's habitat in Fish Lake Valley is within mining claims.

[351] Twitter 2023, *entire.*
[352] NDOM 2025a.

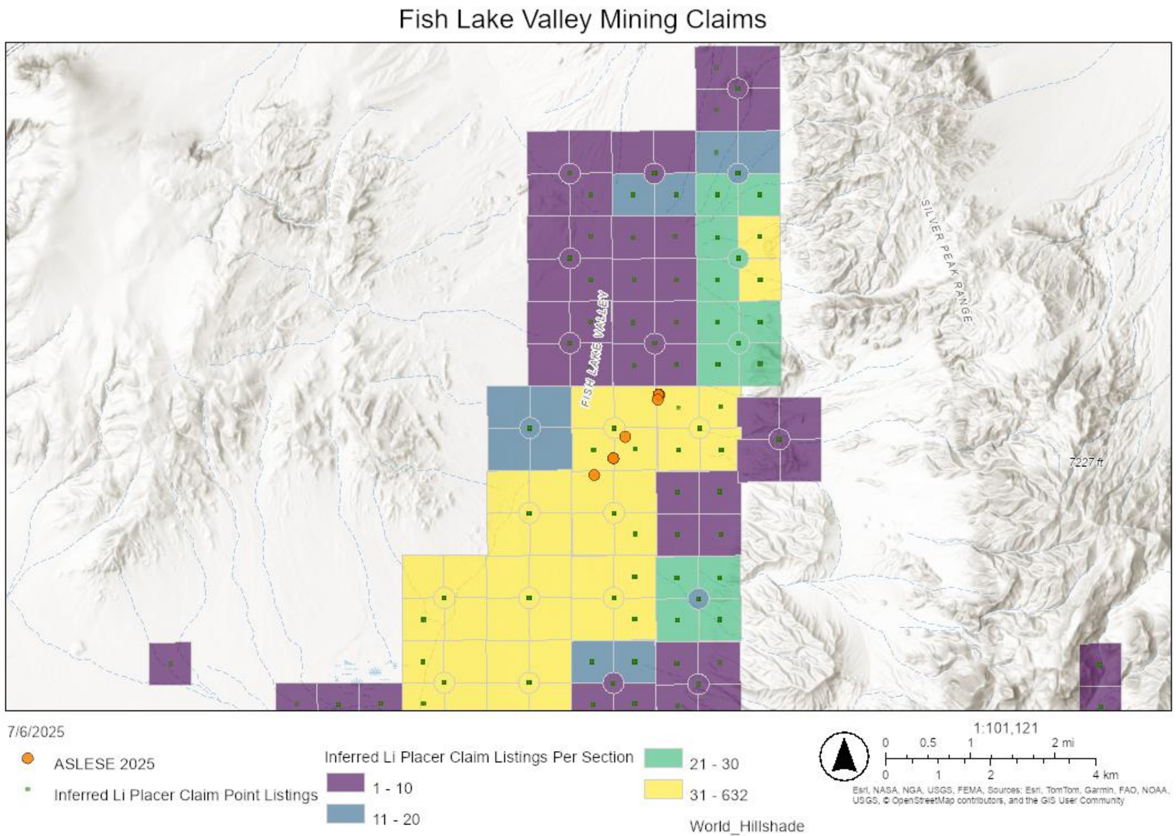

Fig. 24. Map of placer mining claims in Fish Lake Valley Salt Marsh area.[353]

Lithium Corporation claims to hold 11,360 acres of mining claims in Fish Lake Valley, targeting brines underneath the playa.[354] These claims are "covering the most prospective portions of the playa."[355] Lithium Corporation announced they were beginning exploration activities on the playa on September 7, 2023, mobilizing a reverse circulation drill to drill what will eventually be 1200 foot deep boreholes.[356] Exploration activity was observed on the eastern edge of the playa near Sodaville milkvetch habitat on September 14, 2023 (**Fig. 25**).

[353] Data per NDOM 2025a.

[354] Lithium Corporation 2023, *entire.*

[355] Lithium Corporation 2019, *entire.*

[356] Junior Mining Network 2023, *entire.*

Fig. 25. exploration activities near Sodaville milkvetch habitat on the Fish Lake Valley Salt Marsh. This may be the exploration project Lithium Corporation announced. Photo taken September 14, 2023 at 37.90483, -117.92997.

Lithium Corp.’s last communique about Fish Lake Valley came February 1, 2024, in which they reported positive findings from the previous years’ exploration activities.[357]

Acme Lithium Inc. claims to hold 4,139 acres of mining claims in Fish Lake Valley.[358] Their claims are lode claims, meaning they would be targeting lithium claystones for an open-pit mine. They have conducted geophysical surveys and surface sampling.

Nevada Alaska Mining Company holds a significant number of claims in the area, but the exact acreage or number of claims is unknown. Based on evidence from social media and elsewhere, it’s likely this company holds both lode and placer claims. Little is known about this company, they have no public facing website or other external communications outlet. Per LinkedIn, the company’s president and director is Ms. Barbara Craig, who calls it, “Nevada’s most accomplished Lithium Exploratory Company.”[359] She claims to have discovered essentially all of the major lithium prospects in the Tonopah area: Rhyolite Ridge, Fish Lake Valley playa, the

[357] Lithium Corporation 2024, *entire.*
[358] Acme Lithium 2023, *entire.*
[359] LinkedIn 2023a, *entire.*

TLC project, and Tonopah Flats. A subsequent post dated June of 2023 features a photo of the Fish Lake Valley playa and the statement: "Beauty is in the eye of the beholder: 22,000 acres of lithium brine claims over the gravity low in a closed basin, central Nevada. #lithium," (**Fig. 26**).[360]

Fig. 26. LinkedIn post from Nevada Alaska Mining Co. President Barbara Craig, boasting of 22,000 acres of lithium brine claims on the Fish Lake Valley playa.

In sum, while the current lithium-related activity in the Fish Lake Valley Salt Marsh is still exploratory and/or speculative, the area is fully claimed by lithium companies and they appear poised for further action. An increase in mining activity in the area could be devastating to the Sodaville milkvetch population there.

[360] LinkedIn 2023b, *entire.*

vi. Geothermal Energy

It is likely that some amount of the shallow groundwater in the Fish Lake Valley wetlands is sourced from geothermal aquifers. Eakin[361] reports temperatures of 77°F/25°C at the McNett Ranch flowing well, which is approximately 12°C above the average annual air temperature.[362] The Fish Lake Valley Hot Well is famous for its hot spring soaking activities, with water in the tub usually around 103°/40°C.[363] Discharge from both of these springs helps feed the wetlands that the Sodaville milkvetch lives in, and reductions of geothermal water supply to these springs could then reduce the amount of available habitat for the milkvetch.

Another indicator of geothermal input is the chemistry of the water. The chemical character from the McNett Ranch flowing well is indicative of water supplied, at least partially, from sources related to volcanic activity.[364] Water from such sources is typically characterized by relatively high chloride, fluoride and boron content compared to normal groundwater. Partial analysis of the sampled spring in turn indicates lower but still relatively high chloride content, suggesting that it may represent water similar to that of the McNett flowing well mixed in with shallow groundwater of considerably lower dissolved solids.[365]

It's clear that geothermal waters contribute at least some amount of flow to the shallow groundwater system. Further contribution could be made through interconnectivity between the deeper geothermal aquifer and the shallow alluvial aquifer.

Geothermal power production is a known threat to the Fish Lake Valley population of the Sodaville milkvetch. By potentially altering the subsurface hydrology which creates the conditions the Sodaville milkvetch needs for survival, geothermal energy poses a threat to the Sodaville milkvetch's continued existence.

As of 2025, there were active geothermal leases encompassing part or all of 47 sections of public land in the vicinity of the Fish Lake Valley wetlands, including leases held by Open Mountain Energy, Ormat, and a subsidiary of Fervo Energy.[366] 27 of these sections are generally to the west of the Sodaville milkvetch habitat, while 20 of them are to the east (**Fig. 27**).

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361 Eakin 1950, p. 29.
362 Rush and Katzer 1973, p. 39.
363 *P. Donnelly, personal observation.*
364 Eakin 1950, p. 31.
365 *Ibid.*
366 NDOM 2025c.

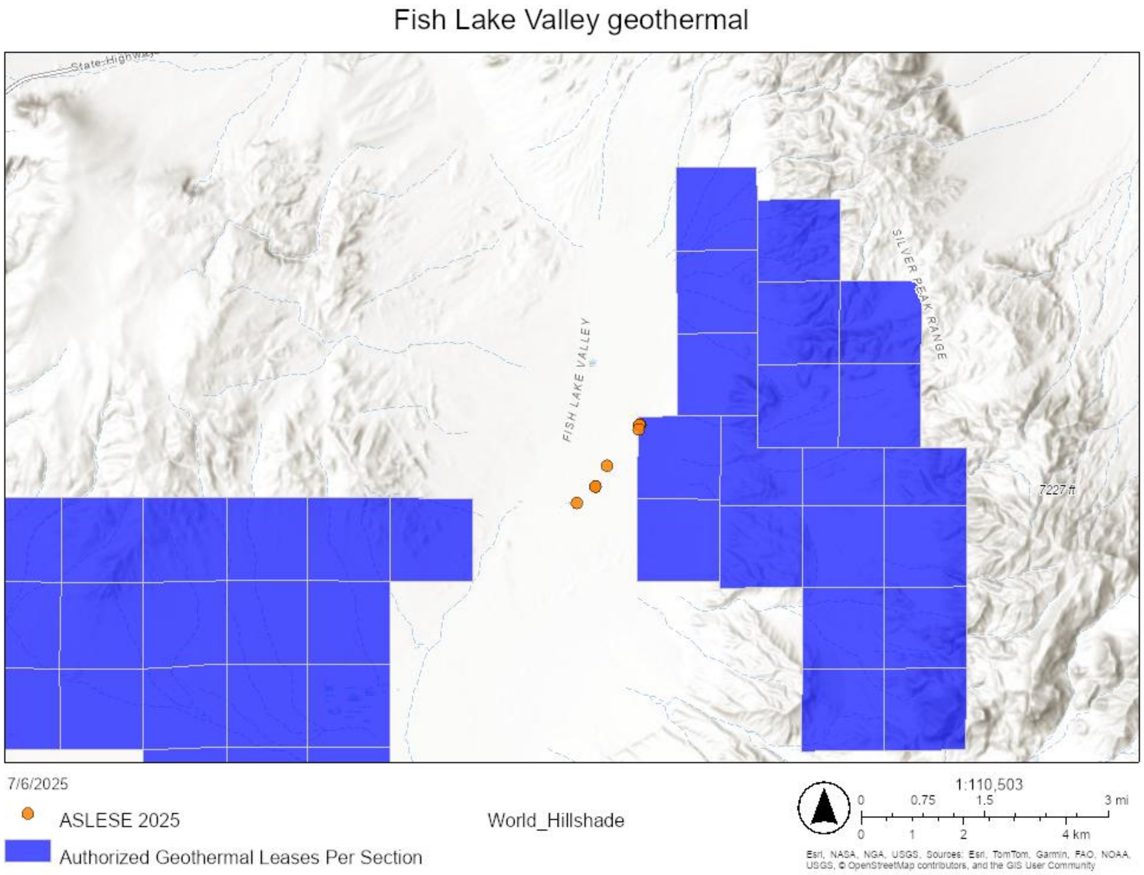

Fig. 27. Map of geothermal leases near the Fish Lake Valley population of Sodaville milkvetch. Each highlighted section has at least one geothermal lease parcel in it.[367]

There are two active geothermal exploration projects in the area.

Open Mountain Energy conducted exploration beginning in summer of 2022, with ongoing activities observed in summer of 2023 (**Fig. 28**). These exploration activities occurred on previously existing well pads. This project was located in the vicinity of McNett Ranch, to the north of Hot Ditch Road, within five miles of the Sodaville milkvetch population. The project was approved by the BLM Tonopah Field Office using a determination of NEPA adequacy (DNA),[368] meaning it was exempt from environmental impacts analysis. The NEPA documents which BLM cited in the DNA as providing adequate environmental review for the impacts of the geothermal exploration project dated back to the 1980s and 1990s. The only modern environmental document pertaining to biology prepared for the authorization of this project was

[367] Data per NDOM 2025c.
[368] BLM 2022a, *entire*.

a baseline biological survey report, dated May 10, 2022 based on surveys conducted in 2021.[369] This document fails to mention or document the Sodaville milkvetch. OME's exploration project, which presumably included pump tests which may perturb the aquifer, was conducted without regard for this rare plant. As of today, the project may be moving forward through permitting, though the project website has not been recently updated.[370]

Fig. 28. Steam emerging from test wells at the Open Mountain Energy geothermal exploration project. Photo taken July 20, 2023. Photo taken at 37.8460224, -118.04352.

There is a second active geothermal exploration project in the vicinity of the Fish Lake Valley wetlands, and that is Ormat's Lone Mountain Geothermal Exploration Project. BLM approved this exploration project in March of 2023, and drilling commenced shortly thereafter (**Fig. 29**). This project is located east of the Fish Lake Valley salt marsh, within 2 miles of the Sodaville milkvetch population. BLM approved the project through an environmental assessment.[371] The document does not mention the Sodaville milkvetch. As discussed, geothermal energy production could alter subsurface hydrology and limit water availability for the Sodaville milkvetch. Drilling activities at this location continue as of summer of 2025.[372]

[369] Open Mountain Energy 2022, *entire*.
[370] Open Mountain Energy 2025, *entire.*
[371] BLM 2023a, *entire*.
[372] *P. Donnelly, personal observation.*

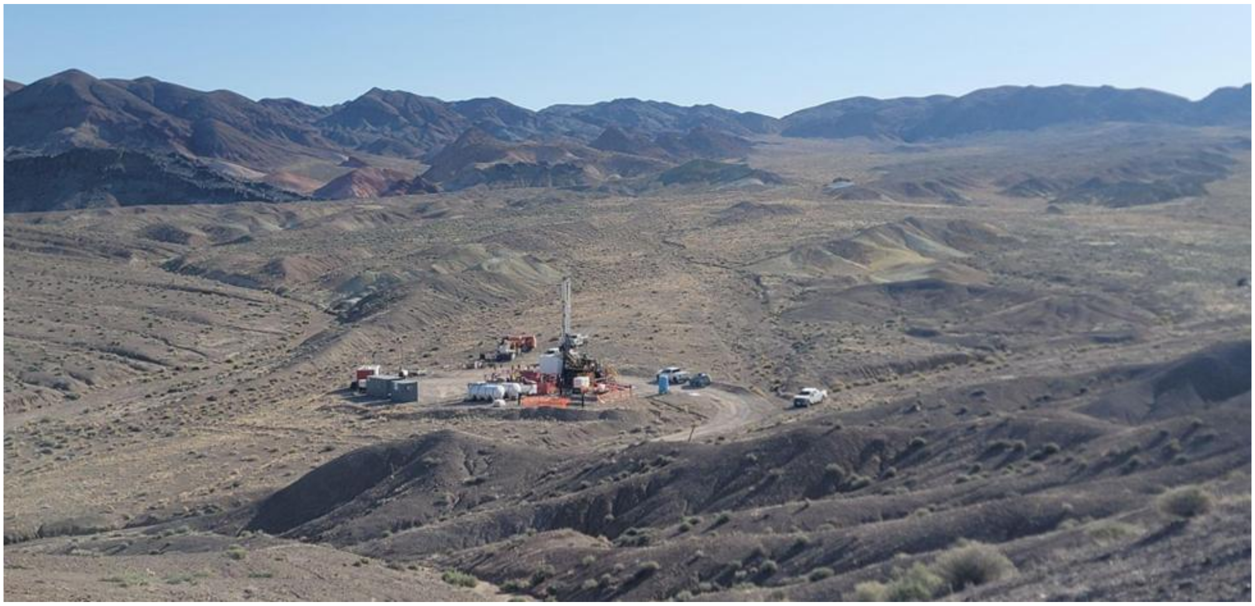

Fig. 29. Drilling at Ormat's Lone Mountain Geothermal Exploration Project. Photo taken April 19, 2023. Photo taken at: 37.885851, -117.913087.

d. Sarcobatus Flat

i. Transmission Line Construction

The Greenlink West Transmission Project was approved by BLM on September 9, 2024, routing the 472-mile transmission line across Sarcobatus Flat.[373] The Sodaville milkvetch was not mentioned or analyzed in the environmental review documentation or other permitting for Greenlink West.[374] To the best of our knowledge, the project proponent has not obtained any state permits to cause take of the state-listed Sodaville milkvetch under NRS 527. However, surveys have revealed that the Greenlink West right-of-way appears to run directly through the Sarcobatus Flat population of Sodaville milkvetch (**Fig. 30**).[375] [376] The vast majority of the population lies completely within the 600-foot construction right-of-way, which as of June of 2025 was fully surveyed and staked out and appears ready for construction.There was significant disturbance caused by OHVs used to access the site (**Fig. 31**). Referring to the Sarcobatus Flat population of Sodaville milkvetch: "Disturbance to its habitat including construction, operation and maintenance of infrastructure, and/or removal of individuals and habitat would leave this occurrence at extreme risk of extirpation."[377]

[373] BLM 2024c at 1-3.
[374] BLM 2024d, *entire.*
[375] Novak and Fraga 2024, p. 6.
[376] Donnelly 2025, p. 2.
[377] Novak and Fraga 2025, p. 10.

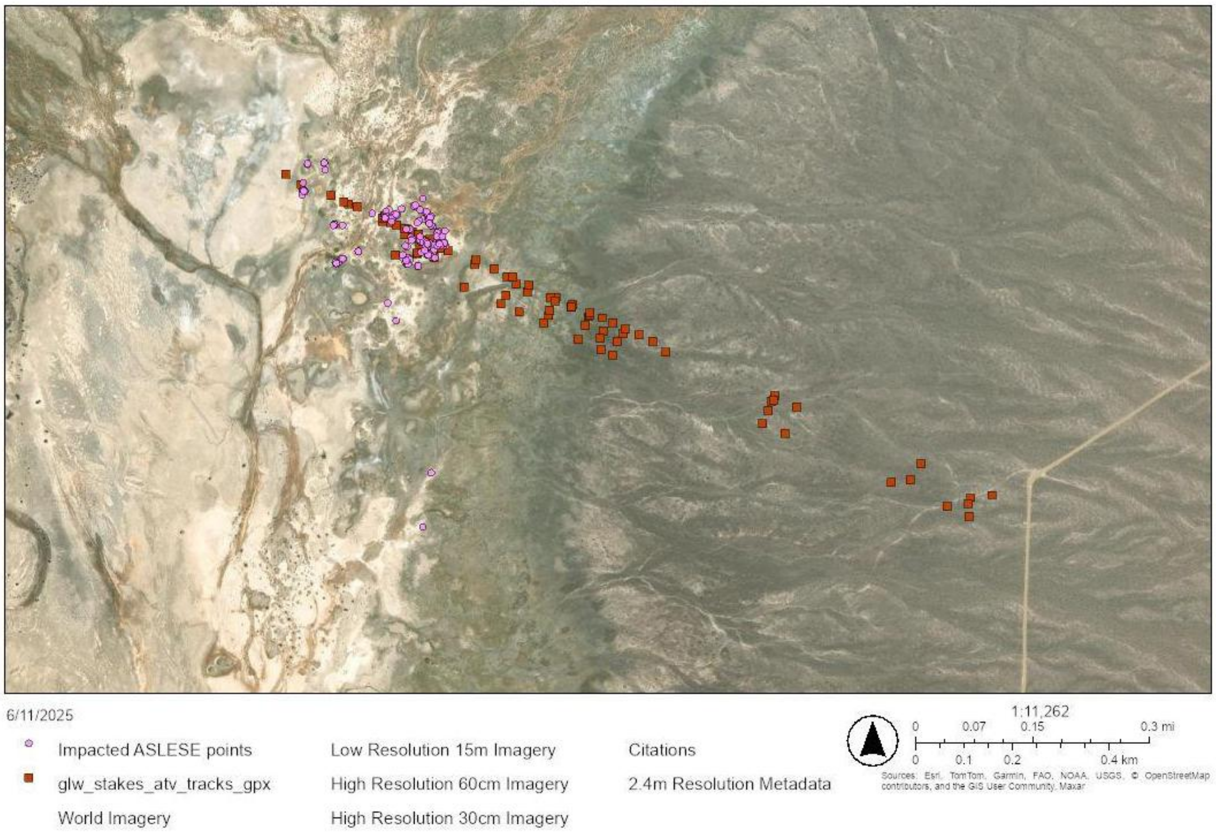

Fig 30. Map depicting Greenlink West survey markers and the portion of the Sodaville milkvetch population which stands to be directly impacted by construction and operation of the transmission line.[378]

[378] Novak and Fraga 2025, p. 6.

Fig. 31. Sodaville milkvetch (circled in purple) near Greenlink West survey markers and habitat disturbed by survey activity.[379]

ii. Gold and Lithium Mining

There are multiple mining operations which could impact the groundwater aquifer that sustains the Sodaville milkvetch on Sarcobatus Flat.

The North Bullfrog Mine is a proposed open-pit gold mine which would be built near Beatty, Nevada in the Bullfrog Hills.[380] These hills rest on the watershed divide between Oasis Valley, in the Amargosa River watershed, and Sarcobatus Flat. The most recent information from AngloGold implies that they will be sourcing all of the water for the mine from Sarcobatus Flat, with both the production wellfield and the dewatering wells for the pit in the Sarcobatus Flat hydrographic basin.[381] According to the 2023 Plan of Operations, they will be dewatering at a maximum rate of 820 gallons per minute, or 1,326 acre-feet per year.[382] However the annual water demands for the project are as much as 1,600 gallons per minute, or 2,588 acre-feet per

[379] Novak and Fraga 2025, p. 8.
[380] BLM 2024e, *entire.*
[381] AngloGold Ashanti 2025, p. 15-16.
[382] EM Strategies 2023, p. 14.

year.[383] AngloGold holds 1,600 acre-feet of water rights in Sarcobatus Flat, approximately half of the total water rights issued in the basin.[384] Anglo also holds 400 acre-feet of water rights in the Oasis Valley basin,[385] and is attempting to secure another 860 acre-feet.[386]

Nevada Lithium Resource Inc.'s Bonnie Claire Project is being developed directly on the playa at Sarcobatus Flat.[387] This project includes 915 placer mining claims spanning 18,300 acres. The project is targeting lithium and boron deposits beneath the playa. They have both a shallow target and a deeper target. For the shallow target they propose open-pit mining at the surface of the playa.[388] They acknowledge that dewatering of the pit may be required. For the deeper target, they propose a "borehole mining" technique, where wells would be drilled to hydraulically excavate caverns in the target mineral deposits using water jets.[389] The resulting slurry would then be pumped to the surface and refined on-site.

Current project documentation does not give estimates for water consumption for these mining projects. No dewatering rates have been provided, or water estimates for the novel mining method they propose for the deep deposits. On September 24, 2024, Nevada Lithium applied for 2,700 acre-feet of new water rights in the Sarcobatus Flat hydrographic basin,[390] which have not yet been granted. AngloGold protested the water rights application, alleging that it would conflict with their water rights on Sarcobatus Flat.[391] The Nature Conservancy also protested the water rights application, and while their primary concern was the impacts of pumping on their properties in Oasis Valley, they also expressed concerns, "about the impacts the Nevada Lithium project could have on groundwater dependent ecosystems and species in… Sarcobatus Flat…"[392]

No matter the technology or water use imposed, the threat to the Sodaville milkvetch from the Bonnie Claire Project is clear. The entirety of the Sarcobatus Flat population of Sodaville milkvetch is within the Bonnie Claire Project area - it is entirely covered in mining claims.

The connectivity between the groundwater flow system in Sarcobatus Flat and that in Oasis Valley has not been precisely determined, but it is thought to exist. In the 2017 update to the Death Valley Regional Flow System model, Belcher et al. included Sarcobatus Flat in their

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[383] EM Strategies 2023, p. 31.
[384] AngloGold 2024, p. 3
[385] NDWR 2025a, *entire.*
[386] AngloGold 2025a, *entire.*
[387] Nevada Lithium 2025, *entire.*
[388] Nevada Lithium 2024, p. 236.
[389] *Id.*
[390] Nevada Lithium 2024a, *entire.*
[391] AngloGold 2024, p. 2
[392] TNC 2024, p. 2.

modeling.[393] They found that a relatively flat potentiometric surface extends far to the northwest out of Oasis Valley into Sarcobatus Flat,[394] implying significant groundwater connection and flow between the two basins, in particular southeastward into Oasis Valley. A figure within the report defines the boundary between Sarcobatus Flat and Oasis Valley as "High potential to transmit groundwater."[395]

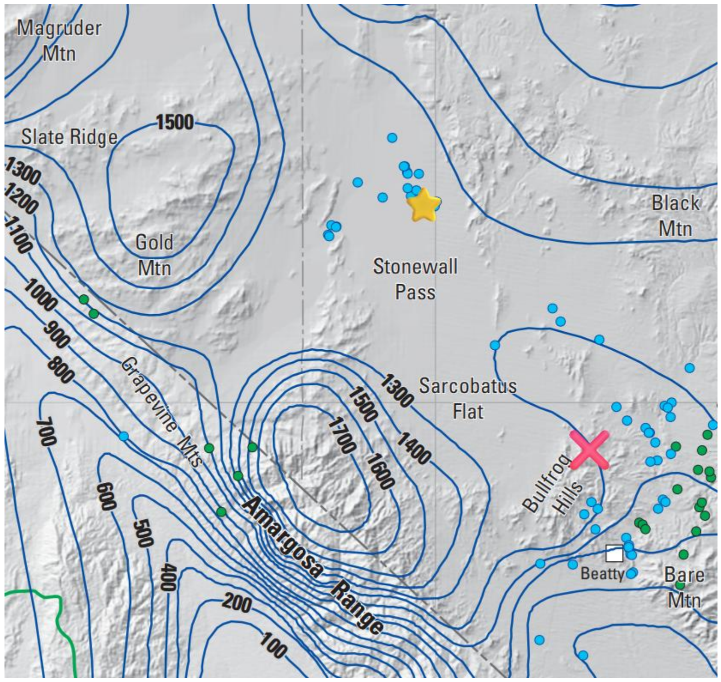

Fig. 32. Plate 1 from Belcher et al. 2017, with the Sarcobatus Flat population of Sodaville milkvetch represented with a star, and the approximate location of the North Bullfrog Mine represented with an X. Blue dots are water level monitoring data sources which informed the model.

There are also numerous other mining claims in the area from other lithium mining companies (**Fig. 33**). Lithium junior Ioneer Inc. has staked out mining claims in the area (**Fig. 34**). There are claims staked from various companies such as Bonaventura, Elmira Capital (US) Corp, Searchlight Exploration LLC, NevLith LLC, and more.

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[393] Belcher, *et al.* 2017, *entire.*
[394] Belcher, *et al.* 2017, Plate 1.
[395] Belcher, *et al.* 2017, p. 36.

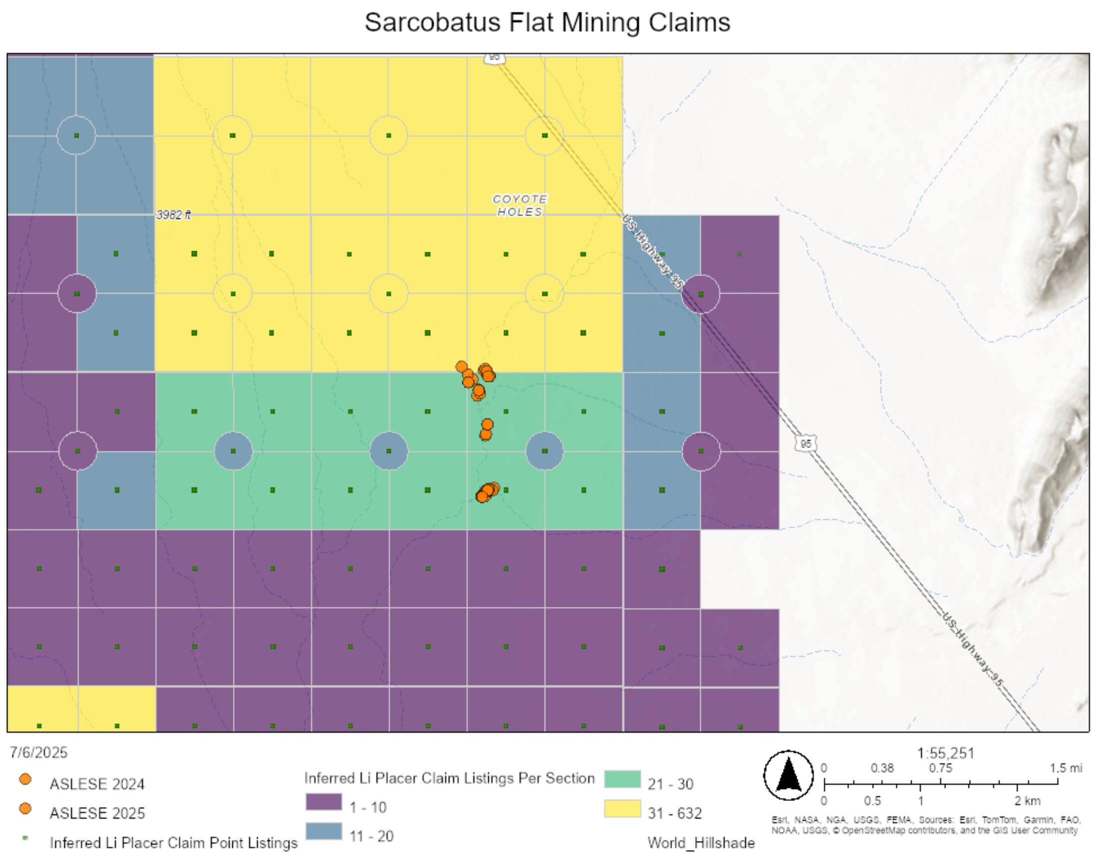

Fig. 33. Placer mining claims across Sodaville milkvetch habitat in Sarcobatus Flat.[396]

[396] Data per NDOM 2025a.

Fig. 34. Ioneer Inc. claim markers and notice documents photographed on Sarcobatus Flat near Sodaville milkvetch habitat, 20 May 2025.

The flat potentiometric surface across Sarcobatus Flat means that drawdown from pumping for Nevada Lithium's project or the North Bullfrog Mine or other mining projects could rapidly propagate across the basin, potentially lowering groundwater levels at the Sodaville milkvetch population and leading to its extirpation.

iii. Grazing

Impacts from grazing cattle and feral burros have been observed in and around the Sodaville milkvetch habitat on Sarcobatus Flat. Significant alterations to springs on the north end of Sarcobatus Flat, including apparently recent infrastructure like a solar-powered well pump (**Fig. 35**), have been observed along with evidence of trampling, grazing impacts to native vegetation, and abundant cattle and burro feces. The Sarcobatus Flat population of Sodaville milkvetch is entirely within the Magruder Mountain grazing allotment, which encompasses 660,205 acres of public land.[397] The allotment failed to meet rangeland health standards during its last inventory in 2004, due to impacts from inappropriate livestock grazing and the preponderance of feral

[397] PEER 2024, *entire*.

horses.[398] Impacts to the plant communities which the Sodaville milkvetch inhabits from livestock constitute a threat to the taxon.

Fig. 35. A solar-powered well pump connected to a water trough, surrounded by signs of heavy grazing and trampling by cattle and feral equids.

iv. Off-Highway Vehicles

Damage from off-highway vehicles has been observed directly within the Sodaville milkvetch population at Sarcobatus Flat.[399] The Legacy Racing Association Baja Nevada race has been known to go through Sarcobatus Flat.[400] For instance in 2022, the race began at Bonnie Claire, on the other side of the playa from the Sodaville milkvetch population. In 2025, the Legacy Racing Baja Nevada race was held June 25-29.[401] On June 27, large clouds of dust from an OHV event could be seen at Sarcobatus Flat (**Fig. 36**). One could only presume this was the Legacy Racing event. Dust can have serious impacts on rare plants, as described above in the mining section. Additionally, increased OHV traffic in the area could increase the likelihood of off-trail travel including through Sodaville milkvetch habitat.

398 *Id.*
399 Novak and Fraga 2025, p. 6-7.
400 Legacy Racing 2022, p. 2.
401 Legacy Racing 2025, *entire.*

Fig. 36. Dust plumes from an off-highway vehicle race held on Sarcobatus Flat, 27 June 2025, approximately 2 miles west of the mapped Sodaville milkvetch population, with additional vehicle tracks in the foreground in Sodaville milkvetch habitat.

<u>e. Big Smoky Valley</u>

Big Smoky Valley is managed as Nevada Groundwater Basin #137A. This basin is badly over-appropriated, with a perennial yield of 6,000 acre-feet per year but total commitments of 22,540 acre-feet per year in water rights issued.[402] This water is primarily used for mining (13,728 acre-feet per year) and irrigation for agriculture (7,889 acre-feet per year). The basin received a "high" vulnerability rating for groundwater shortage.[403] In such a serious state of overdraft, it's likely that groundwater discharge is already being captured by pumping, potentially to the detriment of Sodaville milkvetch habitat.

i. Gold Mining

The Castle Exploration Project is a gold exploration project under permitting in southern Big Smoky Valley.[404] The plan boundary spans 1,658 acres. Based on our mapping analysis, the border of the project comes within 0.8 miles of the Sodaville milkvetch population (**Fig. 37**). The Preliminary EA for the project was released on May 12, 2025. It makes no mention of the Sodaville milkvetch, and does not analyze the impacts of the project to the groundwater dependent habitat that the milkvetch depends on, despite its close proximity to the project. The EA says the project will include 65 boreholes drilled as much as 1,000 feet deep.[405] This will almost certainly intercept the groundwater aquifer. Since the Sodaville milkvetch relies on shallow groundwater, we can assume that the drilling will drill through the aquifer that sustains the plant. Given the history of uncontrolled artesian flows in the Great Basin when drilling through confined aquifers, it seems that there is the potential for impacts to the Sodaville milkvetch from the Castle Exploration Project. Should the project ever get developed into a full mining operation, those impacts could be magnified, particularly if the project includes dewatering or large-scale groundwater pumping. This poses a serious threat to the Sodaville milkvetch in Big Smoky Valley.

[402] NDWR 2025c.
[403] NDWR 2023.
[404] BLM 2025, *entire.*
[405] *Id.*, at 2-4.

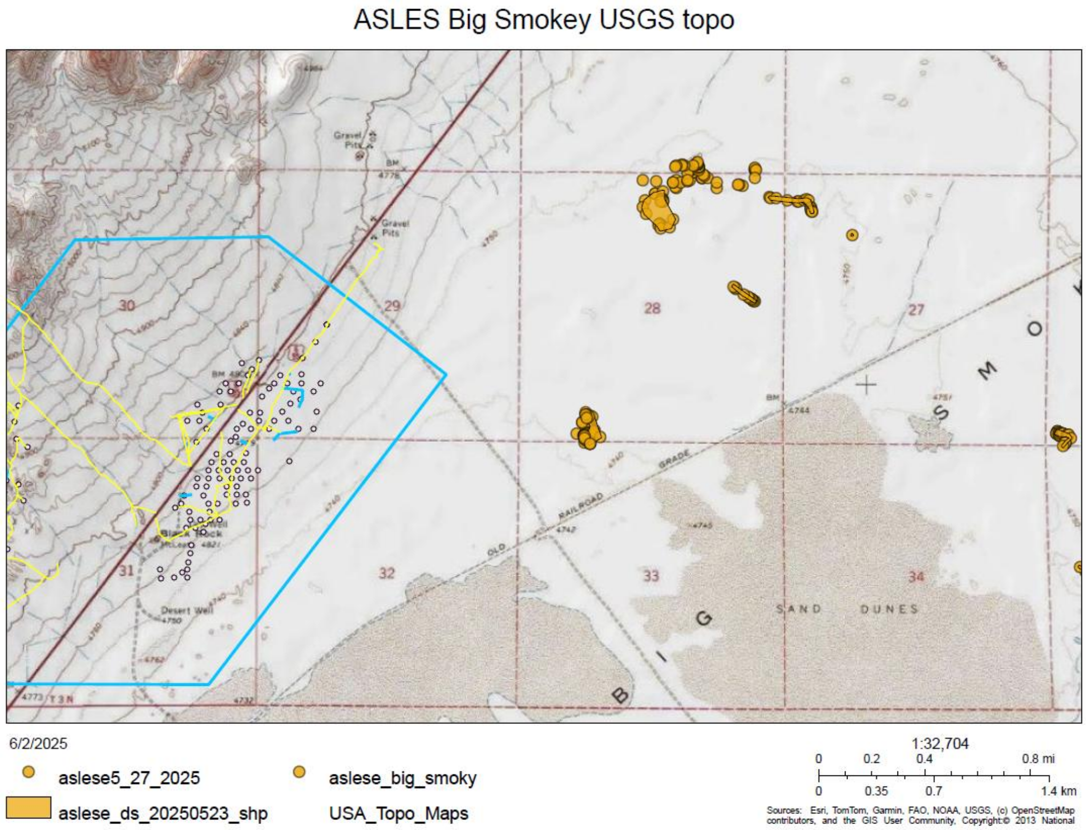

Fig. 37. Map of Castle Exploration Project (left) and Sodaville milkvetch occurrences in Big Smoky Valley.

ii. Solar Projects

The Monte Cristo Solar Project is a proposed 2,500 MW solar energy project to be sited in southern Big Smoky Valley.[406] The project would encompass "16,280 acres of BLM-managed land approximately eleven miles west of Tonopah south of and to the west of U.S. Highway 95 in Esmeralda County, Nevada."[407] The area within their right-of-way application includes all known occurrences of the Sodaville milkvetch in Big Smoky Valley (**Fig. 38**). The only available filing about this project is a Notice of Application to a Federal Agency filed with the Public Utilities Commission of Nevada.[408] It is not clear if they have commenced any permitting with BLM or not. No further information is available, but the right-of-way application remains on the books and the land is encumbered in BLM's right-of-way database. As a result, this

[406] Monte Cristo Solar 2025, p. 3.
[407] *Id.*, p. 4. Given that the western side of US-95 in the area is a mountain, and given all of their right-of-way applications are east of US-95, presumably they meant south and east.
[408] *Ibid.*

project must be considered a threat to the Sodaville milkvetch until the applications have been withdrawn.

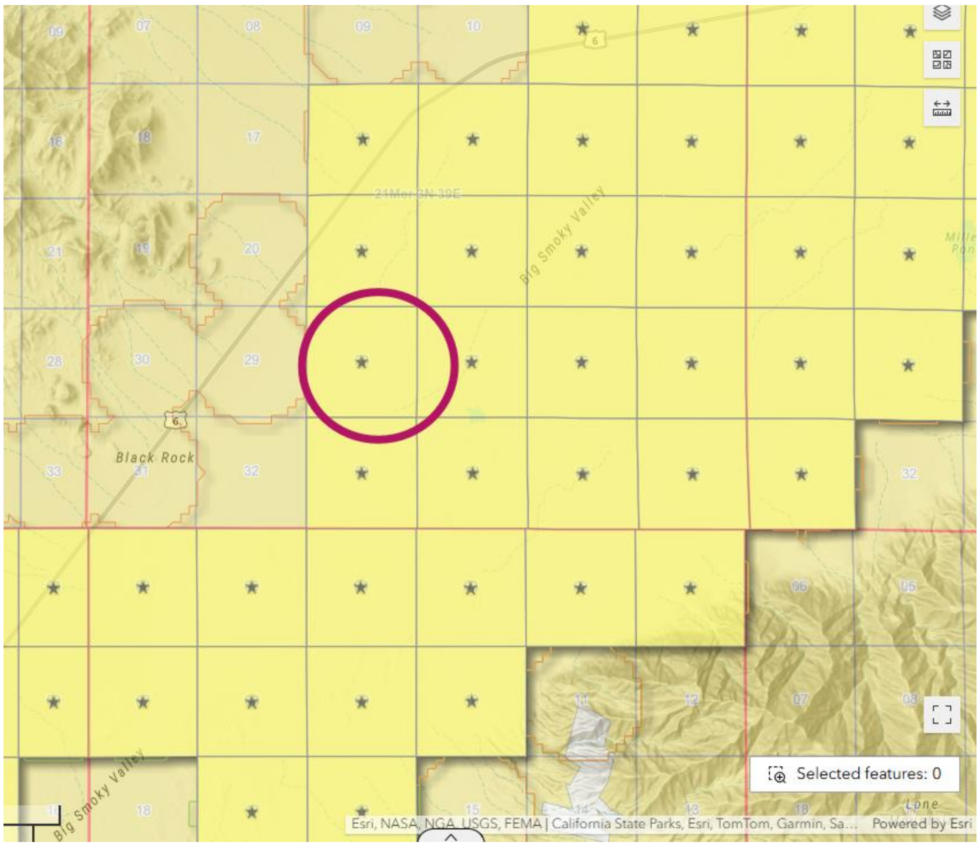

Fig 38. Solar right-of-way applications attributed to Monte Cristo Solar, Inc. The familiar Black Rock location is indicated on the left; the area of densest Sodaville milkvetch occurrences is circled in purple.[409]

Another solar project of concern to this taxon is a proposed group of seven contiguous utility-scale solar projects collectively named the "Esmeralda 7 Solar Project" that would span approximately 62,300 acres and approach within less than 2 kilometers of A. lentiginosus var. sesquimetralis plants that were mapped in May 2024 at Big Smoky Valley Playa.[410] [411] Notably, the Draft Programmatic Environmental Impact Statement for these projects failed to identify the Sodaville milkvetch as a special status species with the potential to occur in the area.[412] [413] This highlights the importance of appropriately-timed and informed survey methods to anticipate and detect potential occurrences of this taxon. The consequences of the Esmeralda 7 Solar Projects

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409 Data from https://claims-nvdataminer.hub.arcgis.com/ .
410 BLM 2024f.
411 Fraga 2024, p. 5.
412 BLM 2024f.
413 BLM 2024g.

on the Sodaville milkvetch have not been analyzed. Until the project appropriately minimizes and mitigates the harms it may cause to the rare plant, it must be considered a threat to the species.

iii. Lithium Mining

There are hundreds of placer mining claims on the playa in Big Smoky Valley, including some which directly intersect with occupied Sodaville milkvetch habitat (**Fig. 39**). Development of these claims would cause significant impacts to the plants both through direct disturbance and also through alteration of the hydrologic system which sustains their wetland habitat.

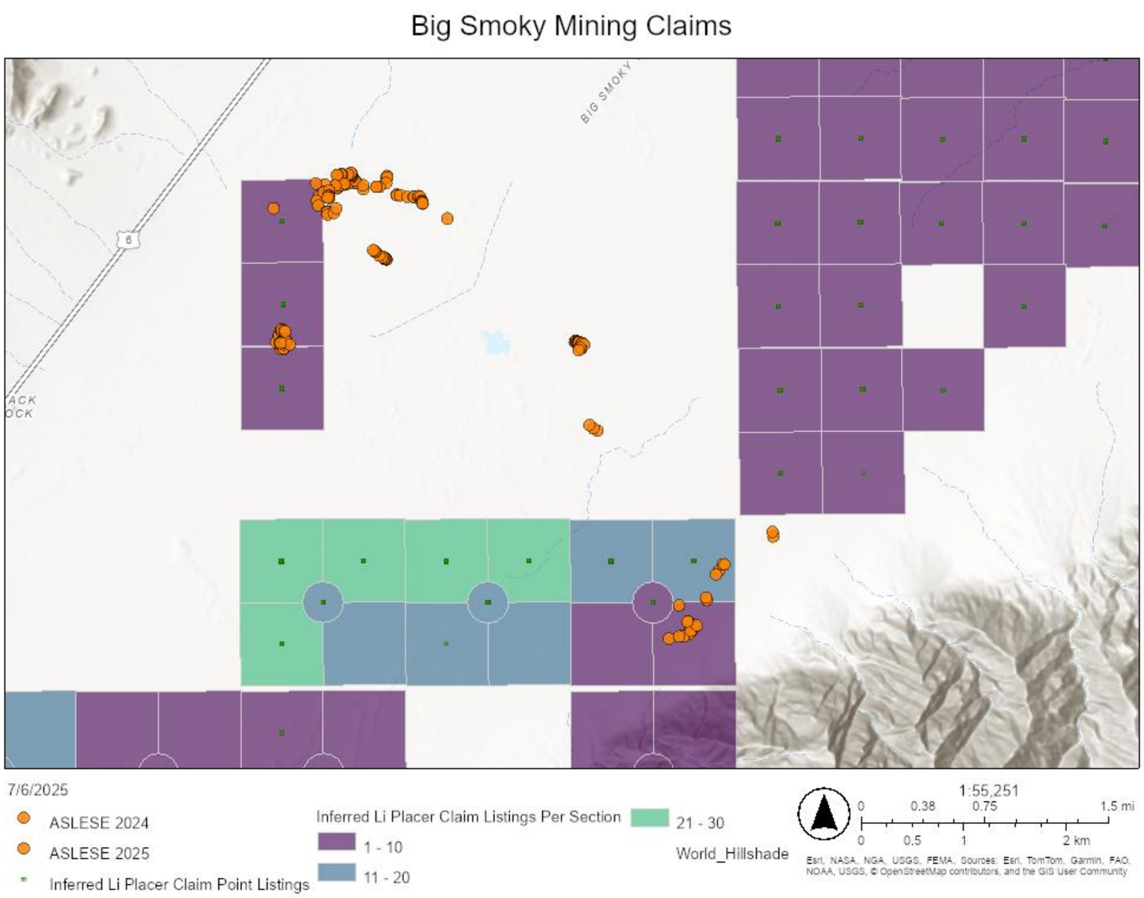

Fig. 39. Placer claims (inferred lithium claims) in or near Sodaville milkvetch habitat in Big Smoky Valley.[414]

[414] Data per NDOM 2025a.

iv. Geothermal Energy

Large areas within and directly adjacent to Sodaville milkvetch habitat in Big Smoky Valley have been leased to geothermal energy companies (**Fig. 40**). While no development has occurred in these lease parcels to date, their development could entail significant changes to the hydrologic system which sustains the Sodaville milkvetch's wetland habitat in Big Smoky Valley.

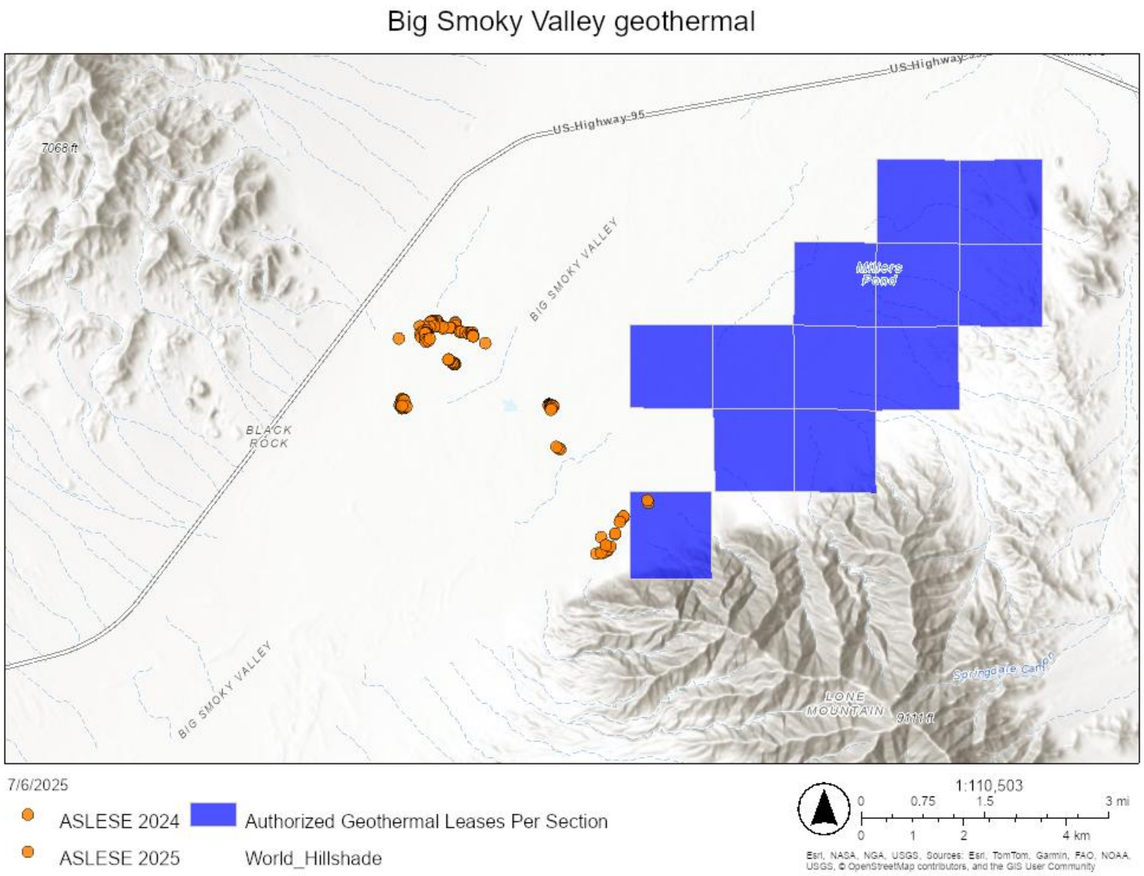

Fig. 40. Geothermal lease parcels in or near Sodaville milkvetch habitat in Big Smoky Valley.[415]

f. Big Sand Spring

The Big Sand Spring population of Sodaville milkvetch is entirely within Death Valley National Park. There are no known threats of direct destruction of this habitat, though the population is

[415] Data per NDOM 2025c.

severely threatened by climate change. Given the complex hydrological connectivity of this region, it is reasonable to consider potential impacts to the aquifer arising from groundwater pumping and/or mining activities outside the national park boundaries.[416]

Historically, non-native ungulate activity was a primary threat affecting the Sodaville milkvetch population at Big Sand Spring.[417] [418] Following the cessation of cattle grazing allotments within the park, feral burro activities have remained an ongoing periodic threat to this population.[419]

B. Disease or Predation

Impacts to Sodaville milkvetch from herbivory have been observed at Big Sand Spring, Cold Springs, Fish Lake Valley, and Sarcobatus Flat. In addition to grazing and trampling pressure from non-native ungulates, natural predators may include lagomorphs, rodents, native ungulates including mule deer and pronghorn antelope, and a variety of arthropods. Signs of herbivory, primarily defoliation, possibly due to native rodents or lagomorphs, have been observed at several locations (**Fig. 41**). Herbivory is recognized as a significant threat to the ecologically and morphologically similar Federally Endangered taxa *Astragalus phoenix* and *Astragalus lentiginosus* var. *piscinensis*.[420] [421] Signs of seed predation consistent with those associated with specialist bean weevils in the genus *Acanthoscelides* have been observed on Sodaville milkvetch fruits at several locations, which may lead to a reduction in viable seed production (**Fig. 42**).[422] [423] Additionally, surveys at Fish Lake Valley on 29 May 2025 found evidence of an as-yet unidentified stem gall on several plants, indicating a potential parasitic arthropod. Arthropod-induced galls have been reported from European species of *Astragalus* and identified as resulting from wasps, flies, beetles, midges, and mites.[424] [425] Plant galls are not generally considered harmful to the host, however they may negatively impact plant reproduction and fitness in combination with other factors.[426]

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416 Bedinger and Harrill 2012, plate 1; pp. 37-38.
417 Kane 2003
418 CNDDB 2025
419 *Ibid.*
420 USFWS 2009b p. 15
421 Tanner et al. 2013 p. 377
422 Johnson 1970 p. 85
423 Soltani 2021 p. 76
424 Fjellberg and Viggiani 2021 p. 5
425 Roskam 2020, entire.
426 Martini et al. 2021, p. 1078.

Fig. 41. Signs of herbivory on Sodaville milkvetch, possibly due to lagomorphs or rodents, observed on Sarcobatus Flat, October 2024-June 2025. *Bottom right:* signs of digging and trampling around Sodaville milkvetch on Sarcobatus Flat, 7 June 2025.

Fig. 42. Evidence of bean weevil seed predation (exit holes) on Sodaville milkvetch fruits observed at Big Smoky Valley, 25 May 2024.

C. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

Overutilization of the Sodaville milkvetch for commercial, recreational, scientific, or educational purposes is not known to be a threat at this time.

D. Inadequacy of Existing Regulatory Mechanisms

Sodaville milkvetch is listed under Nevada state law as a "fully protected species of native flora in danger of extinction," in Nevada Revised Statutes 527.[427] Species of native flora can be protected under law in Nevada when, "the State Forester Firewarden… determines that its existence is endangered and its survival requires assistance… because its habitat is threatened with destruction, drastic modification or severe curtailment."[428] The substantive protection provided for fully protected species of native flora is that, "no member of its kind may be removed or destroyed at any time by any means except under special permit."[429] Anyone who proposes to undertake activities which are otherwise lawful but will result in the destruction of a protected plant incidental to the action the person is undertaking must obtain a permit.[430] The

[427] NRS 527.270; NAC 527.010.
[428] NRS 527.270.
[429] *Id.*
[430] NAC 527.250, 527.260(1).

State Forester Firewarden, "may issue a permit, under such conditions as he or she deems necessary or practicable."[431]

In practice, however, this law does not provide substantive protections for the Sodaville milkvetch. Indeed, as the 1993 Nevada Natural Heritage Program's status report on the taxon clearly states: "Nevada law [...] does not require the continued survival of any plant species which it declares to be in danger of extinction."[432] Nevada's protections for native flora do not include the designation of critical habitat and do not provide any specific standards–such as facilitating the species' continued existence–on the basis of which the State Forester Firewarden can or should deny a permit for take. These permits are handed out to just about anybody who applies. Public records requests and other inquiries have revealed that, at most, one permit has been denied in the past ten years. Some permits don't even have mitigation measures associated with them. Meanwhile permits have been given for such activities as the Lima Gypsum mine expansion in Clark County, which bulldozed an entire subpopulation of Las Vegas bearpoppy.[433] There are also no specific penalties associated with violating NRS 527.

The sole opportunity for NRS 527 to provide substantive protections for the Sodaville milkvetch in recent history is the Greenlink West transmission line construction project in Sarcobatus Flat, which jeopardizes the existence of a significant portion of that population. As detailed in a report and letter to NDF, while the area has already been flagged and staked for bulldozing, causing significant damage to the Sodaville milkvetch's habitat, no NRS 527 permit has yet been obtained by the project proponent.[434] [435] [436] NRS 527 has failed to protect the Sodaville milkvetch.

In California, Sodaville milkvetch is listed under the California Endangered Species Act.[437] The only California population, at Big Sand Spring, occurs within Death Valley National Park. Although CESA prohibits take of listed species in most cases and the National Park Service has regulations governing natural resources on NPS land, feral burros and climate change impacts are not subject to such regulations. Moreover, the preservation of a single isolated population is insufficient to ensure the survival of the species as a whole. Reliance on a patchwork of differing state regulations, with weak Nevada protections applying to the vast majority of Sodaville milkvetch individuals, is unsustainable.

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431 NAC 527.260(1).
432 Morefield 1993 p. 14
433 NDF 2018, *entire.*
434 Novak and Fraga 2025, p. 6-7.
435 Donnelly 2025, p. 2.
436 NDF 2025, *entire.*
437 CNDDB 2025, p. 3.

The Sodaville milkvetch is also a BLM Sensitive Species.[438] This designation may encourage conservation in some cases, but it ultimately carries no substantive protection for the species.[439] A BLM sensitive species is defined as, “A species the BLM has determined to provide special management consideration to help preclude the need for future listing under the ESA.”[440] However, there are no specific policies guiding those management considerations. Although the BLM must consider sensitive species in National Environmental Policy Act documents when evaluating proposed actions,[441] the responsible official may still authorize impacts to occur, as they are not obligated to conserve the species as would be required under Section 7 of the ESA.

A BLM sensitive species designation alone is not enough to prevent impacts to the species or even sufficient to preclude Endangered Species Act listing. For instance, Tiehm’s buckwheat (*Eriogonum tiehmii*) was recently listed under the Endangered Species Act, despite being designated a BLM sensitive species.[442] As FWS pointed out in the Tiehm’s buckwheat listing rule, “BLM's regulations do not require conservation measures for sensitive species as a condition for exploring for, or developing minerals subject to disposal under, the Mining Law of 1872, as amended…”[443]

Existing state-level listing protective measures and inclusion on the Bureau of Land Management’s list of special status taxa for Nevada are not adequate to prevent irreversible declines due to their jurisdictional limitations and/or insufficient enforcement mechanisms. Indeed, Sodaville milkvetch’s status as a BLM sensitive species and a Nevada state endangered species has already proven inadequate to prevent damage to Sodaville milkvetch habitat on BLM land and planned development that would likely cause the extirpation of one of the six occurrences.[444]

E. Other Factors

1. Invasive Species

Non-native species invasion is frequently cited as one of the most significant threats to biodiversity, ranking second only to habitat loss.[445] [446] In one study, invasive species were found

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[438] BLM Memorandum NV-IM-2024-003 & attached list
[439] See generally BLM 2024h.
[440] BLM 2024h, p. 38.
[441] BLM 2024h, p. 23-24.
[442] USFWS 2022d, *entire.*
[443] *Id.*, p. 77377. Internal citations omitted.
[444] Novak and Fraga 2025, *entire.*
[445] Lovich and de Gouvenain 1997, p. 45.
[446] Levine *et al.* 2003, p. 775.

to be one of the most commonly observed threats to rare plant species in Nevada, with 35.9% of all species investigated affected.[447] Specific impacts from introduced species include alteration of community structure, nutrient cycling, hydrology, and fire regimes.[448] Disturbance is a key ecological factor in the distribution and abundance of introduced species; specifically, anthropogenic disturbance can quickly move an ecosystem outside the bounds of its natural range of disturbance.[449]

Wetland and riparian habitats such as those occupied by the Sodaville milkvetch are frequently subject to invasion by introduced species.[450] Playas like the Fish Lake Valley Salt Marsh or Sarcobatus Flat function as sinks that collect seeds from wind and water. For the Sodaville milkvetch, new disturbance in its habitat is becoming commonplace as a rush for resource development plays out. These newly disturbed areas can serve as vectors for the introduction of invasive plant species into Sodaville milkvetch habitat.

Tiehm's buckwheat (*Eriogonum tiehmii*), a federally listed endangered species, occurs just 6 air miles southeast from Sodaville milkvetch habitat in Fish Lake Valley.[451] This species provides a regionally proximal example of where mining exploration activities facilitated new invasions of introduced species into previously uninvaded rare plant habitat.[452] In 2021, Fraga documented heavy infestations of *Halogeton glomeratus* (saltlover, Chenopodiaceae) and emerging infestations of *Salsola tragus* (prickly russian thistle, Chenopodiaceae) and *Amaranthus albus* (common tumbleweed, Amaranthaceae), in critical habitat for Tiehm's where mining exploration occurred in 2019.[453] A survey by former Nevada State Botanist, Jim Morefield provided a complete list of plant species found to co-occur with Tiehm's buckwheat in 1994. At the time of the survey Morefield reported no non-native species as co-occurring with Tiehm's buckwheat.[454] *Halogeton glomeratus* has since become well established within Tiehm's buckwheat critical habitat;[455] *Salsola tragus* and *Amaranthus albus* are emerging threats to the species.[456] Efforts to restore and mitigate the impacts of invasive species from exploration activities have not been effective thus far.

Several introduced plant species have been documented as co-occurring with Sodaville milkvetch throughout its range, placing populations at risk for future invasion. Introduced species that occur with or near Sodaville milkvetch include: *Halogeton glomeratus* (saltlover,

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[447] McClinton et al. 2022, p. 8.
[448] Levine et al. 2003, p. 776.
[449] Meyer et al. 2021, p. 86.
[450] Meyer et al. 2021, p. 94.
[451] Fraga 2021, p. 5.
[452] Morefield 1995, p. 12.
[453] Fraga 2021, p. 3.
[454] Morefield 1995, p. 12.
[455] Fraga 2021, p. 3.
[456] *Id.*, p. 4.

Chenopodiaceae) and *Salsola paulsenii* (barbwire russian thistle, Chenopodiaceae). These species follow disturbance,[457] and the enormous range of disturbances threatening each Sodaville milkvetch population will inevitably bring with it vectors for invasion. *Halogeton glomeratus* is known to alter soil characteristics such that it makes establishment of native vegetation difficult following invasion.[458] *Halogeton* and *Salsola* are both known to tolerate alkaline soil conditions.[459] [460]

<u>2. Climate Change</u>

Climate change impacts to the southwestern U.S. are expected to include warming temperatures,[461] [462] [463] increased aridity,[464] [465] [466] shifts in precipitation patterns,[467] more intense heat waves[468] and severe drought.[469] [470] [471] Indeed, the annual average temperature for the southwestern U.S. has already risen at least 1.61°F since 1901[472] with steeper increases occurring after 1980.[473] Research has found that the mean annual minimum temperature in Nevada increased from 2.6°C to 3.7°C between 1990-2020 (a 1.1°C change) and that climatic changes were more dramatic in the southern parts of Nevada, such as Nye and Esmeralda Counties where the Sodaville milkvetch occurs.[474] These changes were primarily driven by changes in minimum temperature.[475]

A recent study of widespread declines in desert vegetation cover indicates that rising temperatures are an important contributor to this trend.[476] Prolonged exposure to 2°C warming

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[457] Fraga 2021, *entire.*
[458] Pavek 1992, p. 4.
[459] Cal-IPC 2005, p. 7.
[460] Pavek 1992, p. 3.
[461] Adlam et al. 2017, pp. 12-13.
[462] Vose et al. 2017, p. 197.
[463] Bradford et al. 2020, p. 3913.
[464] Seager et al. 2007, pp. 1181-118.
[465] Seager and Vechi 2010, p. 21281.
[466] Wahl et al. 2021, p. 8.
[467] Cook and Seager 2013, pp. 1694-1697.
[468] Hicke et al. 2022, p. 1937.
[469] Cook et al. 2015, pp. 2-5.
[470] Mankin et al. 2021, p. 15.
[471] Cook et al. 2021, p. 15.
[472] Vose et al. 2017, p. 187.
[473] Mankin et al. 2021, p. 6.
[474] McClinton *et al.* 2022, p. 12.
[475] *Id.*, p. 1.
[476] Hantson *et al.* 2021, pp. 9-10.

significantly reduced photosynthesis in desert vegetation[477] and evidence suggests extreme heat events can greatly exacerbate the negative effects of drought on plant growth.[478]

Southwestern North America, including the Mojave Desert, is in the midst of the worst multi-decadal drought experienced in over a millennia.[479] Notably, human caused climate change has contributed to the severity, length, and spatial scale of this megadrought due to the effect of rising temperatures on atmospheric evaporative demand and soil moisture deficit.[480] According to modeling, there is at least a 50% likelihood of another multi-decadal drought at least as severe as the current one.[481] Drought-intensifying atmospheric evaporative demand is certain to increase in the coming decades[482] [483] and will become the regional norm by 2030-2050.[484] Future climate models for the southwestern U.S. indicate that seasonal dry periods will extend in duration and begin in the spring instead of the summer.[485] These changes threaten to push the Sodaville milkvetch beyond its climatic tolerance limits.

Sodaville milkvetch is a groundwater dependent species associated with alkali playa and spring mound habitats in Western Nevada and eastern California. While spring-fed habitats supplied by groundwater systems have been identified as hydrologic refugia in hyper-arid regions, they still remain vulnerable to climate change.[486] [487] [488] A study investigating changes to groundwater recharge in a changing climate found the Death Valley Regional Flow System is expected to experience a loss in groundwater recharge due to decreased winter precipitation and snowpack.[489] Further, projected warmer temperatures for the Mojave and Great Basin deserts are expected to increase the loss of soil moisture and shallow groundwater due to increases in evapotranspiration.[490] The loss of available soil moisture, shallow groundwater, and surface expression at springs could have substantial impact on the Sodaville milkvetch which relies on

[477] Wertin *et al.* 2017, p. 302.
[478] De Boeck *et al.* 2011, p. 813.
[479] Williams *et al.* 2022, p. 232.
[480] *Ibid.*
[481] Cook *et al.* 2021, p. 15.
[482] Ficklin and Novick 2017, p. 2076-2077.
[483] Gamelin *et al.* 2022, p. 5.
[484] Mankin *et al.* 2021, p. 16.
[485] Ting *et al.* 2018, p. 4272.
[486] Cartwright *et al.* 2020, p. 252.
[487] Fraga *et al.* 2023, p. 20.
[488] Meixner *et al.* 2016, p. 133.
[489] *Ibid.*
[490] *Ibid.*

these water sources for its survival.[491] Increased temperatures will also lead to shorter duration snowpacks, and thus less groundwater recharge.[492]

One study examined geospatial data on climate change exposure and found that all the critically imperiled rare species native to Nevada investigated (N=128), including the Sodaville milkvetch, are currently (1990-2020) experiencing non-analogous to extremely different climatic conditions compared to a prior reference period (1960-1989).[493] A different study found five species that grow in alkali wetlands in the Amargosa Basin were rated as highly vulnerable to climate change based on the NatureServe Climate Change Vulnerability Index, and two species (Ash Meadows sunray and spring loving centaury) were rated as moderately vulnerable.[494] With comparable life histories to the Sodaville milkvetch, the vulnerabilities of these species may be analogous to those of the milkvetch.

Similar to a large proportion of rare plant species native to the Great Basin Desert in Nevada, Sodville milkvetch occurs on valley bottoms and is restricted to specialized edaphic conditions such as playas, alkaline deposits, heavy clay soils, and spring outflows.[495] Species that occur at relatively low elevations in valley bottoms are thought to be among the most vulnerable to climate change because they have less elevational amplitude in their ranges and are more likely to experience rapid loss of existing suitable habitat.[496] [497] [498]

Herbivory has been shown to increase during periods of low water availability[499] and drought has been associated with increased mammalian herbivory of perennial plants due to the lack of alternative forage.[500] [501] Aridification and an increase in drought frequency could intensify this phenomenon. The Sodaville milkvetch may face novel herbivores as insects are expected to shift their range in response to climate change.[502] Climate change may also exacerbate vulnerability to other threats such as mining exploration, livestock, invasive plant species, and feral horses.[503]

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[491] Fraga *et al.* 2023, p. 8.
[492] Meixner *et al.* 2016, p. 133.
[493] McClinton *et al.* 2022, p. 15.
[494] Wilkening *et al.* 2021, p. 9-11.
[495] Caicco *et al.* 2023.
[496] McClinton *et al.* 2022, p. 17.
[497] Caicco *et al.* 2023.
[498] Ackerly *et al.* 2010, p. 480-481.
[499] McCluney *et al.* 2012, p. 572.
[500] DeFalco *et al.* 2010, p. 247.
[501] Esque *et al.* 2015, p. 89.
[502] Hamann *et al.* 2021, p. 1895, 1899.
[503] McClinton *et al.* 2022, p. 17.

V. REQUEST FOR CRITICAL HABITAT DESIGNATION

The Center formally requests that the Service designate critical habitat for the Sodaville milkvetch (*Astragalus lentiginosus* var. *sesquimetralis*) concurrently with listing, as required by the ESA.[504] Critical habitat, as defined by Section 3 of the ESA, consists of:[505]

> (i) the specific areas within the geographical area occupied by a species, at the time it is listed . . . 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 protections; and (ii) the specific areas outside the geographical areas occupied by the species as the time it is listed . . . , upon a determinization by the Secretary that such areas are essential for the conservation of the species.

The effectiveness of the ESA depends on the designation of critical habitat; specifically, if a species' survival depends largely on protection of its habitat, then listing a species, on its own, would not accomplish recovery.[506] Accordingly, Congress has long recognized that "classifying a species as endangered or threatened is only the first step in ensuring its survival," and that protecting essential habitat is just as important to a species' survival and recovery as listing.[507]

Without a critical habitat designation, the Sodaville milkvetch has limited chances of survival and recovery. Numerous threats to the plant are indirect - for instance, groundwater pumping. These indirect threats are best addressed by protecting the habitat the Sodaville milkvetch needs to survive, rather than simply relying on the "no jeopardy" standard in Section 7 consultation for the plant. The Center thus requests that the Service propose designating critical habitat for the Sodaville milkvetch concurrently with its proposed listing.

Critical habitat should include all occupied Sodaville milkvetch habitat, as well as any areas otherwise determined to be important to the survival and recovery of the species.

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[504] 16 U.S.C § 1533(a)(3)(A).
[505] *Id.* at § 1532(5).
[506] H. Rep. No. 94-887 at 3 (1976).
[507] *Id.*

VI. CONCLUSION

The rarity of Sodaville milkvetch has been recognized since the taxon was first described. Its unique habitat, already inherently rare, faces rapidly accelerating threats from development, resource extraction, and climate change. Without federal protections, ongoing habitat alteration and planned future disturbances will lead to the species' extirpation from some of the few locales from which it is known and, eventually, its extinction.

Three of the six populations of Sodaville milkvetch known to exist globally have been documented only in recent years. Each of these populations is restricted to land managed by the federal government where current uses and pending developments pose existential threats to their continued survival. Existing protective measures, including state listing and inclusion on the BLM Sensitive Species list, have failed to curtail these threats.

As Rupert Barneby wrote of the Sodaville milkvetch in 1977, "...the plants are restricted to moist alkaline soil in the immediate vicinity of springs where they will depend for survival on preservation of these tiny and precious islands of verdure in the desert."[508] Only listing under the Endangered Species Act can ensure the protection and eventual recovery of these landscapes and their irreplaceable inhabitants.

[508] Barneby 1977 p. 381

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