State of California
Natural Resources Agency
Department of Fish and Wildlife

REPORT TO THE FISH AND GAME COMMISSION

STATUS REVIEW OF LIVERMORE TARPLANT (*Deinandra bacigalupii*)

April 2016

Deinandra bacigalupii, photo by Jeb McKay Bjerke

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LIST OF ABBREVIATIONS, ACRONYMS AND TERMS

BO – Biological Opinion

CEQA – California Environmental Quality Act

CESA – California Endangered Species Act

CNDDB – California Natural Diversity Database

CNPS – California Native Plant Society

Commission – California Fish and Game Commission

CRPR – California Rare Plant Rank

Department – California Department of Fish and Wildlife

Occurrence – Element Occurrence

et al. – “and others”

Evaluation – Initial Evaluation of Petition to List the Livermore tarplant (*Deinandra bacigalupii*) as Endangered under the California Endangered Species Act

Id. – “the same”

NEPA – National Environmental Policy Act

NVCS – National Vegetation Classification Standard

Petition - Petition to the State of California Fish and Game Commission from Mr. Heath Bartosh, Cosponsored by the California Native Plant Society to List Livermore Tarplant as an Endangered Species Pursuant to the California Endangered Species Act

ssp. – Subspecies

var. – Variety

EXECUTIVE SUMMARY

This Status Review of Livermore Tarplant (*Deinandra bacigalupii* B.G. Baldwin) (Status Review) has been prepared by the California Department of Fish and Wildlife (Department) for the California Fish and Game Commission (Commission) pursuant to the requirements of the California Endangered Species Act (CESA). This Status Review has been independently reviewed by scientific peers, and is based upon the best scientific information available to the Department.

Livermore tarplant is an herbaceous plant of the sunflower family (Asteraceae) that was described as a new species in 1999. There are four known occurrences of Livermore tarplant, all restricted to the eastern portion of the Livermore Valley, within the City of Livermore and unincorporated Alameda County, California. Livermore tarplant grows in poorly-drained, seasonally-dry, alkaline meadows in the vicinity of barren alkali scalds, alkali vernal pools and playa-like pools.

All populations of Livermore tarplant occur within the immediate vicinity of urban development. Livermore tarplant is threatened, both directly and indirectly, by recent and ongoing development and changes in land use, impacts from invasive species, recreation activities, and herbicide use. Ground-disturbing impacts from grazing and impacts from thatch accumulation in areas that are not grazed are also potential threats to Livermore tarplant. It is unclear how climate change will affect Livermore tarplant. Livermore tarplant is also vulnerable to extinction due to the small number of Livermore tarplant populations and the relatively small sizes of those populations. Because of the rarity of Livermore tarplant, the loss of all or a significant portion of any Livermore tarplant population would represent the loss of a significant portion of Livermore tarplant's total range.

The scientific information available to the Department indicates that Livermore tarplant is in serious danger of becoming extinct in all or a significant portion of its range due to one or more causes, including loss of habitat, change in habitat, competition and other effects from invasive plant species, and other natural occurrences and human-related activities. The Department recommends that the Commission find that the petitioned action to list Livermore tarplant as an endangered species is warranted, and further recommends implementation of the management recommendations and recovery measures described in this Status Review.

INTRODUCTION

This Status Review addresses Livermore tarplant (*Deinandra bacigalupii* B.G. Baldwin).

Petition History

On August 26, 2014 the Commission received a petition (Petition) from Mr. Heath Bartosh, cosponsored by the California Native Plant Society (CNPS), to list Livermore tarplant as an endangered species pursuant to CESA (Fish & G. Code, § 2050 *et seq*.).

On August 28, 2014, the Commission referred the Petition to the Department for evaluation.

On September 12, 2014, as required by Fish and Game Code, section 2073.3, the Commission published notice of receipt of the Petition in the California Notice Register (Cal. Reg. Notice Register 2014, Vol. 37-Z, p.1627).

On January 14, 2015, the Department provided the Commission with a report, "Initial Evaluation of the Petition to List the Livermore tarplant (*Deinandra bacigalupii*) as Endangered under the California Endangered Species Act" (Evaluation). Based upon the information contained in the Petition, the Department concluded, pursuant to Fish and Game Code, section 2073.5, subdivision (a), that sufficient information exists to indicate that the petitioned action may be warranted, and recommended to the Commission that the Petition should be accepted and considered.

On April 9, 2015, at its scheduled public meeting in Santa Rosa, California, the Commission considered the Petition, the Department's Evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the Petition for consideration.

Subsequently, on April 24, 2015, the Commission published its Notice of Findings for Livermore tarplant in the California Regulatory Notice Register, designating Livermore tarplant as a candidate species (Cal. Reg. Notice Register 2015, No. 17-Z, p. 656, http://www.oal.ca.gov/res/docs/pdf/notice/17z-2015.pdf).

Department of Fish and Wildlife Review

Following the Commission's action to designate Livermore tarplant as a candidate species, the Department notified affected and interested parties and solicited data and comments on the petitioned action pursuant to Fish and Game Code section 2074.4 (see also Cal. Code Regs., tit. 14, § 670.1, subd. (f)(2)). All comments received are included in Appendix B to this report. The Department promptly commenced its review of the status of the species as required by Fish and Game Code section 2074.6, which has now concluded with this Status Review document.

The Department sought independent and competent peer review on its draft Status Review report by scientists with expertise relevant to the status of Livermore tarplant. Appendix C contains the specific input provided to the Department by the individual peer reviewers, as well as a brief explanation of the evaluation and response to the input and any amendments made to the draft Status Review report (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)(2)).

BIOLOGY

Species Description

The information below is paraphrased from the original species description of Livermore tarplant (Baldwin 1999a) and from the Jepson Manual, 2nd Edition (Baldwin 2012).

Livermore tarplant is an herbaceous plant of the sunflower family (Asteraceae) that grows to a height of 3.9 to 15.7 inches (10 to 40 centimeters). The leaves and parts of the stems, flowers, and flower heads of Livermore tarplant have minutely-stalked yellowish or clear glands that are sticky and give the plant a strong odor. Livermore tarplant has erect stems that are shiny near the base, and the stems have coarse, longish hairs. Its leaves have continuous and smooth margins or irregular lobes, and do not have leaf stalks. Leaves are evenly distributed along the stem, except at the base of the stem where the leaves form a rosette. The blades of the primary stem leaves are less than or equal to ten centimeters long, and the blades of leaves that are closer to the ends of stem branches are less than or equal to one centimeter long. The flower heads of Livermore tarplant usually have eight bright yellow ray flowers, each resembling a spreading petal with three lobes at the end. These ray flowers are pistillate, meaning that they only have female flower parts (pistils), and are capable of producing seed. The ray flowers of Livermore tarplant do not have a pappus, which is a structure that sometimes aids in seed dispersal in some plants of the sunflower family. There is a bract, called a phyllary, on the outside of the flower head for each of the ray flowers. There are usually 15-18 disc flowers near the center of the flower head, which each have a pappus made of irregular scales. The disc flowers are bright yellow and are functionally staminate, meaning that typically only the male flower parts (stamens) are functional. The flower heads of Livermore tarplant also have one peripheral series of about 8-11 scale-like bracts between the ray and disc flowers. The dry, one-seeded fruits of Livermore tarplant are called achenes (or cypselae), and are less than 1/10 of an inch (2-2.5 millimeters) long, black and somewhat four-angled with a corrugated appearance. Livermore tarplant has a chromosome number of 2n=24.

Taxonomy

A type specimen is the specimen, or group of specimens of an organism used to describe and name that organism. The type specimen of Livermore tarplant was collected by Robert F. Hoover on August 31, 1966 from the “junction of Ames St. and Raymond Road, north of Livermore… in sandy alkaline soil” (Hoover 1966). Hoover labeled the collection as only *Hemizonia* at the time, without identification to species. On April 26, 1967, Rimo Bacigalupi annotated the type specimen with the statement: “Does not seem to match any thus far published species of *Hemizonia*” (Baldwin 1999a). Dale E. Johnson annotated the type specimen as *Hemizonia paniculata* in 1978. In 1982, Barry Tanowitz included Livermore tarplant specimens as *Hemizonia increscens* ssp. *increscens*, and this inclusion was reflected in the treatment of *Hemizonia* in The Jepson Manual (Tanowitz 1982, Tanowitz 1993). In 1999, Bruce Baldwin proposed revisions in the taxonomy of North American tarplants based on phylogenetic, biosystematic and cytogenetic studies (Baldwin 1999b). Baldwin reinstated the genus *Deinandra* to accommodate many plants that were previously considered to be in the genus *Hemizonia,* including *H. increscens* ssp. *increscens*.

Dean K. Kelch first alerted Bruce Baldwin to the existence of Livermore tarplant, and Robert E. Preston informed Bruce Baldwin of an additional population near Greenville Road (Baldwin 1999a). Based on morphological, ecological, and phylogenetic considerations, Bruce Baldwin described Livermore tarplant as a new species (Baldwin 1999a). Baldwin noted that Livermore

tarplant is morphologically similar to *D. increscens*, but different in that it has (1) yellow and not dark-purple anthers, (2) a shorter and more irregular disc flower pappus, and (3) mostly entire or irregularly lobed leaves towards the base of the stem (rather than leaves that are pinnately divided, but not divided all the way down to the central axis of the leaf). Baldwin also noted that the results of molecular phylogenetic analyses of nuclear rDNA spacer sequences place Livermore tarplant closer to *D. corymbosa* than to *D. increscens* (Baldwin 1999a).

The botanist E. L. Greene coined the name *Deinandra* as a replacement for the genus name *Hartmannia*, which had been previously been used for a different genus of plants (Greene 1891). *Deinandra*, which means "terrible man" or "fierce man" in Greek, appears to have been a play of words on the name Hartmann (German for "stag man," with stags being fiercely territorial) (Borror 1960, Baldwin 2012). Livermore tarplant (*D. bacigalupii*) is named for Rimo Bacigalupi, the first curator of the Jepson Herbarium at University of California, Berkeley.

Range and Distribution

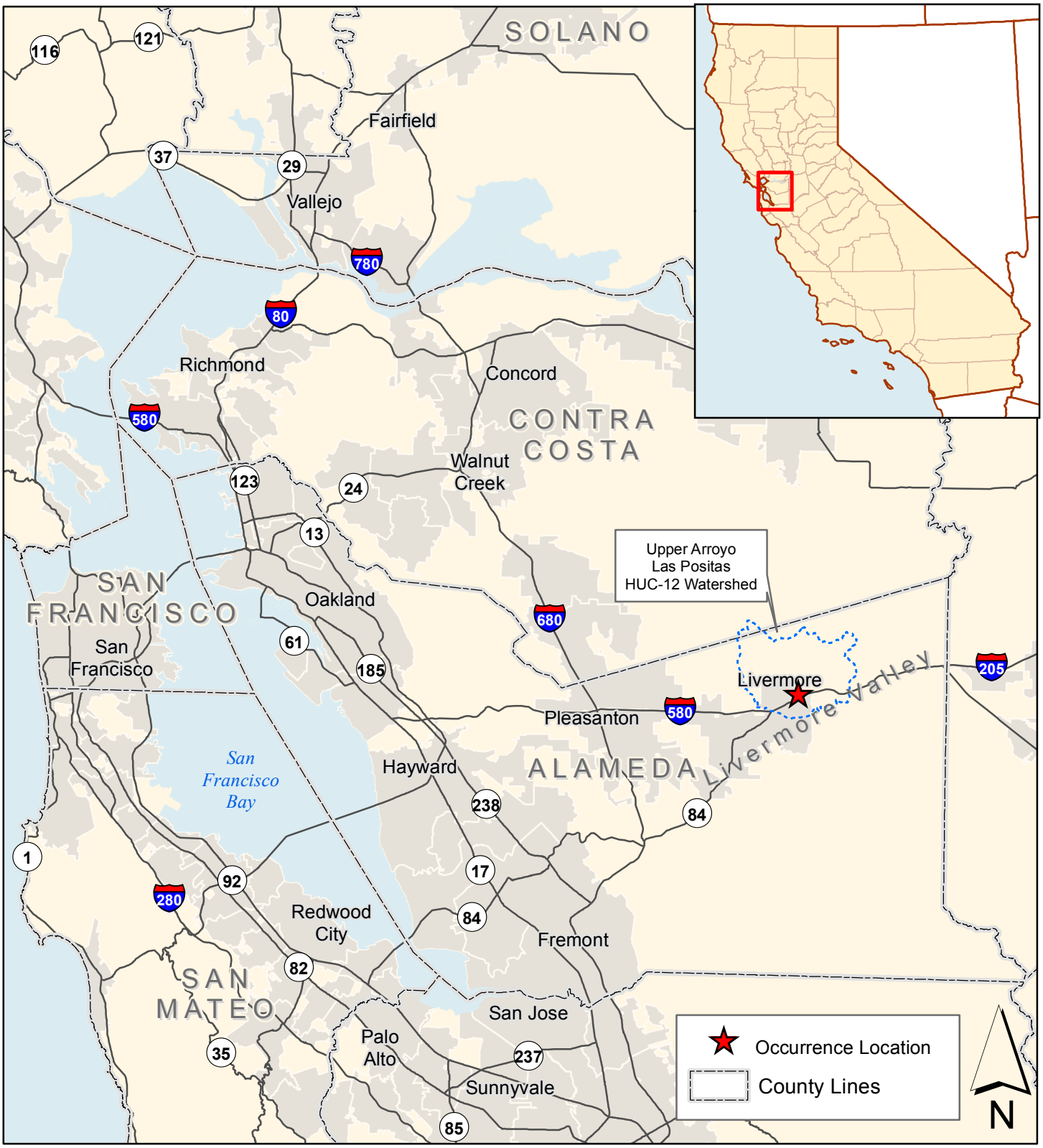
Range is considered to be the general geographical area in which an organism occurs. Distribution is considered to be the actual sites where individuals and populations of the species occur within the species' range.

Based on historical collections and other observational records, all known populations of Livermore tarplant are restricted to the eastern portion of the Livermore Valley within the City of Livermore and in unincorporated Alameda County, California (Figure 1). The Diablo Range is to the south of the Livermore Valley and Mt. Diablo is to the north. All Livermore tarplant populations occur in the Upper Arroyo Las Positas Watershed, which drains into Laguna Creek, Alameda Creek and ultimately the San Francisco Bay. Livermore tarplant occurs near the northern distributional limit of the genus *Deinandra* (Baldwin 1999a, CCH 2015). Livermore tarplant has been reported growing at elevations from approximately 520 to 650 feet above mean sea level (CNDDB 2015).

The distribution of Livermore tarplant is documented within the California Natural Diversity Database (CNDDB). Plant taxa, animal taxa, and natural communities that are documented within the CNDDB are of conservation concern within California and are referred to as "elements." An "element occurrence" (occurrence) is a location record for a site which contains an individual, population, nest site, den, or stand of a special status element. Populations, individuals, or colonies that are located within 1/4 mile of each other generally constitute a single occurrence, sometimes with multiple "parts" (Bittman 2001).

The Department updated the CNDDB occurrences for Livermore tarplant in October 2015 in conjunction with preparation of this Status Review. This update involved entering all information on Livermore tarplant that had been submitted to the Department, and checking for additional information on Livermore tarplant from online resources such as the Consortium of California Herbaria, Calflora.org, and CalPhotos.Berkeley.edu.

There are currently four occurrences for Livermore tarplant that are documented in the CNDDB; however, one of these occurrences consists of two separately-mapped parts that are bisected by a road. To make it easier to refer to the different occurrences and their parts in this Status Review, each occurrence or part of an occurrence has been named as a separate "population" in Table 1, below. A map of all of the known Livermore tarplant populations is presented in Figure 2. All Livermore tarplant populations are located within a three-mile radius of each other.

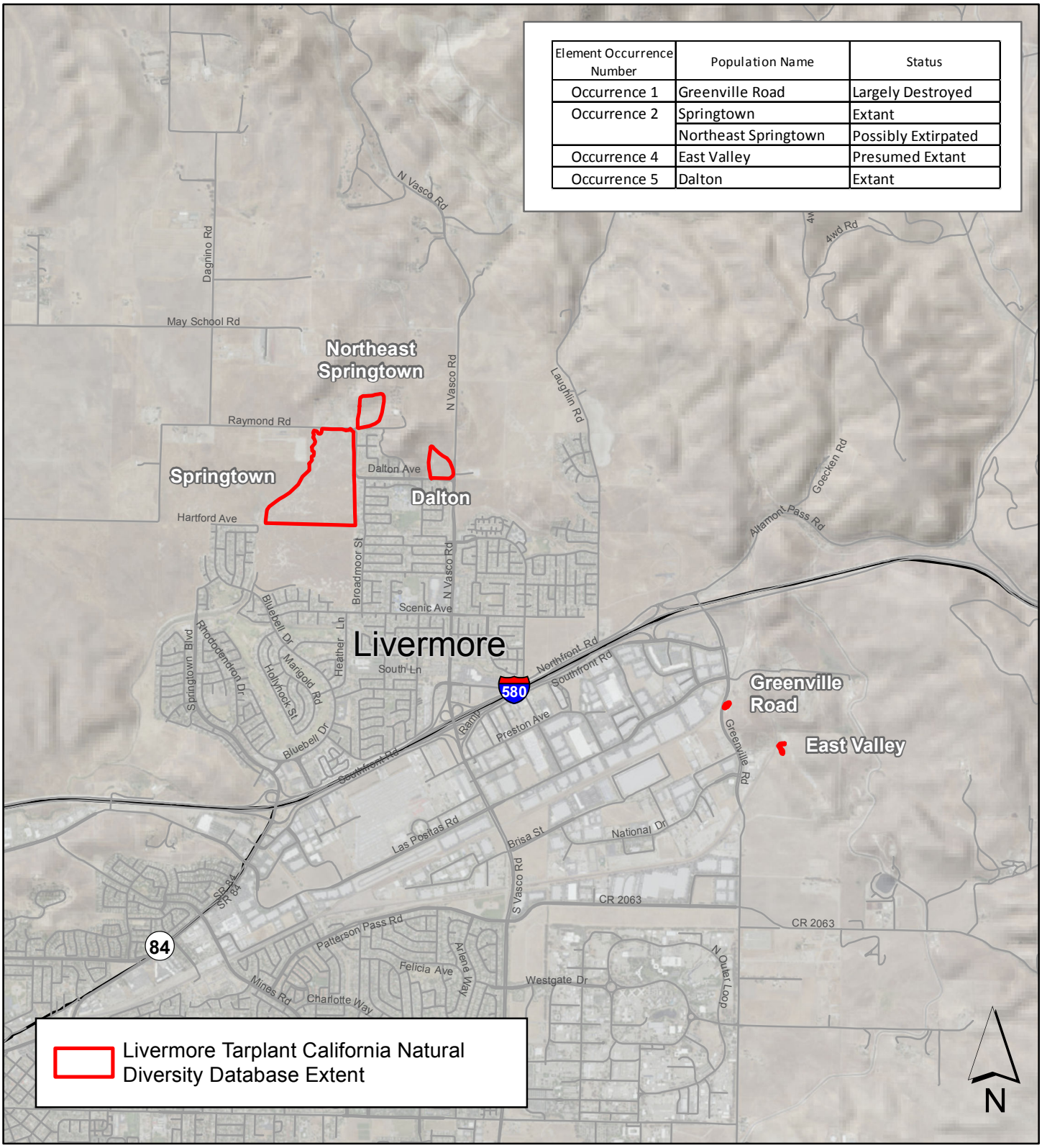


Species Occurrence Data Source: California Natural Diversity Database (October 2015)

0 5 10 20
Miles

California Department of Fish and Wildlife

Figure 1
Regional Vicinity of Livermore Tarplant



Species Occurrence Data Source: California Natural Diversity Database (October 2015)

0 0.25 0.5 1 1.5
Miles

Table 1. Livermore Tarplant Populations

Occurrence Number	*Population Name*	*Parcel Number(s)*	*Location (City or County)*	*Ownership*
Occurrence 1	Greenville Road	99B-5700-2-9	County	Private
Occurrence 2*	Springtown	902-3-3-1	City	City
	Northeast Springtown	99B-5300-7	County	Public Utility
		99B-5300-6-4	County	Private
Occurrence 4	East Valley	99B-5600-4-24	County	Private
Occurrence 5	Dalton	99B-5300-5-5	County	Private

*Includes former Occurrence 3

The locations of Livermore tarplant populations are shown in Figure 2 and described as follows:

Occurrence 1: Greenville Road. The Greenville Road population is located on private property (Assessor's Parcel Number 99B-5700-2-9) within unincorporated Alameda County, south of Interstate 580 and immediately east of Greenville Road south of its intersection with Las Positas Road. The Department estimates that the Greenville Road population was approximately 0.4 acre in area based on information reported to the CNDDB in 2013; however, the population has been largely destroyed as described under the headings Population Trends and Habitat Modification and Destruction.

Occurrence 2: Springtown. The Springtown population is located within the boundaries of the City of Livermore, south of Raymond Road, west of Ames Street and north of Arabian Road. The western edge of the population is approximately halfway between Lorraine Road and Ames Street. The Springtown population is located on a parcel of land owned by the City of Livermore (Assessor's Parcel Number 902-3-3-1). The extent of the Springtown population was reported to the Department in 2000 via a CNDDB field survey form with the extent of the population hand-drawn onto a 7.5 minute topographic quadrangle map as a rectangle. The former Occurrence 3 was merged with Occurrence 2 in the early 2000s. On September 18, 2015, Department staff re-mapped the northern and western extents of the population based on field observations, however, the population in the soil seed bank may extend beyond the mapped polygon, particularly to the south, and if so, recruitment of Livermore tarplant may occur in these areas under appropriate management or environmental conditions. The Department estimates that the outermost extent of the Springtown population occupies approximately 92 acres; however, the distribution of plants within the area is patchy, and there are large areas that do not support Livermore tarplant. The Springtown population is the largest known population of Livermore tarplant.

Occurrence 2: Northeast Springtown. The Northeast Springtown population is located to the northeast of the turn in the road where Raymond Road and Ames Street meet, and was likely once part of the larger Springtown population. The Northeast Springtown population occurs on two parcels; one small parcel (Assessor's Parcel Number 99B-5300-7) is owned by a public utility and has a utility substation on it; the other parcel is much larger (Assessor's Parcel Number 99B-5300-6-4), and is privately owned. The Northeast Springtown population was reported to the Department in 2000 via a CNDDB field survey form and hand-drawn map, using a portion of a 7.5 minute topographic quadrangle map, and representing a polygon of about 11 acres. Livermore tarplant was reported “just up from where the water level would be during inundation, and continued upslope for approx 20-40 m.” Considering the soils and topography of the area, the Department concludes that the actual population may have occupied less than 11 acres.

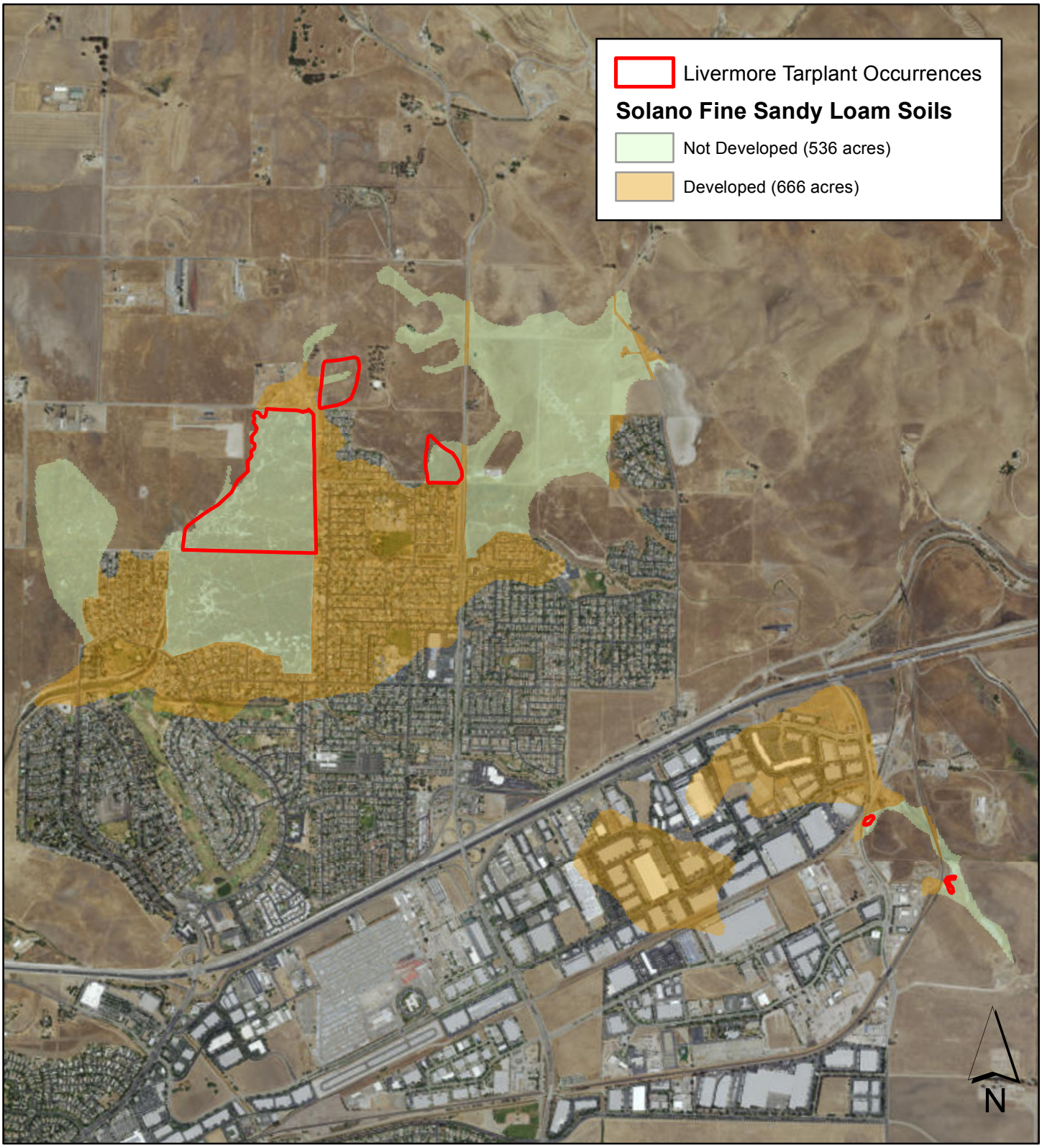
Occurrence 4: East Valley. The East Valley population is located approximately 0.35 mile southeast of the Greenville Road population on the far side of a low prominence (717 feet in elevation). The East Valley population was reported to the Department in 2007 based on observations made in 2002 and 2003. The East Valley population is approximately 0.5 acre in size and located in a swale that leads to the Greenville Road population. The East Valley population is located on private property within unincorporated Alameda County (Assessor's Parcel Number 99B-5600-4-24).

Occurrence 5: Dalton. The Dalton population is located west of Vasco Road and north of Dalton Avenue, and may have once been part of the larger Springtown population before the residential development on the west side of Vasco Road. The extent of the Dalton population was mapped based on the observations of Department staff from Vasco Road and Dalton Avenue in 2014 and 2015. The Dalton population is mapped as approximately nine acres; however, the accuracy of the mapping is low. The Dalton population occurs primarily on a privately owned parcel (Assessor's Parcel Number 99B-5300-5-5) within unincorporated Alameda County and may also occur on a parcel owned by the City of Livermore within the boundaries of the City (Assessor's Parcel Number 99B-8119-18). The Dalton population is separated from Occurrence 2 (the Springtown and Northeast Springtown populations) by roads and a residential subdivision.

The eastern portion of the Livermore Valley has been frequently visited by botanists and scientific plant collectors, including botanists specializing in tarplant species. Despite the past attention of scientific plant collectors there are few herbarium records for Livermore tarplant, which may reflect the rarity of the species (Baldwin 1999a). Additional undocumented populations of Livermore tarplant may exist, particularly if they occur on private property that has not been surveyed. As described below under the heading, Habitat that May be Essential to the Continued Existence of the Species, and subheading, Geology and Soils, the mapped soil that is most closely associated with Livermore tarplant populations is Solano fine sandy loam. It is therefore reasonable to infer that any undiscovered Livermore tarplant populations would also be associated with Solano fine sandy loam. Figure 3 highlights the areas of the Livermore Valley that are mapped as having Solano fine sandy loam (Soil Survey Staff 2015b). There is one other area in California, not shown in Figure 3, that is mapped as Solano fine sandy loam and it is located approximately nine miles northeast of the known Livermore tarplant populations. Although Department staff and others have surveyed properties owned by the City of Livermore, the Department does not know whether or not other areas of Solano fine sandy loam have been surveyed.

Life History

Livermore tarplant is a tap-rooted summer-flowering annual plant, which means that it completes its life cycle within one year or growing season and goes through much of its growth cycle during the driest part of the year, after many other annual plants have died (Reever Morghan et al. 2007). Like other tarplants, light and temperature may play an important role in seed germination, and seeds may germinate with the onset of the first fall/winter rains (Gregory et al. 2001). After germination, tap-rooted summer-flowering annual plants typically put most of their energy into growing a tap root that reaches relatively deep into soil to extract persistent moisture that is unavailable to other plants. Summer-flowering plants are also able to escape the higher temperatures that occur at the soil surface due to their height (Morse 1988).



Species Occurrence Data Source: California Natural Diversity Database (October 2015)
Soils Data Source: Natural Resource Conservation Service

0 0.25 0.5 1
Miles

Figure 3
Solano Fine Sandy Loam and Livermore Tarplant Mapped within the Livermore Valley

Livermore tarplant blooms between June and October (Baldwin 1999a, 2012; CNPS 2015). Department staff have observed unidentified beetles (Figure 4, Photo 1) and bees visiting Livermore tarplant flower heads. Though some members of the sunflower family are wind pollinated, species of the sunflower family with showy corollas and sticky, highly sculptured pollen, such as the bristly pollen grains of Livermore tarplant, are animal pollinated and generally receive many different visitors, typically insects that may act as pollinators (Willmer 2011). Livermore tarplant is sporophytic self-incompatible, meaning that it does not effectively self-pollinate (Baldwin and Strother 2006). Livermore tarplant seed production occurs during summer and fall months (Bartosh 2014). The Department does not have any information about how the seed of Livermore tarplant is dispersed. Because the seed-producing ray flowers of Livermore tarplant do not have a pappus, it is unlikely that wind is the primary dispersal mechanism. Birds or other animals, gravity, water flow or other mechanisms may disperse Livermore tarplant seeds. Like several other species of tarplant, seeds of Livermore tarplant likely experience dormancy, which would promote the presence of a soil seed bank and allow the species to persist during years where climatic conditions are unfavorable to growth or reproduction (Gregory et al. 2001, Bainbridge pers comm. 2016).

Similar-looking Plants

Livermore tarplant blooms in summer and early fall, after many other plant species have dried up. Several tap-rooted summer-flowering annual plants of the sunflower family with yellow flower heads may be observed in the same or similar habitats at the same time of year that Livermore tarplant blooms. Such plants include narrow tarplant (*Holocarpha virgata* ssp. *virgata*), three-ray tarplant (*Deinandra lobbii*) and common spikeweed (*Centromadia pungens* ssp. *pungens*). Narrow tarplant is different from Livermore tarplant in that it has phyllaries (small leaf-like structures below the flowers of the flower head) that are pit-gland tipped and look knobby, and flower heads with dark anthers. In contrast, the phyllaries of Livermore tarplant are smooth and not knobby in appearance from a distance, and the flower heads are uniformly yellow, without dark anthers (Figure 4, Photo 2). Three-ray tarplant is easily distinguished from Livermore tarplant because it has three, or occasionally four, ray flowers and the plant has thinner, more delicate-looking stems, whereas Livermore tarplant typically has eight ray flowers and thicker stems. Common spikeweed is easily distinguished from Livermore tarplant because the plant has sharp spines that are painful if the plant is handled, whereas Livermore tarplant does not have spines. The ranges of narrow tarplant, three-ray tarplant, and common spikeweed are broader than the range of Livermore tarplant.

Habitat that may be Essential to the Continued Existence of the Species

Livermore tarplant grows in poorly-drained, seasonally-dry alkaline meadows in the vicinity of barren alkali scalds, alkali vernal pools and playa-like pools, and is associated with Solano fine sandy loam soil (Baldwin 1999a, CNDDB 2015, Soil Survey Staff 2015b).

Vegetation Communities

Livermore tarplant is commonly observed growing with the non-native grasses ripgut brome (*Bromus diandrus*) and soft chess (*Bromus hordeaceus*), along with salt grass (*Distichlis spicata*), and the native herbs alkali heath (*Frankenia salina*) and narrow tarplant (Bartosh 2010). Other plant species associated with Livermore tarplant include iodine bush (*Allenrolfea occidentalis*), brittlescale (*Atriplex depressa*), common spikeweed, salt dodder (*Cuscuta salina*), three-ray tarplant, annual hair grass (*Deschampsia danthonioides*), brome fescue (*Festuca bromoides*), small fescue (*Festuca microstachys*), rattail sixweeks grass (*Festuca myuros*),

Photo 1: Unidentified beetle visiting *Deinandra bacigalupii* flower head (possibly genus *Epicauta* of Meloidae)

Photo 2: *Holocarpha virgata* ssp.*virgata* (above) and *Deinandra bacigalupii* (below)

alkali barley (*Hordeum depressum*), Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*), toad rush (*Juncus bufonius* var. *bufonius*), goldfields (*Lasthenia californica*), narrowflower flaxflower (*Leptosiphon liniflorus*), sickle grass (*Parapholis incurva*), sticky sand-spurrey (*Spergularia macrotheca* var. *longistyla*) and small-head clover (*Trifolium microcephalum*) (Baldwin 1999a, Department observation).

Vegetation communities of the Upper Arroyo Las Positas Watershed were classified by Susan Bainbridge (Bainbridge 2010) based on field data following the National Vegetation Classification Standard (FGDC 2008) (NVCS) and A Manual of California Vegetation (Sawyer and Keeler-Wolf 1995). Aerial Information Systems (AIS) then mapped the watershed in 2008 for the University of California, Berkeley. Not all vegetation classes could be reliably mapped given the imagery used. Therefore, AIS modified the vegetation classification to create a mapping classification that included NVCS alliances, macrogroups (a higher level of the NVCS hierarchy), and mapping units that are not standard NVCS types. The vegetation at the Springtown population of Livermore tarplant was mapped in detail, while the vegetation at the other Livermore tarplant populations (Northeast Springtown, Dalton, Greenville Road, and East Valley) was mapped at a coarser resolution (AIS 2008). It is important to note that the mapping of vegetation was done in one instance, and fluctuations in weather, soil moisture, and other factors may change the locations where plants, particularly annual plants, are observed in the watershed from year to year.

The Springtown population is the largest known population of Livermore tarplant and is within the area that was mapped in more detail. Several vegetation types were mapped within the boundaries of the Springtown population, but due to the patchy distribution of Livermore tarplant in much of the mapped polygon, not all vegetation mapped within it is associated with Livermore tarplant (Bainbridge pers. comm. 2015). Livermore tarplant can occur in the mapping units listed below and described in greater detail in Appendix 4 of the 2010 Bainbridge report:

- Mediterranean California Naturalized Annual & Perennial Grassland & Meadow Macro Group,
- *Distichlis spicata*,
- *Bromus diandrus* – *B. hordaeceous* – Clover mix, and
- *Hordeum* spp. – *B. hordaeceous* mix.

Livermore tarplant can occur along the edges of the following vegetation mapping units:

- *Downingia pulchella*,
- Alkali Scalds,
- Western North American Vernal Pools & Other Seasonally Flooded Macro Group,
- *Juncus balticus* – *Eleocharis* spp.,
- *Lasthenia fremontii*,
- *Frankenia salina,*
- Western North American Interior Alkali-Saline Wetland, and
- Water

The Greenville Road and Northeast Springtown populations were mapped as Mediterranean California Naturalized Grassland and Meadow. The Dalton population was also mapped predominately as Mediterranean California Naturalized Grassland and Meadow, with small areas of *Lasthenia fremontii* and *Distichlis spicata* vegetation mapped nearby. The East Valley population was mapped as Mediterranean California Naturalized Grassland and Meadow and

Alkali Scalds. Due to coarser resolution of the mapping in these areas, these vegetation types do not provide precise characterization of the habitat that may be essential to the continued existence of the species; however, it is reasonable to extrapolate that Livermore tarplant occurs in microhabitats that are similar to those observed at the Springtown population.

The habitat for Livermore tarplant would likely be classified as Alkali Meadow (Element Code 45310) under Robert Holland's Preliminary Descriptions of the Terrestrial Natural Communities of California (1986). Alkali Meadow is described as having relatively few plant species, dense to fairly open growth of perennial grasses and sedges that are usually low growing, a growing and flowering season from late spring to early fall, and fine-textured, more or less permanently moist alkaline soils (Holland 1986). The Holland classification system was used by the Department in the past to classify natural communities within California, but has been superseded by A Manual of California of Vegetation Second Edition (Sawyer et al. 2009). However, Alkali Meadow is considered a rare plant community, and the CNDDB continues to maintain records of the community occurrences.

Alkali Meadow has a natural heritage global rarity rank of G3 (Vulnerable) and a state rarity rank of S2.1 (Imperiled and very threatened) in the CNDDB. A rank of G3 means that an element is at moderate risk of global extinction or elimination due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors (CNDDB 2015). A state rank of 2 means that an element is imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state, and the ".1" signifies that the element is "very threatened" (CNDDB 2015). Livermore tarplant is therefore restricted to an imperiled habitat.

Geology and Soils

Livermore tarplant populations occur in the Livermore Valley, which dates from the Neogene geologic period between 23 million and 2.6 million years ago (Alexander 2009). To the northeast of the Springtown Alkali Sink are the Altamont uplands, comprised of marine shale and sandstone. Groundwater and springs from these sedimentary rocks are high in soluble salts and are probably the source of salts that have accumulated in the alkali sink (Coats et al. 1988, Nomad Ecology 2008). Although the sediments are still accumulating in the Livermore Valley, the major soils of the Springtown area have horizons that likely took tens of thousands of years to develop (Alexander 2009). The Springtown population of Livermore tarplant occurs on an alluvial plain.

As discussed above, the soil mapped by Natural Resources Conservation Service that is most closely associated with the known Livermore tarplant populations is Solano fine sandy loam (Figure 3, Appendix A, Soil Survey Staff 2015b). The soil maps used to make this determination were made at a scale of 1:20,000 and therefore do not show small areas of contrasting soils.

Solano soils occur on nearly level low terraces and in valley plains with a slightly irregular or hummocky surface, and were formed in mixed, moderately fine textured, sedimentary alluvium. Solano soils are classified within the Typic Natrixeralfs subgroup of soils. Solano soils have a thermic soil temperature regime class, with a difference in soil temperature of greater than 6°C (11°F) between summer and winter and a mean annual soil temperature of approximately 15°C (60°F) to 18°C (65°F) (Soil Survey Staff 2014, 2015a). Solano soils also have a superactive cation-exchange activity class, which means that they have a relatively high ratio of cation-exchange capacity (in a standard solution) to percent clay by weight (Soil Survey Staff 2014).

Solano soil is usually dry between the depths of about 4 and 12 inches by May and usually remains dry until October, with some or all of this profile moist for the rest of the year (Soil Survey Staff 2015a). Solano soils are described as typically having light brownish gray and light gray, strongly acid to very strongly acid, loam A2 (topsoil) horizons, and brown and light yellowish brown, neutral to strongly alkaline clay loam Bt (subsoil) horizons (Soil Survey Staff 2015a). Solano soils are somewhat poorly drained with slow or very slow runoff and very slow permeability (Soil Survey Staff 2015a).

Gaviota rocky sandy loam, Pescadero clay, and San Ysidro loam are also mapped within the vicinity of Livermore tarplant populations, or within poorly mapped areas of Livermore tarplant populations; however, it is not clear whether or not Livermore tarplant grows on these soil series. The Gaviota soil series occurs on hills and mountains and consists of shallow to very shallow well drained soils that formed in material weathered from hard sandstone or meta-sandstone (Soil Survey Staff 2015a), and it is unlikely that Gaviota soil supports significant populations of Livermore tarplant. The Pescadero soil series occurs in basins and consists of very deep, poorly drained soils that formed in alluvium from sedimentary rocks. San Ysidro series soils occur on old, low terraces and consist of deep, moderately well drained soils that formed in alluvium from sedimentary rocks.

Underground mammal burrows are common at the Springtown population (Department staff observation). Because Livermore tarplant seeds fall later in the year than seeds from many other plant species, Livermore tarplant may be able to colonize excavated soil that is unavailable to other plants (Hobbs and Mooney 1985). Mammal burrows may therefore be important features of Livermore tarplant habitat.

A detailed report on the soils of Springtown Alkali Sink is provided as Appendix 3 of a 2010 report on Baseline Mapping, Habitat Mapping, and Modeling for Palmate-Bracted Bird's-Beak at Springtown Alkali Sink (Bainbridge 2010).

Hydrology

The hydrologic system at Livermore tarplant populations starts with the Altamont and Tassajara uplands, where rainfall generates surface runoff or shallow subsurface flow that moves rapidly to well-defined channels (Coats et al. 1988). These channels deliver runoff to the bases of hills where much of the surface runoff infiltrates into the soils and the stream channels become less well defined. During intense or prolonged storms surface runoff may reach the Springtown Alkali Sink; however, the relative importance of surface versus subsurface flow at the site is unknown (Coats et al. 1988). There are two aquifers beneath the Springtown Alkali Sink: there is a shallow aquifer at a depth of 5 to 10 feet (1.5 to 3 meters), and a deeper groundwater body at a depth of over 100 feet (30 meters) (DWR 1974). The shallow aquifer and characteristics of Natrixeralfs soils (Pescadero and Solano soils) may allow moisture and dissolved salts to migrate to the soil surface through capillary action, allowing salts to accumulate on the surface.

Alkali scalds, and other habitat features at the Springtown population such as alkali vernal pools and playa-like pools are evident from aerial photography. The pattern and timing of water flow through the Springtown Alkali Sink and other areas of Livermore has been significantly altered by human activity, particularly through installation of storm drainage systems and realignment and deepening of Altamont Creek.

Climate

Livermore tarplant populations occur in an area with a Mediterranean climate, which consists of cool, wet winters and warm, dry summers. Using PRISM weather data from 1895 to 2014 in the vicinity of the Springtown population, the average minimum temperature is 8°C (46°F), the average maximum temperature is 23°C (73°F), the average temperature is 15 °C (59°F), and the average precipitation is 14 inches (35.6 centimeters) per year (PRISM 2015).

POPULATION TRENDS

Little is known about the population trends of Livermore tarplant. Livermore tarplant populations have either not been monitored regularly or have not been monitored at all, and to date, only one statistical population estimate has been made at one population, for one year. Most observations of population size have been rough, visual estimates that are not typically useful for year-to-year comparisons or documenting trends. The visual population estimates that have been made are documented in the Department's CNDDB (2015).

The Department recognizes that annual plant populations can have high annual variability depending upon environmental conditions and are thus very difficult to monitor directly to detect population trends. Annual plant numbers can fluctuate wildly from year-to-year, depending on the seed production in previous years, germination of seedlings and environmental conditions (e.g., timing and amount of rainfall) (Fischer and Matthies 1998; Harrison et al. 1999). Aerial extent of populations is sometimes used as a rough indicator of population size; however, it is often more effective to focus on a habitat factor or significant threat when trying to monitor or understand trends (Elzinga et al. 1998).

Information regarding the population trends of Livermore tarplant is presented below.

Occurrence 1: Greenville Road. Livermore tarplant was collected from the Greenville Road population by Robert E. Preston and Bruce Baldwin between 1996 and 1999. In 2009, Heath Bartosh visually estimated the Greenville Road population to have approximately 1,600 Livermore tarplant individuals. Department staff visited the Greenville Road population on September 19, 2014, and observed that it was completely or almost completely buried by piles of dirt or trampled by heavy equipment, and no Livermore tarplants were observed (Figure 5, Photos 3 and 4). Department staff visited the Greenville Road population again on September 8, 2015, and observed two Livermore tarplant individuals, one on the outside of a fence surrounding the site (Figure 5, Photo 5) and one growing inside the fence on the side of a pile of recently-moved dirt. Through evaluation of aerial photographs and direct observation of the site, the Department infers that a severe decline in the Livermore tarplant population has taken place at Greenville Road, although dormant Livermore tarplant seeds may remain in the soil. Figure 6 shows the progression of habitat destruction that has taken place at the Greenville Road population from road construction, earthmoving, and soil storage activities. Without restoration, the Greenville Road population may become extirpated in the near future.

Occurrence 2: Springtown. The Springtown population was observed in 1966, 1969, 1976, and 1999, as documented by voucher specimens collected in those years. The Springtown population was also observed in 2000, and a field survey form submitted to the CNDDB reported that plants were more dense in the northeastern portion of the population, and became less dense in the southwestern portion of the population. The number of plants at the Springtown population was sampled in 2009, and was estimated to consist of between 237,690

Photo 3. Occurrence 1: Greenville Road on September 24, 2014, view direction North-northeast

Photo 4. Occurrence 1: Greenville Road on September 24, 2014, view direction South-southeast

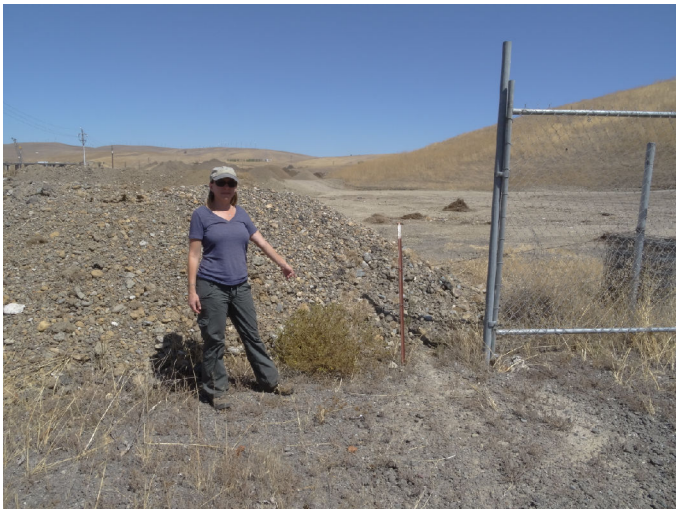


Photo 5: *Deinandra bacigalupii* at Occurrence 1: Greenville Road on September 8, 2015, view direction North-northeast

Photo 6: *Deinandra bacigalupii* at Occurrence 2: Springtown on September 8, 2015

Figure 5
Photos at Occurrence 1: Greenville Road and Occurrence 2: Springtown

Data Sources: California Natural Diversity Database (October 2015), Google Earth, Digital Globe.

Livermore Tarplant Occurrence

0 50 100 Feet

California Department of Fish and Wildlife

Figure 6
Aerial Photos Showing Habitat Destruction at Livermore Tarplant Occurrence 1: Greenville Road

and 365,552 individuals, with a 95 percent confidence interval (Bartosh 2010). The Springtown population has not been estimated via sampling again, therefore a population trend cannot be documented. The Springtown population was also observed in 2010 (CNDDB 2015). Department staff visited the Springtown population in 2014 and 2015, and although no quantitative data were collected, Livermore tarplant was observed to be present in both years, and appeared more abundant in 2015 than in 2014 (Figure 5, Photo 6). Although population data have not been collected in a systematic way, the Springtown population has been regularly observed over a span of almost 50 years.

Occurrence 2: Northeast Springtown. A population estimate of greater than 100 individuals was reported to the CNDDB for the Northeast Springtown population in 2000, and a voucher collection from the population was made. Heath Bartosh reported in the Petition that the Northeast Springtown population is no longer considered extant. Mr. Bartosh later clarified that this determination was made because Mr. Bartosh has not observed Livermore tarplant at the location and the population is grazed by horses (H. Bartosh pers. comm. 2014). Department staff was unable to see any Livermore tarplant individuals at the Northeast Springtown population in 2015; however, buildings, fences, and the topography of the property obscured the view, and a survey of the property was not conducted. The Northeast Springtown population of Livermore tarplant population may now be extirpated; however, dormant Livermore tarplant seeds may remain in the soil, and additional surveys should be conducted to confirm whether or not the population remains.

Occurrence 4: East Valley. The East Valley population was reported to have “many plants” in 2002, and a voucher specimen was collected from this population (CNPS 2005). The population was observed by CNPS again in 2003. CDFW could not view the East Valley population because it is on private property and far from the road. The status of the East Valley population has not been reported since 2003, and its current status is unknown; however, imagery from 2014 shows that the habitat remains intact (Google Earth 2016).

Occurrence 5: Dalton. The Dalton population was observed in 2004, and again in 2009 when Mr. Bartosh visually estimated the population to consist of roughly 500 individuals (Bartosh 2014, CNDDB 2015). Department staff observed Livermore tarplant at the Dalton population from adjacent roads in 2014 and 2015, but did not visually estimate the size of the population.

Scientific information on Livermore tarplant’s population trends is limited, and while there is no scientifically-measured or statistical information available regarding the general population trends of Livermore tarplant, the Department nonetheless concludes that there is sufficient information to reasonably infer that the Greenville Road and Northeast Springtown populations of Livermore tarplant have declined substantially and have possibly been extirpated, respectively.

FACTORS AFFECTING THE ABILITY TO SURVIVE AND REPRODUCE

Habitat Modification and Destruction

All populations of Livermore tarplant are threatened either directly or indirectly by development, changes in land use, or other habitat modification or destruction. Development or changes in land use could directly destroy plants or destroy both occupied and potential habitat. Indirect threats to Livermore tarplant may occur from development or changes in land use near Livermore tarplant populations. Development or land use changes may alter the hydrologic

regime, change water quality, alter soil chemistry, introduce non-native species, create conditions that are favorable for the spread of non-native species, increase the number of human visitors, cause soil disturbance and compaction, and increase garbage and pollution.

Past modification and destruction of habitat may also be a factor affecting the ability of Livermore tarplant to survive and reproduce. Habitat destruction that has already taken place may lead to an "extinction debt," where species that appear abundant disappear over time (Tilman et al. 1994, Kuussaari et al. 2009). Extinction processes often occur with a time delay and populations living close to their extinction threshold might survive for long time periods before they go extinct (Hanski & Ovaskainen 2002, Lindborg & Eriksson 2004, Helm et al. 2006, Vellend et al. 2006). Habitat specialist species may be more sensitive to changes in habitat and thus more prone to local extinction than generalist species (Helm et al. 2006, Krauss et al. 2010, Cousins and Vanhoenacker 2011, Guardiola et al. 2013).

Past Modification and Destruction of Habitat

Livermore tarplant was likely present to a greater extent prior to development of the Livermore Valley. Barren areas, alkali scalds and vernal pools are all associated with Livermore tarplant. These landscape features are visible in historic aerial images of the Upper Arroyo Las Positas Watershed, in areas that are now developed or under more intensive land use (Bainbridge 2010, Historic Aerials 2015). Some of these landscape features occurred on Solano fine sandy loam soil, which is the soil series most closely associated with Livermore tarplant. The Department estimates that approximately 55 percent of the Solano fine sandy loam soil in the Livermore Valley has been developed (Figure 3). Livermore tarplant may have occurred within or near to some of these areas, and if so Livermore tarplant habitat was destroyed by the development of Livermore Valley.

Furthermore, all known populations of Livermore tarplant occur adjacent to or in the immediate vicinity of residential, industrial, or other intensive land use. Considering the extent of Solano fine sandy loam soil in the vicinity of known Livermore tarplant populations and historic aerial imagery, the existing Livermore tarplant populations may have once extended into areas that are now developed, such as the Proud Country subdivision developed in the late 1960s, the Greenville North subdivision developed in the 1960s and 1970s, the Saddleback subdivision developed in the late 1990s, and the industrial area to the west of Greenville Road developed beginning in the 1980s, with impacts continuing into 2015. Since 1962, the Springtown area has been disked, used as a landfill, used for placement of fill, and its main tributary (Altamont Creek) has been realigned and widened for flood control purposes (Bartosh et al. 2010).

The pattern and timing of water flow through the Springtown and larger Livermore area has also been significantly altered by human activity, particularly through installation of hardscape and storm drainage systems related to development. Because extinction processes often occur with a time delay, these past changes may affect the ability of Livermore tarplant to survive and reproduce.

Comparisons of current vegetation conditions in the Springtown area with conditions shown in historic aerial imagery also suggest that many areas that were barren or with alkali scalds in 1940 have been replaced with mesic annual grassland dominated by annual grasses or saltgrass (Bainbridge 2010). Such a decline in barren areas is consistent with altered hydrology, including diminishing salt concentrations (Bainbridge 2010).

Recent and Future Modification and Destruction of Habitat

Occurrence 1: Greenville Road. The Greenville Road population has recently been permanently damaged by habitat loss and degradation resulting from soil deposition activities, excavation of the western portion of the property, and the construction of a roadway accompanied by grading and gravelling of natural habitat. These activities occurred intermittently over several years, beginning before 2002, and culminating with severe habitat degradation and loss in 2014.

The Greenville Road population occurs on property with an agricultural ("A") zoning designation and there are no pending projects or anticipated zoning changes for the property (McElligott pers. comm. 2015). According to the Alameda County Planning Department, the current land use at the property is a landscape business with the majority of the parcel vacant. According to the website for the business, the company transforms yard trimmings, wood debris and food waste into compost, mulch, decorative bark, and soil amendment, and in 2013 a new Livermore facility was opened on property already owned by the business (Vision Recycling 2015).

The Alameda County zoning ordinance lists uses and accessory uses allowed in agricultural zones, and also provides a list of conditional uses allowed with a conditional use permit (Table 2). The agricultural conditional uses from Table 2 that most closely match the activities taking place at the Greenville Road population are:

- Composting Facility, and
- Administrative offices accessory to the principal use on the premises including activities by the same occupancy, which are not related to the principal use providing such activities not so related are accessory to the administrative office activity.

The Alameda County Planning Commission issued a conditional use permit for the property with the Greenville Road population as a chip and grind facility in November of 2013. A California Environmental Quality Act initial study and mitigated negative declaration was prepared by BSK Associates for the action; however, environmental impacts to Livermore tarplant were not disclosed or evaluated in the initial study and mitigated negative declaration, and therefore no avoidance, minimization or mitigation measures were implemented for Livermore tarplant (Alameda County Planning Commission 2013, BSK Associates 2013).

Department staff visited the Greenville Road population on September 19, 2014 and observed that the population had been completely encroached upon by soil deposition activities and the habitat was largely destroyed. A large volume of dirt/fill had been deposited directly upon the former known location of the population, and related operation of heavy equipment had compacted and disturbed remaining areas of the Greenville Road population. Aerial imagery shows the habitat of the Greenville Road population to be relatively intact on March 31, 2014; however, the area was heavily disturbed by September 13, 2014 (Figure 6). From the vantage point of Department staff on the shoulder of Greenville Road, there was no evidence of any living Livermore tarplant on the site on September 19, 2014. Department staff visited the Greenville Road population again on September 8, 2015, and observed two Livermore tarplant individuals, one on the outside of a fence surrounding the site (Figure 5, Photo 6), and one growing inside the fence on the side of a pile of dirt. It is likely that the functionality of the habitat at the Greenville Road population is now permanently degraded or destroyed. The soil deposition activities may also cause indirect impacts to the population by facilitating establishment and expansion of non-native plant populations, changing hydrologic conditions, or changing soil chemistry from application of herbicides, fertilizers, or pesticides. It is also unlikely that the few remaining plants at the Greenville Road population will be sufficient to sustain the

Table 2: Land Uses Allowed under the Alameda County Zoning Ordinance in "A" and "R1-L-BE" Zoning Districts	
"A" Agriculture District	"R1-L-BE" Single Family Residential with Limited Agricultural Uses District
Permitted Uses	
• On a building site, one one-family dwelling or one-family mobilehome; • Crop, vine or tree farm, truck garden, plant nursery, greenhouse, apiary, aviary, hatchery,horticulture; • Raising or keeping of poultry, fowl, rabbits, sheep or goats or similar animals; • Grazing, breeding or training of horses or cattle; • Winery or olive oil mill; • Fish hatcheries and rearing ponds; • Public or private riding or hiking trails; • One secondary dwelling unit per building site on parcels twenty-five (25) acres in size or larger that are zoned for not more than one dwelling and have one but no more than one dwelling unit on the parcel • Occupancy of agricultural caretaker dwelling(s) subject to a site development review. • Boarding stables and riding academies subject to site development review. *Accessory Uses:* • Farm buildings, including stable, barn, pen, corral, or coop; • Building or room for packing or handling products raised on the premises; • Killing and dressing of poultry, rabbits and other small livestock raised on the premises, but not including an abattoir for sheep, cattle or hogs; • Stand for the sale at retail of items produced or raised on the premises having a ground coverage not in excess of four hundred (400) square feet; • Accessory business signs not exceeding an aggregate area of twenty (20) square feet; having no moving parts or illumination; • Administrative office, maintenance building, when accessory to a principal use permitted by Section 17.06.040.	• One one-family dwelling; • Field crop, orchard, garden. The following uses in addition to those above on a site of 40,000 square feet minimum size: • Fifty fowl (chicken, duck, goose, turkey) or rabbits, guinea pigs, or other similar small animals); • Two sheep, or two goats or other similar domestic animals or one cow, or one horse, or other similar domestic animal or any combination thereof, for each 20,000 square feet of lot area; • Grazing or pasturing of horses for remuneration.
Conditional Uses (Conditional Use Permit Required):	
• Sanitary landfill not to include processing salvaged material; • Flight strip; • Cemetery; • Composting facility. • Outdoor recreation facility; • Animal hospital, kennel; • Killing and dressing of livestock, except when accessory as specified in Section 17.06.050; • Public or private hunting of wildlife or fishing, and public or private hunting clubs and accessory structures; • Packing house for fruit or vegetables, but not including a cannery, or a plant for food processing or freezing; • Flight strip when accessory or incidental to a permitted or conditional use; • Hog ranch; • Drilling for and removal of oil, gas or other hydrocarbon substances; • Radio and television transmission facilities; • Public utility building or uses, excluding such uses as a business office, storage garage, repair shop or corporation yard; • Administrative offices accessory to the principal use on the premises including activities by the same occupancy which are not related to the principal use providing such activities not so related are accessory to the administrative office activity; • Administrative support and service facilities of a public regional recreation district; • Privately owned wind-electric generators; • Remote testing facility; • Winery or olive oil mill related uses.	• Community facility; • Community clubhouse; • Parking lot, only when established to fulfill the residential parking requirements of this title for a use on an abutting lot or lots; • Plant nursery or greenhouse used only for the cultivation and wholesale of plant materials; • Medical or residential care facility for seven or more persons per unit; • Licensed transitional or supportive housing for seven or more persons per unit; • Mobilehome parks subject to the provisions provided in sections 17.52.1000 to 17.52.1065. *The following uses if approved by the board of zoning adjustments:* • The keeping of a number of animals in excess of that permitted by Section 17.26.030; • Kennel; • Boarding stables and riding academies; • Sale of any products of any permitted use, including a stand for the sale at retail of such items as regulated in Section 17.06.050D.

population without a significant and immediate restoration effort and habitat protection. The Greenville Road population, therefore, has a high likelihood of becoming extirpated from recent habitat modification and destruction.

Occurrence 2: Springtown. The Springtown population is mapped on one parcel (Assessor's Parcel Number 902-3-3-1) owned by and within the boundaries of the City of Livermore. The Springtown population is zoned as open space-agriculture, a zone designation applied to areas that are appropriate for permanent or semi-permanent open space, which the City of Livermore has determined to meet one or more of the following criteria (Stewart pers. comm. 2015, Livermore Development Code 3.03.180):

- Represents the actual use of the land,
- Establishes the best use of the land,
- Indicates land intended by the City of Livermore not to be converted to urban use in the foreseeable future,
- Indicates land having resources found to be in the public interest to preserve, or
- Indicates land found not suitable for urban use due to natural or other hazards associated with the land.

Properties with an open space-agriculture zoning designation are considered unsuitable for development by the City of Livermore, and are limited to open space uses such as parks, trailways, recreation areas, recreation corridors, and protected areas, such as creeks and arroyos, or similar appropriate open space uses (Stewart pers. comm. 2015). The City of Livermore does not anticipate any zoning designation changes at or near Livermore tarplant populations in the future; however, the City is investigating the feasibility of a mitigation bank on properties owned by the City in the Springtown area (Stewart pers. comm. 2015). A draft prospectus for the mitigation bank is currently under review by an interagency review team (WRA 2015). According to the draft prospectus, the mitigation bank would protect and manage for the exceptional resources of the site while restoring degraded habitats and potentially establishing, re-establishing, rehabilitating, or enhancing wetlands and waters. Establishment of a mitigation bank may provide resources for the management and protection of Livermore tarplant populations. However, Livermore tarplant populations may be directly or indirectly impacted by actions to establish, re-establish, rehabilitate, or enhance wetlands and waters through destruction of habitat, alteration of surface hydrology, introduction of non-native plant species or creation of conditions that are favorable for the spread of non-native plant species.

Although the property on which the Springtown population occurs is currently zoned as open space agriculture, it is not permanently protected by a conservation easement or similar restriction. The Livermore City Council could therefore, change the zoning designation at some time in the future in a way that allows for more intensive use of all or a portion of the property.

Occurrence 2: Northeast Springtown. As previously noted, the Northeast Springtown population was likely once part of the larger Springtown population and may now be extirpated. If the Northeast Springtown population is still present, it may be impacted by future habitat modification and destruction.

The Northeast Springtown population occurs on property with an agricultural ("A") zoning designation and there are no pending projects or anticipated zoning changes for the property (McElligott pers. comm. 2015). According to the County of Alameda, the current land uses at the property are a utility tower and vacant/agriculture. The Alameda County zoning ordinance lists

uses allowed in agricultural zones, and also provides a list of conditional uses allowed with a conditional use permit (Table 2). The agricultural conditional uses from Table 2 that most closely match the activities taking place at the Northeast Springtown population are:

- Grazing, breeding or training of horses or cattle, and
- Public utility building or uses, excluding such uses as a business office, storage garage, repair shop or corporation yard.

Although the utility tower has already been built, maintenance or reconstruction of the tower may impact Livermore tarplant in the future. Agricultural zoning could allow significant changes in land use, possibly without the issuance of a conditional use permit by the County of Alameda, or an environmental review under the California Environmental Quality Act. Significant modification or destruction of habitat may take place in the future to accommodate a change to one of the land use activities identified in Table 2. Agricultural zoning at the Northeast Springtown population could, therefore, allow land use changes that result in the complete destruction of the Northeast Springtown population, if one is extant.

Occurrence 4: East Valley. Aerial imagery shows the habitat at the East Valley population to be intact, although there appears to have been hydrological modification approximately 0.2 mile upstream from the population (Google Earth 2016). The East Valley population is considered extant and may be impacted by future habitat modification and destruction. The property on which the East Valley population occurs is currently within a Planned Development (PD) heavy industrial district. However, with the passage of the Alameda County Save Agriculture and Open Space Lands Initiative (Measure D) in November 2000, the Alameda County General Plan was amended to include limitations on development outside of city urban growth boundaries. This change limited the land use at the East Valley population by changing the Alameda County General Plan land use designation; however, the zoning designation for the property has not yet been changed. The parcel will need to be rezoned to correct this inconsistency prior to or in conjunction with any development project being conducted on the property in the future, but there are no immediate plans to do so (McElligott pers. comm. 2015). According to the Alameda County Planning Department, there are no pending projects for the property with the East Valley population.

If the property on which the East Valley population occurs is rezoned to Agriculture (A), as may be eventually required due to the passage of Measure D, then land uses identified in Table 2 would be permitted. Agricultural zoning could allow for significant changes in land use, possibly without the issuance of a conditional use permit by the County of Alameda or an environmental review under the California Environmental Quality Act. Significant modification or destruction of habitat may take place in the future to accommodate a change to one of the land use activities identified in Table 2. Agricultural zoning at the East Valley population could, therefore, allow land use changes that result in the complete destruction of the East Valley population.

Occurrence 5: Dalton. The Dalton population is considered extant and may be impacted by future habitat modification and destruction. The property on which the Dalton population occurs is within a Single Family Residential with Limited Agricultural Uses (R1-L-BE) district, and there are no pending projects or anticipated zoning changes for the property (McElligott pers. comm. 2015). According to the Alameda County Planning Department, the current land use at the property is vacant/agriculture. The Alameda County zoning ordinance lists uses allowed in R1-L-BE districts, and also provides a list of conditional uses allowed with a conditional use permit (Table 2). There are no structures or other obvious developments on the property. The property

is partially surrounded by a barbed wire fence; however, Department staff observed the fence separating the property from the Vasco Road right-of-way to be damaged in 2015.

Agricultural zoning at the Dalton population could allow significant changes in land use, possibly without the issuance of a conditional use permit by the County of Alameda or an environmental review under the California Environmental Quality Act. Significant modification or destruction of habitat may take place in the future to accommodate a change to one of the permitted uses identified in Table 2. Agricultural zoning at the Dalton population could, therefore, allow land use changes that result in the complete destruction of the Dalton population.

Impacts from Invasive Species (Competition and other Factors)

Invasive species are often cited as the second greatest threat to biodiversity behind habitat loss (Wilcove et al. 1998, Levine et al. 2003, Pimentel et al. 2004) and North America has accumulated the largest number of naturalized plants in the world (van Kleunen et al. 2015). Many studies hypothesize or suggest that competition is the process responsible for observed invasive species impacts to biodiversity; however, invasive species may impact native species in different ways (Levine et al. 2003). Invasive species may threaten native populations through competition for light, water, or nutrients; allelopathic mechanisms; alteration of soil chemistry; thatch accumulation that inhibits seed germination and seedling recruitment; changes in natural fire frequency; disruptions to pollination or seed-dispersal mutualisms; changes in soil microorganisms or other mechanisms. The magnitude of invasive species impacts in Mediterranean habitats, such as those in California, largely depends on the characteristics of the invading species and the habitat being invaded (Fried et al. 2014). The invader's life form and ability to form very dense stands have an effect on the magnitude of impacts, with creeping plant species having greater effect (Gaertner et al. 2009, Fried et al. 2014). Greater invasive species impacts also have been recorded in areas with high soil moisture (Reever Morghan and Rice 2006, Fried et al. 2014). Invasive species may also influence native species colonization rates, and may thus lead to declines in local diversity over longer timescales (Yurkonis and Meiners 2004). Studies have not been conducted on the impact of invasive species on Livermore tarplant specifically; however, the negative impacts of plant invasions on Mediterranean ecosystems have been well demonstrated (Gaertner et al. 2009, Fried et al. 2014).

Mediterranean grasses and other aggressive invaders such as perennial pepperweed (*Lepidium latifolium*) and stinkwort (*Dittrichia graveolens*) occur within or in the vicinity of Livermore tarplant populations. Comparisons of current vegetation conditions in the Springtown area with conditions shown in historic aerial imagery suggest that many areas that were barren or with alkali scalds in 1940 have been replaced with mesic annual grassland, dominated by annual grasses or saltgrass (Bainbridge 2010). Nitrogen deposition from air pollution may increase the suitability of previously nutrient-poor habitats for invasive species, allowing such habitats to become more easily invaded (Weiss 1999).

Livermore tarplant populations are likely to be subject to ongoing and increasing inputs of invasive plant propagules from nearby populations and other sources. All populations of Livermore tarplant occur adjacent to transportation corridors, which provide ongoing sources of invasive plant propagule introductions. The area immediately to the south of the Springtown population is heavily used by pedestrians and bicycle riders, both of which can serve as vectors for invasive species into the area. The area immediately to the south of the Springtown population has also been used as a place to illegally dump garbage, which may provide an additional vector for invasive species introduction. Grazing of the Springtown population may

introduce invasive species via livestock and ranching operations. Habitat disturbances resulting from the close proximity of Livermore tarplant populations to urban development are also likely to provide opportunities for invasive species populations to establish and expand.

Ripgut brome, ryegrass (*Festuca perennis*), and other invasive annual grasses that are present at Livermore tarplant populations may inhibit germination and suppress seedling recruitment of plant species through thatch accumulation and reduced soil disturbance in the areas that have been heavily invaded (Bergelson 1990, Thomson 2005). In areas with established annual grass populations, carefully managed grazing may reduce some of the negative effects of thatch accumulation.

Perennial pepperweed is an erect perennial plant that grows up to six feet tall and is able to grow in many different areas and habitats including wetlands, meadows, vernal pools, and roadsides. Perennial pepperweed occurs most typically on moist or seasonally wet sites, tolerates saline and alkaline conditions, and can rapidly form dense stands that displace desirable vegetation and wildlife (DiTomaso et al. 2013). Perennial pepperweed reproduces from seed and vegetatively from vigorously underground rhizomes or pieces of rootstock. Once established, perennial pepperweed is persistent and difficult to control. The spread of perennial pepperweed in the Springtown Alkali Sink is likely directly related to soil disturbance and changes in hydrology, such as those related to construction of a wetland and flood control berms. Department staff have observed stands of perennial pepperweed on the east and west sides of Ames Street, in the immediate vicinity of Livermore tarplant.

Stinkwort is a fall-flowering annual plant that grows up to three feet tall and is able to grow in roadside habitats, washes, margins of vernal pools and other areas. Stinkwort is rapidly expanding its range; thrives in areas with hot, dry summers; and can grow in serpentine, saline and metal-contaminated soils (DiTomaso et al. 2013). Stinkwort is a prolific seeder, with seeds distributed by wind, water or by sticking to fur or clothing, allowing populations of the plant to spread easily. Herbarium records show that stinkwork has been observed and collected at the Greenville Road population (CCH 2015). Stinkwort is also considered to be a managed and spreading invasive species within the two 7.5-minute topographic quadrangles that Livermore tarplant occurs (Cal-IPC 2016). The impacts of stinkwort to natural habitats are not known, but it may pose an emerging threat.

The distribution of perennial pepperweed and stinkwort in the Springtown Alkali Sink may be facilitated by soil disturbance, which creates a focal population from which the plants spread into less disturbed areas, such as alkali meadow (Bainbridge pers. comm. 2016, Appendix C).

Invasive species may threaten Livermore tarplant populations through competition for light, water or nutrients; allelopathic mechanisms; alteration of soil chemistry; thatch accumulation that inhibits seed germination and seedling recruitment; disruptions to pollination or seed-dispersal mutualisms; or changes in soil microorganisms.

Recreation Activities

Recreation activities threaten the Springtown population, and may threaten other Livermore tarplant populations. Off-road vehicle use, bicycle riding, construction of bicycle ramps and tracks, and pedestrian foot traffic have all been observed at the Springtown population, and may be the reason that Livermore tarplant is infrequently observed in the heavily-used areas of the population. Recreation activities may displace Livermore tarplant through direct trampling of plants, disturbance and compaction of soil, and introduction of invasive species.

Most of the property where the Springtown population occurs is fenced with barbed wire, which has limited the amount of trespassing that occurs in the fenced area (East Pasture in Figure 7). There is an old county road to the south of the fenced area of the Springtown population and north of a privately-owned unfenced property. This road provides pedestrian and bicycle access to the area via the surrounding neighborhoods. The unfenced, publicly-accessible area is heavily used by pedestrians and bicycle riders. Many trails have developed and the landscape has been modified for use as bicycle or off-road vehicle ramps and tracks. The impacts of these use trails can be clearly seen in aerial imagery of the area (Figure 7). In 2015, no Livermore tarplant was observed in the unfenced, heavily-used area south of the fenceline, although plants were observed north of the fence. This observation could be a result of a natural gradient in the Livermore tarplant population density, combined with heavy use of the unfenced area.

The Department is not aware of any impacts from recreation activities at the other Livermore tarplant populations, but recreation impacts may impact these other populations in the future. The Dalton population may be at particular risk of impacts from recreation activities in the future, due to its proximity to residential neighborhoods.

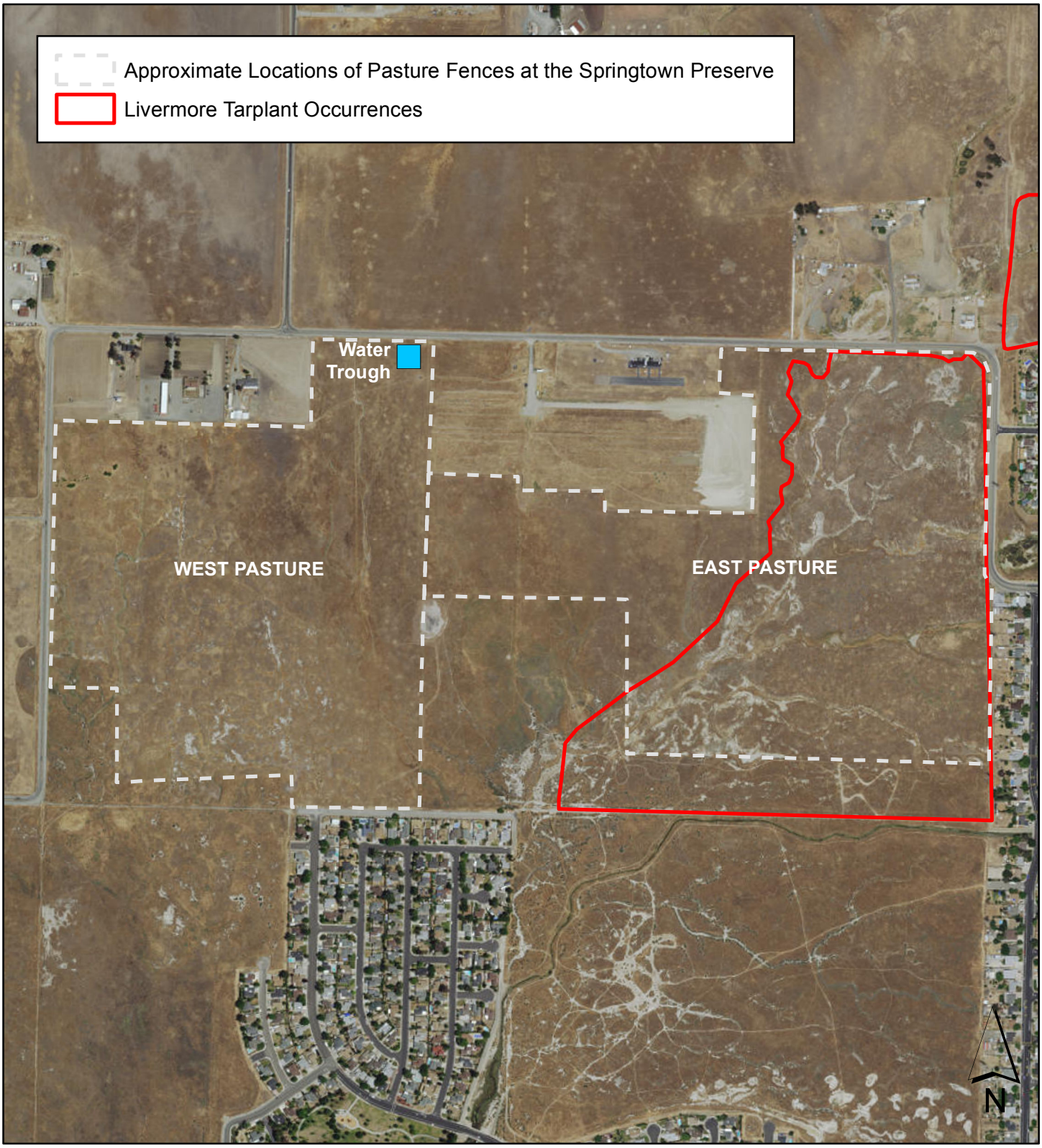
Grazing

Since Spanish settlement in California in 1769, the introduction of livestock and alien plants has had profound consequences for native biodiversity. Impacts from livestock have contributed to the degradation of many habitats, particularly in California's Central Valley (Mack 1989). Although poorly managed grazing can significantly damage native habitats, carefully managed grazing can be a useful tool for the management of habitat to support native species by reducing some negative effects from non-native plants (Weiss 1999, Marty 2005).

Livestock may avoid direct consumption of tarplants; therefore, tarplants have been considered undesirable components of rangelands by rangeland managers in the past, and have been the target of control or elimination efforts (Perrier et al. 1981). Although consumption of Livermore tarplant by livestock may not be a significant threat, livestock presence in Livermore tarplant habitat may nevertheless result in negative impacts from plant trampling, disturbance of soil, the spread of invasive species, or the creation of conditions that are favorable for the establishment of invasive species. Grazing may support the continued existence of Livermore tarplant in areas with a history of heavy disturbance and established invasive plant populations by reducing negative impacts from competition or thatch accumulation; however, only invasive species that are palatable to cattle or other livestock are likely to be controlled by grazing, and non-palatable plants may increase.

The Greenville Road population is not grazed, the Springtown population appears to be grazed intermittently, the Dalton population has been grazed in the past, possibly by goats, and the Department does not have any information on whether or not, or to what extent the Northeast Springtown and East Valley populations are grazed.

The Springtown population occurs within the pasture labeled "East Pasture," shown in Figure 7. The City of Livermore currently has grazing leases to manage properties owned by the City for biological resources, fuel reduction and to maintain fences. The City of Livermore's Springtown Preserve has been grazed by the same operator for approximately 20 to 30 years, but the grazing lease expired in 2015, so there may be a new grazing operator in 2016 (Stewart pers. comm. 2015). Mr. Stewart speculated that there were 10-20 animals on the Springtown Preserve in 2015; however, the City of Livermore did not have any additional information on



Species Occurrence Data Source: California Natural Diversity Database (October 2015)
Background image source: ESRI

0 250 500 1,000 1,500 2,000
Feet

Figure 7
Fences and Evidence of Recreation Activity Impacts at Occurrence 2: Springtown

grazing of the property. During site visits in 2014 and 2015, Department staff observed evidence of grazing on the East Pasture that likely took place prior to 2014. Department staff observed evidence of recent grazing in the pasture labeled “West Pasture,” shown in Figure 7, and a water trough is visible in aerial photography of the West Pasture to the northwest of a decommissioned landfill. Grazing operations in 2014 and 2015 may have been limited to the West Pasture, and therefore the Springtown population may not have been grazed recently.

The Department does not have any information on how grazing affects Livermore tarplant, specifically; however, the Department recognizes that excessive grazing has the potential to degrade Livermore tarplant habitat through plant trampling, disturbance of soil, the spread of invasive species, and the creation of conditions that are favorable for the establishment of invasive species. Any grazing of Livermore tarplant habitat should, therefore, be monitored closely under an adaptive management program. Monitoring for such an adaptive management program should focus on Livermore tarplant or an appropriate habitat indicator such as residual dry matter, and the program should ensure that monitoring results trigger appropriate management responses such as changing the timing or intensity of grazing or implementing other measures. The data and reports from any monitoring and adaptive management programs should also be made available to resource agencies and the public.

Grazing could become a threat to the continued existence of Livermore tarplant in the future, if not managed carefully, and is therefore considered to be a potential threat to the species. In areas where Livermore tarplant habitat is not grazed and excessive thatch has accumulated, the lack of grazing may also be a potential threat to the species.

Climate Change

Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia (IPCC 2014). Climate change is a major challenge to the conservation of California’s natural resources, and it will amplify existing risks and create new risks to natural systems.

Department staff conducted an assessment of the vulnerability of Livermore tarplant to climate change using the NatureServe Climate Change Vulnerability Index Version 3.0. However, some ecological and life history information used for the climate change vulnerability assessment is not yet known for Livermore tarplant. In particular, the Department does not know the species or other mechanisms required for effective pollination of Livermore tarplant, the mechanisms used by Livermore tarplant for seed dispersal, or Livermore tarplant’s seed dispersal distance. Furthermore, the Department does not know whether or to what extent competing plant species will be favored by projected future climates. If more information becomes available, the Department’s assessment may change.

Based upon the Department’s assessment, Livermore tarplant likely has a climate change vulnerability index value of Less Vulnerable (LV), indicating that available evidence does not suggest that abundance or range extent within the geographical area of the species will change (increase/decrease) substantially by the year 2050, though actual range boundaries may change.

If the Department learns that the seed dispersal mechanisms for Livermore tarplant are limited, that there are a limited number of effective pollinator species for Livermore tarplant, or that competing plant species that are favored by climate change will strongly affect Livermore tarplant, then the vulnerability index value may change to Moderately Vulnerable (MV),

indicating that abundance or range extent within the geographical area assessed is likely to decrease by the year 2050. If the Department learns that the seed dispersal mechanisms for Livermore tarplant are not limited, that there are many effective pollinator species for Livermore tarplant, and that competing plant species will not be strongly favored by climate change, then the vulnerability index value will likely remain Less Vulnerable.

Vulnerability of Small Populations

Livermore tarplant has a narrow distribution and few populations, with three of the four known populations occupying relatively small areas. The Department recognizes that species with small numbers of populations and small population sizes are highly vulnerable to extinction due to stochastic (chance) demographic, environmental and genetic events (Shaffer 1981, 1987; Primack 2006; Groom et al. 2006). Chance events, such as a spill or accident associated with a road or railroad track could result in the loss of all or a significant part of a Livermore tarplant population.

Species with small numbers of populations or small populations may also be subject to increased genetic drift and inbreeding (Menges 1991, Ellstrand and Elam 1993). Livermore tarplant does not self-pollenate, and is therefore more vulnerable to extinction from small population sizes because plants cannot pollenate themselves to produce seeds in the absence of other plants (Baldwin and Strother 2006, Bainbridge pers. comm. 2016). A persistent soil seed bank, if one exists, would buffer the Livermore tarplant population from vulnerability to loss of diversity and genetic drift. However, any activities that allow the depletion of the soil seed bank will threaten the long-term persistence of Livermore tarplant.

Due to the vulnerability and rarity of Livermore tarplant, the loss of all or a significant portion of any Livermore tarplant population would represent the loss of a significant portion of Livermore tarplant's total range.

Herbicide Use and Right-of-way Maintenance

All known populations of Livermore tarplant occur adjacent to transportation corridors. Transportation corridors are subject to right-of-way maintenance activities and often subject to discing or herbicide treatments.

Department staff observed Livermore tarplant growing immediately beneath the barbed-wire fence that delineates the Dalton population from the Dalton Avenue right-of-way. The right-of-way, and some areas of the private property adjacent to the right-of-way, were observed to only have dead vegetation, clearly a result of herbicide application. Several dead Livermore tarplants were found in these areas that appeared to have been killed by the herbicide treatment. Herbicide treatments may also directly impact other Livermore tarplant populations, particularly in areas adjacent to transportation corridors.

Furthermore, because the above ground portion of Livermore tarplant's life cycle can occupy a majority of the year, it is difficult to avoid impacts to Livermore tarplant from herbicide treatments for co-occurring non-native plant species. Herbicide use and right-of-way maintenance is considered to be a threat to Livermore tarplant.

Disease and Parasites

The Department does not have any information on diseases or parasites affecting Livermore tarplant.

Predation

The Department does not have any information on predation affecting Livermore tarplant that is not related to grazing.

Overexploitation

The Department does not have any information on overexploitation affecting Livermore tarplant.

REGULATORY AND LISTING STATUS

Federal

Livermore tarplant is not protected pursuant to the federal Endangered Species Act.

State

On April 24, 2015, the Commission published its Notice of Findings for Livermore tarplant in the California Regulatory Notice Register, designating Livermore tarplant a candidate species pursuant to CESA. The provisions of CESA apply to Livermore tarplant while it is a candidate species (Fish & G. Code, § 2085). CESA prohibits the import, export, take, possession, purchase or sale of Livermore tarplant, or any part or product of Livermore tarplant, except in limited circumstances, such as through a permit or agreement issued by the Department under the authority of the Fish and Game Code. For example, the Department may issue permits that allow the incidental take of listed and candidate species if the take is minimized and fully mitigated, the activity will not jeopardize the continued existence of the species, and other conditions are met (Fish & G. Code § 2081(b)). The Department may also authorize the take and possession of Livermore tarplant for scientific, educational, or management purposes (Fish & G. Code § 2081(a)).

Natural Heritage Program Ranking

All natural heritage programs, such as the CNDDB, use the same ranking methodology originally developed by The Nature Conservancy and now maintained by NatureServe. This ranking methodology consists of a global rank describing the rank for a given taxon over its entire distribution, and a state rank describing the rank for the taxon over its state distribution. Both global and state ranks reflect a combination of rarity, threat, and trend factors. Livermore tarplant has been assigned a global rank of G1 and a state rank of S1, indicating that the species is critically imperiled both within California and throughout its range, with a very high risk of extinction due to extreme rarity (often five or fewer populations), very steep declines, or other factors.

California Rare Plant Rank

Some plants in California are assigned a California Rare Plant Rank (CRPR) to identify them as species of conservation concern. The Department works in collaboration with the California Native Plant Society and botanical experts throughout the state to assign rare and endangered plants a CRPR reflective of their status. Livermore tarplant has been assigned a CRPR of 1B.2.

Plants with a CRPR of 1B are rare throughout their range with the majority of them endemic to California. Most of the plants that are ranked 1B have declined significantly over the last century. The threat code extension of ".2" indicates that the species is moderately threatened in California, with 20 to 80 percent of occurrences threatened or a moderate degree and immediacy of threat.

City of Livermore General Plan

The Open Space and Conservation Element of the City of Livermore's General Plan contains policies and objectives related to the preservation and protection of rare and endangered species and alkali habitat (City of Livermore 2004). These objectives do not provide specific regulatory protection for Livermore tarplant, but are likely to be considered by the City of Livermore during planning and while making other decisions that may affect Livermore tarplant.

EXISTING MANAGEMENT EFFORTS

Resource Management Plans

The Department is not aware of any resource management plans prepared for Livermore tarplant, but activities by the City of Livermore and a Springtown Alkali Sink Working Group may provide some short-term management actions at the Springtown population that may benefit Livermore tarplant.

The City of Livermore Planning Department convened a Springtown Alkali Sink Working Group to work on issues related to the management of parcels owned by the City of Livermore in the Springtown area. The Springtown Alkali Sink Working Group works on issues such as establishing and maintaining signage, fundraising, outreach, weed control, additional fencing, and enhancing long-term protection and management. The Springtown Alkali Sink Working Group does not work specifically on Livermore tarplant management, but management activities in the Springtown area are likely to benefit Livermore tarplant. Funding may be acquired for near-term fencing, signage and noxious weed removal in the vicinity of the Springtown population through the mitigation requirements of a federal biological opinion (BO) that is unrelated to Livermore tarplant (Stewart pers. comm. 2015).

The East Alameda County Conservation Strategy provides guidance for open space and habitat acquisition, covers 19 focal species of plants and animals, including Livermore tarplant, and includes landscape-level conservation maps (ICF International 2010). Although the East Alameda County Conservation Strategy is not a resource management plan, and does not provide Livermore tarplant with any management or formal protection, it does describe goals and objectives related to protection and enhancement of alkali meadow and scalds, which are important habitats for Livermore tarplant. The purpose of the East Alameda County Conservation Strategy is to streamline permitting and to be helpful for planning public agency projects by providing more certainty with regard to mitigation ratios, while promoting the

protection of the covered species. There is a federal programmatic BO for federally-listed species associated with the East Alameda County Conservation Strategy.

Monitoring and Research

The Baldwin Lab at University of California, Berkeley is continuing to study the evolution of Livermore tarplant as part of a large-scale analysis of the genus *Deinandra* and other tarweed genera. The Department is not aware of any other ongoing Livermore tarplant research, or monitoring of Livermore tarplant populations.

Habitat Restoration Projects

The Department is not aware of any Livermore tarplant habitat restoration projects. The Department does not have any information indicating that Livermore tarplant seed has been banked for restoration, or any other purposes.

Impacts of Existing Management Efforts

As discussed above, the Springtown population has been grazed by cattle in the past, but the Department does not have any information on the current grazing regime, such as the timing, duration or intensity.

SCIENTIFIC DETERMINATIONS REGARDING THE STATUS OF LIVERMORE TARPLANT IN CALIFORNIA

CESA directs the Department to prepare this report regarding the status of Livermore tarplant based upon the best scientific information available to the Department. CESA's implementing regulations identify key factors that are relevant to the Department's analyses. Specifically, a "species shall be listed as endangered or threatened ... if the Commission determines that its continued existence is in serious danger or is threatened by any one or any combination of the following factors: (1) present or threatened modification or destruction of its habitat; (2) overexploitation; (3) predation; (4) competition; (5) disease; or (6) other natural occurrences or human-related activities." (Cal. Code Regs., tit. 14, § 670.1, subd. (i)(1)(A)).

The definitions of endangered and threatened species in the Fish and Game Code provide key guidance to the Department's scientific determination. An endangered species under CESA is one "which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, over exploitation, predation, competition, or disease" (Fish & G. Code, § 2062). A threatened species under CESA is one "that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts required by [CESA]" (*Id.*, § 2067).

The preceding sections of this Status Review report describe the best scientific information available to the Department, with respect to the key factors identified in the regulations.

Present or Threatened Modification or Destruction of Habitat

The habitats in the Livermore Valley have been impacted by a history of modification and destruction from development, grazing, and other land use. Evaluation of soil maps and aerial imagery show that these activities have almost certainly resulted in the loss of Livermore tarplant habitat. Current land use practices, zoning, and designations have led to recent and severe habitat modification and destruction that is likely to lead to the extirpation of a significant portion of Livermore tarplant's range, and the modification and destruction of habitat is likely to continue into the future. In addition, recreation activities within and in the vicinity of Livermore tarplant populations have resulted in habitat degradation that is evident on the ground and visible from aerial imagery. The Department considers modification and destruction of habitat to be a significant threat to the continued existence of Livermore tarplant.

Overexploitation

The Department does not consider overexploitation to be a significant threat to the continued existence of Livermore tarplant.

Predation

The Department does not consider predation to be a significant threat to the continued existence of Livermore tarplant.

Competition

Invasive plant species have been documented to pose serious threats to biodiversity around the world, and are a particularly pervasive problem in Mediterranean-type habitats like those in California. Invasive thatch-forming grasses, and other invasive plants such as perennial pepperweed, occur within and in close proximity to all Livermore tarplant populations. The Department considers invasive plant species to be a significant threat to the continued existence of Livermore tarplant.

Disease

There are no diseases known to be threats to the continued existence of Livermore tarplant. The Department does not consider disease to be a significant threat to the continued existence of Livermore tarplant.

Other Natural Occurrences or Human-related Activities

The climate of California is certain to change due to warming of the global climate system; however, it is unclear how such changes will affect Livermore tarplant. Livermore tarplant has a narrow distribution and few populations, with three of the four known populations occupying relatively small areas. Livermore tarplant's rarity and extremely limited distribution, and its occurrence only in and near developed areas, make the species very vulnerable to stochastic (chance) events such as droughts, wildfires, and accidents, and to all other threats. Therefore, the loss of all or a significant portion of any Livermore tarplant population would represent the loss of a significant portion of Livermore tarplant's total range. Impacts from grazing and impacts from thatch accumulation in areas that are not grazed are potential threats to Livermore tarplant. Livermore tarplant is also threatened by herbicide application and other right-of-way maintenance activities.

SUMMARY OF KEY FINDINGS

Livermore tarplant is a very rare species that is known from only four populations, all located within or less than 0.5 mile from the City of Livermore. All Livermore tarplant populations occur in close proximity to urban or other intensive land uses, and have been either directly or indirectly impacted by modification or destruction of habitat. Based upon current land use practices, zoning and designations, the modification or destruction of Livermore tarplant habitat is likely to continue into the future. Livermore tarplant populations have also been, and continue to be subject to ongoing impacts from invasive plant species, recreation activities, and herbicide use and right-of-way maintenance. Impacts from grazing and impacts from thatch accumulation in areas that are not grazed are potential threats to Livermore tarplant. It is unclear how climate change will affect Livermore tarplant. Compounding the threats to the species is the inherent vulnerability of small populations to extirpation due to stochastic (chance) events. Due to the limited distribution of Livermore tarplant, the loss of any Livermore tarplant population or a significant portion thereof would be considered the loss of a significant portion of the species total range.

The information available to the Department regarding the status of Livermore tarplant indicates that there are significant threats to the continued existence of the species.

RECOMMENDATION FOR PETITIONED ACTION

CESA directs the Department to prepare this report regarding the status of Livermore tarplant in California based upon the best scientific information available to the Department. CESA also directs the Department to indicate in this Status Review whether the petitioned action is warranted (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)). The Department includes and makes its recommendation in this Status Review as submitted to the Commission in an advisory capacity based on the best available science. Based on the criteria described above, the scientific information available to the Department indicates that Livermore tarplant is in serious danger of becoming extinct in all or a significant portion of its range due to one or more causes including loss of habitat, change in habitat, competition and other effects from invasive plant species, and other natural occurrences and human-related activities.

The Department recommends that the Commission find the petitioned action to list Livermore tarplant as an endangered species to be warranted.

PROTECTION AFFORDED BY LISTING

It is the policy of the state to conserve, protect, restore and enhance any endangered or any threatened species and its habitat (Fish & G. Code, § 2052). If listed as an endangered or threatened species, unauthorized “take” of Livermore tarplant will be prohibited, making the conservation, protection, and enhancement of the species and its habitat an issue of statewide concern. As noted earlier, CESA defines “take” as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (*Id.*, § 86). Any person violating the take prohibition would be punishable under state law. The Fish and Game Code provides the Department with related authority to authorize “take” under certain circumstances (*Id.*, §§ 2081, 2081.1, 2086, 2087, 2089.6, 2089.10 and 2835). As authorized through an incidental take

permit, however, impacts of the taking on Livermore tarplant caused by the activity must be minimized and fully mitigated according to state standards.

Additional protection of Livermore tarplant following listing would also occur with required public agency environmental review under CEQA, and its federal counter-part, the National Environmental Policy Act (NEPA). CEQA and NEPA both require affected public agencies to analyze and disclose project-related environmental effects, including potentially significant impacts on endangered, rare, and threatened special status species. Under CEQA's "substantive mandate," for example, state and local agencies in California must avoid or substantially lessen significant environmental effects to the extent feasible. With that mandate, and the Department's regulatory jurisdiction generally, the Department expects related CEQA and NEPA review will likely result in increased information regarding the status of Livermore tarplant in California as a result of, among other things, updated occurrence and abundance information for individual projects. Where significant impacts are identified under CEQA, the Department expects project-specific required avoidance, minimization and mitigation measures will also benefit the species. While both CEQA and NEPA would require analysis of potential impacts to Livermore tarplant regardless of their listing status under CESA, the acts contain specific requirements for analyzing and mitigating impacts to listed species. In common practice, potential impacts to listed species are examined more closely in CEQA and NEPA documents than potential impacts to unlisted species. State listing, in this respect, and required consultation with the Department during state and local agency environmental review under CEQA, is also expected to benefit the species in terms of related impacts for individual projects that might otherwise occur absent listing.

If Livermore tarplant is listed under CESA, it may increase the likelihood that state and federal land and resource management agencies will allocate funds towards protection and recovery actions. However, funding for species recovery and management is limited, and there is a growing list of threatened and endangered species.

MANAGEMENT RECOMMENDATIONS AND RECOVERY MEASURES

The utility of current data on Livermore tarplant is limited by being largely anecdotal and qualitative. Studies designed to provide quantitative data on Livermore tarplant populations, and the factors that affect the potential for Livermore tarplant to survive and reproduce, are necessary for species management. Department staff with considerations from local agencies, non-profits, and interested parties generated the following list of recommended management actions:

- Permanently protect all Livermore tarplant habitat from modification and destruction via fee title acquisition, conservation easements or similar protective measures;
- Restrict public access to portions of the Springtown Preserve that support Livermore tarplant and other species of conservation concern;
- Restore degraded Livermore tarplant habitat at the Springtown, Northeast Springtown, and Greenville Road populations. Salvage the soil seed bank from the Greenville Road population;
- Implement monitoring and adaptive management programs for all Livermore tarplant populations. Focus monitoring on Livermore tarplant, indicator species (if identified), or an appropriate habitat indicator such as residual dry matter, evidence of impacts from recreation activities, or an assessment of the soil seed bank density. Ensure that

monitoring results trigger appropriate management responses such as changing the timing or intensity of grazing, implementing other measures to control invasive species, or controlling recreational activities. Make the data and reports from monitoring and adaptive management programs available to resource agencies and the public;
- Establish an invasive plant species early detection and prevention program for all Livermore tarplant populations;
- Research the life history characteristics of Livermore tarplant, including factors related to pollination, seed dispersal, seed longevity, and microhabitat requirements for germination and recruitment;
- Bank seeds of Livermore tarplant from all extant populations for conservation purposes;
- Survey for additional populations of Livermore tarplant; and
- Implement a program to detect Livermore tarplant population trends using statistically valid population estimates.

PUBLIC RESPONSE

Comments were invited in response to the Petition in a Department press release dated September 16, 2015, and in letters mailed on November 17, 2015 to owners of private land with Livermore tarplant populations. The Department received three e-mail messages in response to the press release, which are included in Appendix B. Additionally, one landowner contacted the Department via e-mail message to request information about the Livermore tarplant population on his property, but did not provide any additional comments. Representatives from another landowner contacted the Department via telephone to express concern about limitations on property use and development options, and ask about the possibility of the State of California purchasing the property.

PEER REVIEW

Independent botany experts were invited to review the Status Review report before submission to the Fish and Game Commission. The letters of invitation and all comments received are included in Appendix C.

ACKNOWLEDGEMENTS

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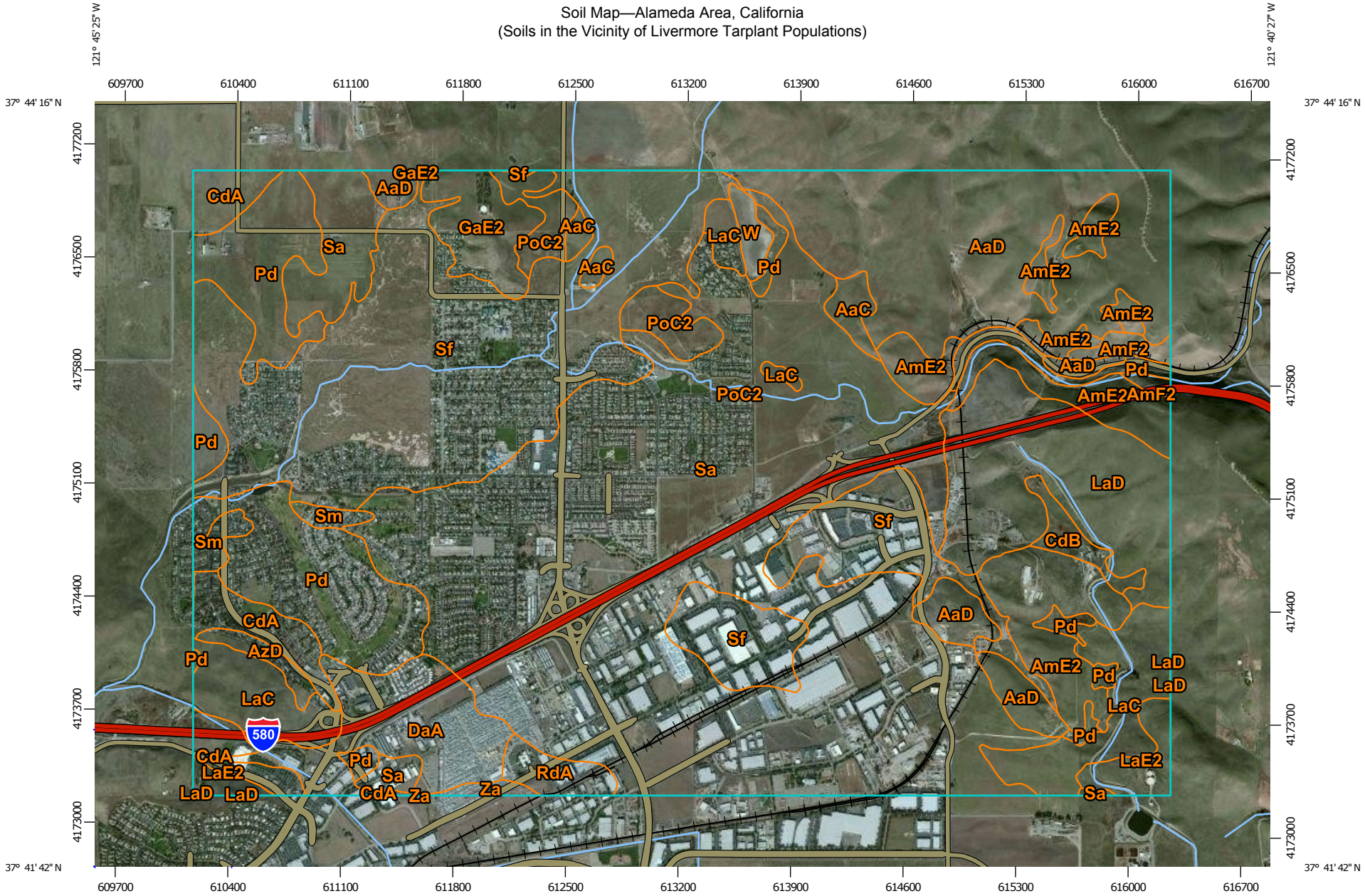
APPENDIX A: Soils in the Vicinity of Livermore Tarplant Populations

Soil Map—Alameda Area, California
(Soils in the Vicinity of Livermore Tarplant Populations)



Map Scale: 1:33,400 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 450 900 1800 2700

Feet
0 1500 3000 6000 9000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Alameda Area, California
Survey Area Data: Version 9, Sep 25, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: May 12, 2010—Nov 15, 2010

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Alameda Area, California (CA609)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
AaC	Altamont clay, 3 to 15 percent slopes	39.6	0.7%
AaD	Altamont clay, 15 to 30 percent slopes	616.6	10.6%
AmE2	Altamont clay, moderately deep, 30 to 45 percent slopes, eroded	292.0	5.0%
AmF2	Altamont clay, moderately deep, 45 to 75 percent slopes, eroded	24.6	0.4%
AzD	Azule clay loam, 3 to 30 percent slopes	21.9	0.4%
CdA	Clear Lake clay, drained, 0 to 2 percent slopes, MLRA 14	135.7	2.3%
CdB	Clear Lake clay, drained, 3 to 7 percent slopes	31.0	0.5%
DaA	Danville silty clay loam, 0 to 3 percent slopes	190.4	3.3%
GaE2	Gaviota rocky sandy loam, 5 to 40 percent slopes, eroded	89.6	1.5%
LaC	Linne clay loam, 3 to 15 percent slopes	239.1	4.1%
LaD	Linne clay loam, 15 to 30 percent slopes	324.0	5.5%
LaE2	Linne clay loam, 30 to 45 percent slopes, eroded	58.5	1.0%
Pd	Pescadero clay	439.1	7.5%
PgA	Pleasanton gravelly loam, 0 to 3 percent slopes	0.9	0.0%
PoC2	Positas gravelly loam, 2 to 20 percent slopes, eroded	80.2	1.4%
RdA	Rincon clay loam, 0 to 3 percent slopes	39.8	0.7%
Sa	San Ysidro loam	2,019.5	34.6%
Sf	Solano fine sandy loam	1,133.7	19.4%
Sm	Sunnyvale clay loam over clay	31.2	0.5%
W	Water	20.7	0.4%
Za	Zamora silt loam, 0 to 4 percent slopes	10.2	0.2%
Totals for Area of Interest		**5,838.5**	**100.0%**

APPENDIX B: Comments from Affected and Interested Parties on the Petitioned Action

Wildlife Native Plants

From: JockScot@comcast.net
Sent: Wednesday, October 14, 2015 7:30 PM
To: Wildlife Native Plants
Subject: Comments re: Livermore Tarplant

Hello,.... I'm writing to express my support for listing the Livermore Tarplant for protections under the CA Endangered Species Act.

According to what was reported on-line by KRON4 News:

"In April, California Department of Fish and Wildlife officials concluded that there was ample evidence to make the plant a candidate for protection under the California Endangered Species Act."

"The initial petition that recommended protection of the Livermore Tarplant reported that it is threatened by alteration of habitat due to industrial and agricultural uses, non-native grasses, off-road vehicle use and possible development."

This situation seems to be a choice of whether or not to afford protections under the laws of this state to a plant species unlucky enough to exist in a limited geographical area which is highly valued, developed and densely populated or allowing that plant species to decline in numbers or be potentially pushed into extinction.

In each instance where this circumstance arises, it seems to me that the Department has a duty to defend it's original decision
without allowing for introduction of bias from the general public. Otherwise, what's the point of having the California Endangered Species Act.

Thanks for providing the opportunity to comment on this.

Darian Calhoun
P O Box 161123
Sacramento, CA 95816

Wildlife Native Plants

From: James Hadley <jrhadley@comcast.net>
Sent: Thursday, September 24, 2015 4:42 PM
To: Wildlife Native Plants
Subject: FW: Tar Plants AKKA tarweed

From: James Hadley [mailto:jrhadley@comcast.net]
Sent: Thursday, September 24, 2015 4:22 PM
To: 'native' <plants@wildlife.ea.gov>
Subject: Tar Plants AKKA tarweed

I was given your address by someone in CDFW, and I hope that you are an appropriate receiver of comments on the tarweed issue.
There was a featured article in today's (9/24) Independent Newspaper in Livermore, mentioning ongoing studies of the tarweed plant concerning a possible listing of this plant under CESA; public comment was solicited. The tone of the article suggested that this a rare and important plant.
I was amused; I am a hiker and have spent many hours exploring the trails around Lake De Valle near Livermore in the State Recreation Area of the same name. Having reached the age of ninety, I am slowing down and my comments on tarweed may be a little out of date; however, I don't think that the weed is rare. The Park's Internet posting's discriptive remark is: "local nature includes live oak trees with mistletoe and red galls, tarweed and other local wildflowers." As of a few years ago, the tarweed was widespread and I heard that the park management was trying to stamp it out (perhaps it disagrees with the grazing cows?). Indeed it doesn't seem as thick as it was, but it's still evident in the park. I think its nature is to spread vigorously if not controlled. I believe I saw some on the ground behind the Livermore Police Department building, in the Livermore Civic Center area, too.
Sincerely, Jim Hadley
4355 Emory Way, Livermore
925-447-2752
jrhadley@comcast.net

Wildlife Native Plants

From: Mary <hannonma@comcast.net>
Sent: Thursday, December 10, 2015 7:05 PM
To: Wildlife Native Plants
Cc: stewart, steve; MayorMarchand@cityoflivermore.net; swgary@cityoflivermore.net; leturner@cityoflivermore.net; SSpedowfski@cityoflivermore.net; BWoerner@cityoflivermore.net
Subject: Comment on listing of Livermore Tarplant

Dec. 10, 2015

Dear California Department of Fish and Wildlife:

I am writing on behalf of Friends of Springtown Preserve to support the listing of the Livermore Tarplant (*Deinandra bacigalupii)* as an endangered species under the California Endangered Species Act. We are a small grassroots group that has been together since 2006 working to educate and advocate for the alkali sink habitat. This habitat and the tarplant continue to be threatened by negative impacts from human activities. We have alerted the City of Livermore to the damages done to the habitat by the digging of pits and making of dirt bike courses. We have advocated for its protection—fences, patrols, weed control, educational signs. You are probably aware that the city is looking into creating a mitigation bank in the Springtown Preserve. We view any wetland creation associated with the mitigation bank a threat to the long-term health and abundance of the Livermore Tarplant. Disturbing the soil in the upland to create wetland in this habitat will significantly alter the hydrology and facilitate the introduction of invasive weeds. We believe that listing the Livermore Tarplant as endangered will give this area and plant a higher status and visibility such that the community of Livermore will take special pride in its "own" special plant and special habitat. Hopefully, then, the habitat and tarplant will receive a higher level of monitoring and protection. Please list *Deinandra bacigalupii* as endangered.

Thank you,

Mary Ann Hannon
Coordinator, Friends of Springtown Preserve
309 Pearl Dr.
Livermore, CA 94550

cc: Steve Stewart
Planner, City of Livermore

Mayor John Marchand
Livermore City Council Members: Stewart Gary, Laureen Turner, Steven Spedowfski, Bob Woerner

APPENDIX C: Comments from Peer Reviewers on the Livermore Tarplant Status Review Report

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Director's Office
1416 Ninth Street, 12th Floor
Sacramento, CA 95814
www.wildlife.ca.gov

EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

January 14, 2016

Susan Bainbridge
Museum Scientist
University and Jepson Herbarium
1001 Valley Life Sciences Bldg. #2465
University of California Berkeley
Berkeley, CA 94720-2465

Dear Ms. Bainbridge:

LIVERMORE TARPLANT (*DEINANDRA BACIGALUPII*); DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

Thank you for agreeing to serve as a scientific peer reviewer for the California Department of Fish and Wildlife Status Review of Livermore tarplant (*Deinandra bacigalupii*). Please review the copy of the Department of Fish and Wildlife's (Department) peer review draft report dated January 14, 2016 that is included with this letter. The Department seeks your expert analysis and input regarding the scientific validity of the report and its assessment of the status of Livermore tarplant in California based on the best scientific information currently available. The Department respectfully requests that you focus your peer review effort on the body of relevant scientific information and the Department's related assessment of the population and life history elements prescribed in the California Endangered Species Act (CESA). **The Department would appreciate receiving your peer review input on or before February 11, 2016**.

The Department seeks your scientific peer review as part of formal proceedings pending before the California Fish and Game Commission under CESA. As you may know, the Commission is a constitutionally established entity distinct from the Department, exercising exclusive statutory authority under CESA to list species as endangered or threatened (Fish & G. Code, § 2070). The Department serves in an advisory capacity during CESA listing proceedings, charged by the Fish and Game Code to focus on the best scientific information available to make related recommendations to the Commission (Fish & G. Code, § 2074.6).

The Commission received the petition to list Livermore tarplant under CESA on August 26, 2014. On April 24, 2015, the Commission published findings formally designating Livermore tarplant as a candidate for listing as threatened or endangered under CESA. Livermore tarplant is currently protected under CESA in California in that capacity.

The peer review draft report forwarded to you today reflects the Department's effort to identify and analyze the best scientific information available regarding the status of

Livermore tarplant in California. At this time, the Department believes that the best available science indicates that listing the species as endangered under CESA is warranted. We underscore, however, that scientific peer review plays a critical role in the Department's effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code. Our expected recommendation to the Commission at this point may change following your input.

We ask you to focus your peer review on the best scientific information available regarding the status of Livermore tarplant in California. As with our own effort to date, your peer review of the science and analysis regarding each of the population and life history categories prescribed in CESA are particularly important (Cal. Code Regs., tit. 14, § 670.1(i)(1)(A)) (i.e., present or threatened habitat modification, overexploitation, predation, competition, disease, and other natural occurrences or human-related activities that could affect the species) as well as whether it indicates, in your opinion, that Livermore tarplant is at serious risk of becoming extinct throughout all or a significant portion of its range in California, or whether the species is likely to become so in California in the foreseeable future. Please note that the Department releases this peer review report to you solely as part of the peer review process, and it is not yet public.

A Microsoft Word version and a PDF version of the report are included with this letter; however, only the PDF version includes figures and appendices. For ease of review, you may submit your comments in "track changes" format, or in list form by page and line number. Please submit your comments electronically to Ms. Cherilyn Burton, Senior Environmental Scientist (Specialist) at cherilyn.burton@wildlife.ca.gov. Ms. Burton may also be reached at (916) 651-6508. If there is anything the Department can do to facilitate your review, please let us know.

Following receipt and consideration of peer review comments, the Department will prepare and submit its final report and related recommendation to the Commission. After at least a 30 day public review period, the Commission will consider the petition to list Livermore tarplant, the Department's report and related recommendations including peer review, and public testimony during a regularly scheduled Commission meeting prior to making their decision.

Thank you again for your contribution to the status review effort and the important input it provides during the Commission's related proceedings.

Sincerely,

Richard Macedo, Chief
Habitat Conservation Planning Branch

ec: Department of Fish and Wildlife

William Condon, Program Manager
Timberland Conservation and Native Plant Programs
Habitat Conservation Planning Branch
William.condon@wildlife.ca.gov

Cherilyn Burton, Senior Environmental Scientist
Native Plant Program
Habitat Conservation Planning Branch
Cherilyn.Burton@wildlife.ca.gov

Jeb Bjerke, Senior Environmental Scientist
Native Plant Program
Habitat Conservation Planning Branch
Jeb.Bjerke@wildlife.ca.gov

February 10, 2016

Richard Macedo, Chief
Habitat Conservation Planning Branch
Department of Fish and Wildlife
State of California – Natural Resources Agency
1416 Ninth Street, 12th Floor
Sacramento, CA 95814

Dear Mr. Macedo,

I have reviewed the Peer Review Draft of the Status of the Livermore Tarplant (*Deinandra bacigalupii*) (January 14, 2016) and have determined that it is a very thorough, accurate and objective review of the status of the Livermore Tarplant. I found the information to reflect my observations, the current knowledge and understanding of the status of this taxon and conservation science. My main comments are listed below.

I concur that the scientific evidence indicates the Livermore Tarplant is "at serious risk of becoming extinct throughout all or a significant portion of its range". Its range, distribution and population sizes are extremely small. No new element occurrences outside its range have been located in the over fifteen years since it was described. Two of the five occurrences have been severely altered and could easily become extirpated and all of the known occurrences are in the vicinity of urban development and vulnerable to the direct and indirect impacts of development. Even the largest population which is somewhat secure on city land is severely threatened by non-native species that are actively invading the site, in addition to historic habitat alterations for which its distribution may not have reached equilibrium, including fragmentation of a larger population and changes to the hydrology and chemistry of the site. Listing of this taxon as endangered CESA would help afford the protection, management and bring resources that would help prevent extinction of this species.

Page 2. Species Description.

Line 25. The fruits of sunflowers are often called achenes but are more accurately called cypselae.

Line 27. The chromosome number is 2n=24 per Baldwin 1999a.

Page 6. Range and Distribution.

Occurrence 2: Springtown. In my experience, the distribution of Livermore tarplant in the mapped polygon for this occurrence is much larger than the population extent, at least in recent years. However, the distribution of this plant at the Springtown Preserve, and adjacent areas with appropriate soils such as south of the mapped occurrence, may be larger and dormant in the soil as seeds but requiring appropriate vegetation management for recruitment.

Page 10. Similar-looking plants.

Line 20. Livermore tarplant has most often 8 ray flowers, not 3-35.

Line 22. The range of narrow tarplant, three-rayed tarplant and common spikeweed is broader than Livermore tarplant.

Page 21. Recent and Future Modification and Destruction of Habitat

Lines 20-25 are exactly correct that some of the proposed mitigation activities pose a threat to the Livermore Tarplant, its habitat and other existing values of the Springtown Preserve. For example, the spread of perennial pepperweed in the Springtown Alkali Sink is directly related to soil disturbance and for the perennial pepperweed, also changes in hydrology, including mitigation wetlands (e.g., the created wetland northwest of the junction of Ames and Dalton) and flood control berms.

Page 23. Impacts from Invasive Species

Lines 24-43. *Lepidium latifolium* and *Dittrichia graveolens* distribution in the Springtown alkali sink are largely facilitated by soil disturbance which creates a focal population from which they spread into less altered habitat including alkali meadow (personal observation and unpublished data).

Page 24. Grazing.

It is probably important to point out that invasive species that are palatable to cattle are more likely to be controlled with appropriate grazing in favor of the Livermore Tarplant. But non-palatable taxa often increase even with carefully managed grazing and may require additional management to control.

Page 27. Climate Change.

If the potential for displacement by new invasive taxa that benefit from climate change or increased competitive ability of existing non-native plant species have not been taken into account, then the threat from climate change is much higher.

Page 27. Vulnerability of Small Populations.

Deinandra is known to be sporophytic self-incompatible and therefore more vulnerable to small population sizes than gametophytic self-incompatible organisms. A persistent soil seed bank, which is documented for several tarplants with ray cypselae with strong dormancy, should buffer the population from vulnerability to loss of S-allele diversity and genetic drift. Therefore,

activities that would allow depletion of the persistent soil seed bank, would threaten the long term persistence of the taxon as well as have more immediate demographic impacts.

Page 27-28. Herbicide Use (and also applicable to Page 33. Management Recommendations.)

The above ground portion of the Livermore Tarplant life cycle can occupy the majority of the year. Unlike shorter-lived annuals that can be avoided after seed dispersal in the spring, it is difficult to avoid impacts by herbicide treatments for co-occurring non-natives only control by herbicide. Thus pro-active management to prevent spread of non-native taxa that are not controlled by other treatments into Livermore Tarplant populations is highly recommended.

Page 33. Management Recommendations.

- Monitoring should include a baseline and periodic quantitative assessment of the soil seed bank density.
- If the Greenville Road population cannot be restored, the soil seed bank should be salvaged in case it contains unique genetic diversity for the taxon.

Thank you for the opportunity to comment on this important document. I hope my comments are useful.

Sincerely,

Susan Bainbridge

Berkeley, CA

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Peer Review Comments from Ms. Susan Bainbridge and Department Responses

Page	Line	Reviewer Comment	Department Response
N/A	N/A	I concur that the scientific evidence indicates the Livermore Tarplant is "at serious risk of becoming extinct throughout all or a significant portion of its range". Its range, distribution and population sizes are extremely small. No new element occurrences outside its range have been located in the over fifteen years since it was described. Two of the five occurrences have been severely altered and could easily become extirpated and all of the known occurrences are in the vicinity of urban development and vulnerable to the direct and indirect impacts of development. Even the largest population which is somewhat secure on city land is severely threatened by nonnative species that are actively invading the site, in addition to historic habitat alterations for which its distribution may not have reached equilibrium, including fragmentation of a larger population and changes to the hydrology and chemistry of the site. Listing of this taxon as endangered CESA would help afford the protection, management and bring resources that would help prevent extinction of this species.	No response needed
2	25	The fruits of sunflowers are often called achenes but are more accurately called cypselae.	Text updated
2	27	The chromosome number is 2n=24 per Baldwin 1999a.	Text updated
6		Occurrence 2: Springtown. In my experience, the distribution of Livermore tarplant in the mapped polygon for this occurrence is much larger than the population extent, at least in recent years. However, the distribution of this plant at the Springtown Preserve, and adjacent areas with appropriate soils such as south of the mapped occurrence, may be larger and dormant in the soil as seeds but requiring appropriate vegetation management for recruitment.	The mapped polygon was based on Department observations of the outermost extent of the population in 2014 and 2015, however, the Department acknowledges that the polygon over-estimates the area that plants were actually observed to grow. The Department also acknowledges that the soil seed bank of Livermore tarplant may extend into areas where plants were not observed. The following text has been added: "However, the population in the soil seed bank may extend beyond the mapped polygon, particularly to the south of the mapped polygon, and if so, recruitment of Livermore tarplant may occur in these areas under appropriate management or environmental conditions."
10	20	Livermore tarplant has most often 8 ray flowers, not 3-35.	Text updated

10	22	The range of narrow tarplant, three-rayed tarplant and common spikeweed is broader than Livermore tarplant.	Text updated
21	20-25	Lines 20-25 are exactly correct that some of the proposed mitigation activities pose a threat to the Livermore Tarplant, its habitat and other existing values of the Springtown Preserve. For example, the spread of perennial pepperweed in the Springtown Alkali Sink is directly related to soil disturbance and for the perennial pepperweed, also changes in hydrology, including mitigation wetlands (e.g., the created wetland northwest of the junction of Ames and Dalton) and flood control berms.	Text added to the "Impacts from Invasive Species (Competition and other Factors)" section: "The spread of perennial pepperweed in the Springtown Alkali Sink is likely directly related to soil disturbance and changes in hydrology, such as those related to construction of a wetland and flood control berms."
23	24-43	*Lepidium latifolium* and *Dittrichia graveolens* distribution in the Springtown alkali sink are largely facilitated by soil disturbance which creates a focal population from which they spread into less altered habitat including alkali meadow (personal observation and unpublished data).	Text added to the "Impacts from Invasive Species (Competition and other Factors)" section: "The distribution of perennial pepperweed and stinkwort in the Springtown Alkali Sink may be facilitated by soil disturbance which creates a focal population from which the plants spread into less disturbed areas, such as alkali meadow (Bainbridge pers. comm. 2016, Appendix C)."
24	Grazing	It is probably important to point out that invasive species that are palatable to cattle are more likely to be controlled with appropriate grazing in favor of the Livermore Tarplant. But non- palatable taxa often increase even with carefully managed grazing and may require additional management to control.	Text added: ", however only invasive species that are palatable to cattle or other livestock are likely to be controlled by grazing, and non-palatable plants may increase."
27	Climate Change	If the potential for displacement by new invasive taxa that benefit from climate change or increased competitive ability of existing non-native plant species have not been taken into account, then the threat from climate change is much higher.	The potential for displacement by plants that benefit from climate change was taken into account in the climate change vulnerability assessment, however the Department does not know whether or to what extent competing plant species will be favored by projected future climates. If the Department determines that Livermore tarplant will be "Strongly affected by a native or non-native competing species that is likely to be favored by climate change" then the vulnerability assessment may change to "Moderately Vulnerable". Text has been added to the Climate Change section to address this possibility.

27	Vulnerability of Small Populations	*Deinandra* is known to be sporophytic self-incompatible and therefore more vulnerable to small population sizes than gametophytic self-incompatible organisms. A persistent soil seed bank, which is documented for several tarplants with ray cypselae with strong dormancy, should buffer the population from vulnerability to loss of S-allele diversity and genetic drift. Therefore, activities that would allow depletion of the persistent soil seed bank, would threaten the long term persistence of the taxon as well as have more immediate demographic impacts.	Text has been added to the "Life History" and "Vulnerability of Small Populations" sections of the Status Review regarding seed dormancy and the seed bank.
27-28; 33	Herbicide Use; Management Recommendations	The above ground portion of the Livermore Tarplant life cycle can occupy the majority of the year. Unlike shorter-lived annuals that can be avoided after seed dispersal in the spring, it is difficult to avoid impacts by herbicide treatments for co-occurring non-natives only control by herbicide. Thus pro-active management to prevent spread of non-native taxa that are not controlled by other treatments into Livermore Tarplant populations is highly recommended.	Added text to the "Herbicide Use and Right-of-way Maintenance" section regarding the vulnerability of Livermore tarplant to herbicide use through a majority of the year. Added text to the "Management Recommendations and Recovery Measures" section regarding establishment of an early detection and prevention program for invasive plant species.
33	Management Recommendations	Monitoring should include a baseline and periodic quantitative assessment of the soil seed bank density.	Added text to the "Management Recommendations and Recovery Measures" section regarding monitoring of the soil seed bank.
33	Management Recommendations	If the Greenville Road population cannot be restored, the soil seed bank should be salvaged in case it contains unique genetic diversity for the taxon.	Added text to the "Management Recommendations and Recovery Measures" section regarding salvage of the Greenville Road population soil seedbank.

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
Director's Office
1416 Ninth Street, 12th Floor
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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

January 14, 2016

Bruce Baldwin, Ph.D.
Curator
University and Jepson Herbarium
1001 Valley Life Sciences Bldg. #2465
University of California Berkeley
Berkeley, CA 94720-2465

Dear Dr. Baldwin:

LIVERMORE TARPLANT (*DEINANDRA BACIGALUPII*); DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

Thank you for agreeing to serve as a scientific peer reviewer for the California Department of Fish and Wildlife Status Review of Livermore tarplant (*Deinandra bacigalupii*). Please review the copy of the Department of Fish and Wildlife's (Department) peer review draft report dated January 14, 2016 that is included with this letter. The Department seeks your expert analysis and input regarding the scientific validity of the report and its assessment of the status of Livermore tarplant in California based on the best scientific information currently available. The Department respectfully requests that you focus your peer review effort on the body of relevant scientific information and the Department's related assessment of the population and life history elements prescribed in the California Endangered Species Act (CESA). **The Department would appreciate receiving your peer review input on or before February 11, 2016**.

The Department seeks your scientific peer review as part of formal proceedings pending before the California Fish and Game Commission under CESA. As you may know, the Commission is a constitutionally established entity distinct from the Department, exercising exclusive statutory authority under CESA to list species as endangered or threatened (Fish & G. Code, § 2070). The Department serves in an advisory capacity during CESA listing proceedings, charged by the Fish and Game Code to focus on the best scientific information available to make related recommendations to the Commission (Fish & G. Code, § 2074.6).

The Commission received the petition to list Livermore tarplant under CESA on August 26, 2014. On April 24, 2015, the Commission published findings formally designating Livermore tarplant as a candidate for listing as threatened or endangered under CESA. Livermore tarplant is currently protected under CESA in California in that capacity.

The peer review draft report forwarded to you today reflects the Department's effort to identify and analyze the best scientific information available regarding the status of

Livermore tarplant in California. At this time, the Department believes that the best available science indicates that listing the species as endangered under CESA is warranted. We underscore, however, that scientific peer review plays a critical role in the Department's effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code. Our expected recommendation to the Commission at this point may change following your input.

We ask you to focus your peer review on the best scientific information available regarding the status of Livermore tarplant in California. As with our own effort to date, your peer review of the science and analysis regarding each of the population and life history categories prescribed in CESA are particularly important (Cal. Code Regs., tit. 14, § 670.1(i)(1)(A)) (i.e., present or threatened habitat modification, overexploitation, predation, competition, disease, and other natural occurrences or human-related activities that could affect the species) as well as whether it indicates, in your opinion, that Livermore tarplant is at serious risk of becoming extinct throughout all or a significant portion of its range in California, or whether the species is likely to become so in California in the foreseeable future. Please note that the Department releases this peer review report to you solely as part of the peer review process, and it is not yet public.

A Microsoft Word version and a PDF version of the report are included with this letter; however, only the PDF version includes figures and appendices. For ease of review, you may submit your comments in "track changes" format, or in list form by page and line number. Please submit your comments electronically to Ms. Cherilyn Burton, Senior Environmental Scientist (Specialist) at cherilyn.burton@wildlife.ca.gov. Ms. Burton may also be reached at (916) 651-6508. If there is anything the Department can do to facilitate your review, please let us know.

Following receipt and consideration of peer review comments, the Department will prepare and submit its final report and related recommendation to the Commission. After at least a 30 day public review period, the Commission will consider the petition to list Livermore tarplant, the Department's report and related recommendations including peer review, and public testimony during a regularly scheduled Commission meeting prior to making their decision.

Thank you again for your contribution to the status review effort and the important input it provides during the Commission's related proceedings.

Sincerely,

Richard Macedo, Chief
Habitat Conservation Planning Branch

ec: Department of Fish and Wildlife

William Condon, Program Manager
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State of California
Natural Resources Agency
Department of Fish and Wildlife

REPORT TO THE FISH AND GAME COMMISSION

STATUS REVIEW OF LIVERMORE TARPLANT (*Deinandra bacigalupii*)

Peer Review Draft
January 14, 2016

Deinandra bacigalupii, photo by Jeb McKay Bjerke

Charlton H. Bonham, Director
Department of Fish and Wildlife

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LIST OF ABBREVIATIONS, ACRONYMS AND TERMS

BO – Biological Opinion

CEQA – California Environmental Quality Act

CESA – California Endangered Species Act

CNDDB – California Natural Diversity Database

CNPS – California Native Plant Society

Commission – California Fish and Game Commission

CRPR – California Rare Plant Rank

Department – California Department of Fish and Wildlife

Occurrence – Element Occurrence

et al. – "and others"

Evaluation – Initial Evaluation of Petition to List the Livermore tarplant (*Deinandra bacigalupii*) as Endangered under the California Endangered Species Act

Id. – "the same"

NEPA – National Environmental Policy Act

NVCS – National Vegetation Classification Standard

Petition - Petition to the State of California Fish and Game Commission from Mr. Heath Bartosh, Cosponsored by the California Native Plant Society to List Livermore Tarplant as an Endangered Species Pursuant to the California Endangered Species Act

ssp. – Subspecies

var. – Variety

EXECUTIVE SUMMARY

This Status Review of Livermore Tarplant (*Deinandra bacigalupii* B.G. Baldwin) (Status Review) has been prepared by the California Department of Fish and Wildlife (Department) for the California Fish and Game Commission (Commission) pursuant to the requirements of the California Endangered Species Act (CESA). This Status Review has been independently reviewed by scientific peers, and is based upon the best scientific information available to the Department.

Livermore tarplant is an herbaceous plant of the sunflower family (Asteraceae) that was described as a new species in 1999. There are four known occurrences of Livermore tarplant, all restricted to the eastern portion of the Livermore Valley, within the City of Livermore and unincorporated Alameda County, California. Livermore tarplant grows in poorly-drained, seasonally-dry, alkaline meadows in the vicinity of barren alkali scalds, alkali vernal pools and playa-like pools.

All populations of Livermore tarplant occur within the immediate vicinity of urban development. Livermore tarplant is threatened, both directly and indirectly, by recent and ongoing development and changes in land use, impacts from invasive species, trampling and recreation activities, inappropriate grazing or lack of grazing, and perhaps also by herbicide treatments and the effects of climate change. Livermore tarplant is also vulnerable to extinction due to the small number of Livermore tarplant populations and the relatively small sizes of those populations. Because of the rarity of Livermore tarplant, the loss of all or a significant portion of any Livermore tarplant population would represent the loss of a significant portion of Livermore tarplant's total range.

[Department recommendation will be added in the final report]

INTRODUCTION

This Status Review addresses Livermore tarplant (*Deinandra bacigalupii* B.G. Baldwin).

Petition History

On August 26, 2014 the Commission received a petition (Petition) from Mr. Heath Bartosh, cosponsored by the California Native Plant Society (CNPS), to list Livermore tarplant as an endangered species pursuant to CESA (Fish & G. Code § 2050 *et seq*.).

On August 28, 2014 the Commission referred the Petition to the Department for evaluation.

On September 12, 2014, as required by Fish and Game Code, section 2073.3, the Commission published notice of receipt of the Petition in the California Notice Register (Cal. Reg. Notice Register 2014, Vol. 37-Z, p.1627).

On January 14, 2015, the Department provided the Commission with a report, "Initial Evaluation of the Petition to List the Livermore tarplant (*Deinandra bacigalupii*) as Endangered under the California Endangered Species Act" (Evaluation). Based upon the information contained in the Petition, the Department concluded, pursuant to Fish and Game Code, section 2073.5, subdivision (a), that sufficient information exists to indicate that the petitioned action may be warranted, and recommended to the Commission that the Petition should be accepted and considered.

On April 9, 2015, at its scheduled public meeting in Santa Rosa, California, the Commission considered the Petition, the Department's Evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the Petition for consideration.

Subsequently, on April 24, 2015, the Commission published its Notice of Findings for Livermore tarplant in the California Regulatory Notice Register, designating Livermore tarplant as a candidate species (Cal. Reg. Notice Register 2015, No. 17-Z, p. 656, http://www.oal.ca.gov/res/docs/pdf/notice/17z-2015.pdf).

Department of Fish and Wildlife Review

Following the Commission's action to designate Livermore tarplant as a candidate species, the Department notified affected and interested parties and solicited data and comments on the petitioned action pursuant to Fish and Game Code section 2074.4 (see also Cal. Code Regs., tit. 14, § 670.1, subd. (f)(2)). All comments received are included in Appendix B to this report. The Department promptly commenced its review of the status of the species as required by Fish and Game Code section 2074.6, which has now concluded with this Status Review document.

The Department sought independent and competent peer review on its draft Status Review report by scientists with expertise relevant to the status of Livermore tarplant. Appendix C contains the specific input provided to the Department by the individual peer reviewers, as well as a brief explanation of the evaluation and response to the input and any amendments made to the draft Status Review report (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)(2)).

BIOLOGY

Species Description

The information below is paraphrased from the original species description of Livermore tarplant (Baldwin 1999a) and from the Jepson Manual, 2nd Edition (Baldwin 2012).

Livermore tarplant is an herbaceous plant of the sunflower family (Asteraceae) that grows to a height of 3.9 to 15.7 inches (10 to 40 centimeters). The leaves and parts of the stems, flowers and flower heads of Livermore tarplant have minutely-stalked yellowish or clear glands that are sticky and give the plant a strong odor. Livermore tarplant has erect stems that are shiny near the base, and the stems have coarse, longish hairs. Its leaves have continuous and smooth margins or irregular lobes, and do not have leaf stalks. Leaves are evenly distributed along the stem, except at the base of the stem where the leaves form a rosette. The blades of the primary stem leaves are less than or equal to ten centimeters long, and the blades of leaves that are closer to the ends of stem branches are less than or equal to one cm long. The flower heads of Livermore tarplant usually have eight bright yellow ray flowers, each resembling a spreading petal with three lobes at the end. These ray flowers are pistillate, meaning that they only have female flower parts (pistils), and are capable of producing seed. The ray flowers of Livermore tarplant do not have a pappus, which is a structure that sometimes aids in seed dispersal in some plants of the sunflower family. There is a bract, called a phyllary, on the outside of the flower head for each of the ray flowers. There are usually 15-18 disc flowers near the center of the flower head which each have a pappus made of irregular scales. The disc flowers are bright yellow and are functionally staminate, meaning that typically only the male flower parts (stamens) are functional. The flower heads of Livermore tarplant also have one peripheral series of about 8-11 scale-like bracts between the ray and disc flowers. The dry, one-seeded fruits of Livermore tarplant are called achenes, and are less than 1/10 of an inch (2-2.5 millimeters) long, black and somewhat four-angled with a corrugated appearance. Livermore tarplant has a chromosome number of 2n= 12.

Taxonomy

A type specimen is the specimen, or group of specimens of an organism used to describe and name that organism. The type specimen of Livermore tarplant was collected by Robert F. Hoover on August 31, 1966 from the "junction of Ames St. and Raymond Road, north of Livermore… in sandy alkaline soil" (Hoover 1966). Hoover labeled the collection as only *Hemizonia* at the time, without identification to species. On April 26, 1967 Rimo Bacigalupi annotated the type specimen with the statement: "Does not seem to match any thus far published species of *Hemizonia*" (Baldwin 1999a). Dale E. Johnson annotated the type specimen as *Hemizonia paniculata* in 1978. In 1982 Barry Tanowitz included Livermore tarplant specimens as *Hemizonia increscens* ssp. *increscens*, and this inclusion was reflected in the treatment of *Hemizonia* in The Jepson Manual (Tanowitz 1982, Hickman 1993). In 1999, Bruce Baldwin proposed revisions in the taxonomy of North American tarplants based on phylogenetic, biosystematic and cytogenetic studies (Baldwin 1999b). Baldwin reinstated the genus *Deinandra* to accommodate many plants that were previously considered to be in the genus *Hemizonia,* including *H. increscens* ssp. *increscens*.

Dean K. Kelch first alerted Bruce Baldwin to the existence of Livermore tarplant, and Robert E. Preston informed Bruce Baldwin of an additional population near Greenville Road (Baldwin 1999a). Based on morphological, ecological, and phylogenetic considerations, Bruce Baldwin described Livermore tarplant as a new species (Baldwin 1999a). Baldwin noted that Livermore

tarplant is morphologically similar to *D. increscens*, but different in that it has (1) yellow and not dark-purple anthers, (2) a shorter and more irregular disc flower pappus, and (3) mostly entire or irregularly lobed leaves towards the base of the stem (rather than leaves that are pinnately divided, but not divided all the way down to the central axis of the leaf). Baldwin also noted that the results of molecular phylogenetic analyses of nuclear rDNA spacer sequences place Livermore tarplant closer to *D. corymbosa* than to *D. increscens* (Baldwin 1999a).

The word *Deinandra* means "terrible man" or "fierce man" in Greek, which was probably selected as a replacement for the name *Hartmannia*, which means "stag man", with stags being fiercely territorial (Borror 1960, Baldwin 2012). Livermore tarplant (*D. bacigalupii*) is named for Rimo Bacigalupi, the first curator of the Jepson Herbarium at University of California, Berkeley.

Range and Distribution

Range is considered to be the general geographical area in which an organism occurs. Distribution is considered to be the actual sites where individuals and populations of the species occur within the species' range.

Based on historical collections and other observational records, all known populations of Livermore tarplant are restricted to the eastern portion of the Livermore Valley within the City of Livermore and in unincorporated Alameda County, California (Figure 1). The Diablo Range is to the south of the Livermore Valley and Mt. Diablo is to the north. All Livermore tarplant populations occur in the Upper Arroyo Las Positas Watershed, which drains into Laguna Creek, Alameda Creek and ultimately the San Francisco Bay. Livermore tarplant occurs near the northern distributional limit of the genus *Deinandra* (Baldwin 1999a, CCH 2015). Livermore tarplant has been reported growing at elevations from approximately 520 to 650 feet above mean sea level (CNDDB 2015).

The distribution of Livermore tarplant is documented within the California Natural Diversity Database (CNDDB). Plant taxa, animal taxa, and natural communities that are documented within the CNDDB are of conservation concern within California and are referred to as "elements." An "element occurrence" (occurrence) is a location record for a site which contains an individual, population, nest site, den, or stand of a special status element. Populations, individuals, or colonies that are located within 1/4 mile of each other generally constitute a single occurrence, sometimes with multiple "parts" (Bittman 2001).

The Department updated the CNDDB occurrences for Livermore tarplant in October 2015 in conjunction with preparation of this Status Review. This update involved entering all information on Livermore tarplant that had been submitted to the Department, and checking for additional information on Livermore tarplant from online resources such as the Consortium of California Herbaria, Calflora.org, and CalPhotos.Berkeley.edu.

There are currently four occurrences for Livermore tarplant that are documented in the CNDDB; however, one of these occurrences consists of two separately-mapped parts that are bisected by a road. To make it easier to refer to the different occurrences and their parts in this Status Review, each occurrence or part of an occurrence has been named as a separate "population" in Table 1, below. A map of all of the known Livermore tarplant populations is presented in Figure 2. All Livermore tarplant populations are located within a three mile radius of each other.

[Insert Figure 1]

[Insert Figure 2]

Table 1. Livermore Tarplant Populations

Occurrence Number	*Population Name*	*Parcel Number(s)*	*Location (City or County)*	*Ownership*
Occurrence 1	Greenville Road	99B-5700-2-9	County	Private
Occurrence 2	Springtown	902-3-3-1	City	City
	Northeast Springtown	99B-5300-7	County	Public Utility
		99B-5300-6-4	County	Private
Occurrence 4	East Valley	99B-5600-4-24	County	Private
Occurrence 5	Dalton	99B-5300-5-5	County	Private

The locations of Livermore tarplant populations are shown in Figure 2 and described as follows:

Occurrence 1: Greenville Road. The Greenville Road population is located on private property (Assessor's Parcel Number 99B-5700-2-9) within unincorporated Alameda County, south of Interstate 580 and immediately east of Greenville Road south of its intersection with Las Positas Road. The Department estimates that the Greenville Road population was approximately 0.4 acre in area based on information reported to the CNDDB in 2013; however, the population has been largely destroyed as described below.

Occurrence 2: Springtown. The Springtown population is located within the boundaries of the City of Livermore, south of Raymond Road, west of Ames Street and north of Arabian Road. The western edge of the population is approximately halfway between Lorraine Road and Ames Street. The Springtown population is located on a parcel of land owned by the City of Livermore (Assessor's Parcel Number 902-3-3-1). The extent of the Springtown population was reported to the Department in 2000 via a CNDDB field survey form with the extent of the population hand-drawn onto a 7.5 minute topographic quadrangle map as a rectangle. On September 18, 2015 Department staff re-mapped the northern and western extents of the population based on field observations. The Department estimates that the outermost extent of the Springtown population occupies approximately 92 acres; however, the distribution of plants within the area is patchy, and there are large areas that are unsuitable as habitat that do not support Livermore tarplant. The Springtown population is the largest known population of Livermore tarplant.

Occurrence 2: Northeast Springtown. The Northeast Springtown population is located to the northeast of the turn in the road where Raymond Road and Ames Street meet, and was likely once part of the larger Springtown population. The Northeast Springtown population occurs on two parcels; one small parcel (Assessor's Parcel Number 99B-5300-7) is owned by a public utility and has a utility substation on it; the other parcel is much larger (Assessor's Parcel Number 99B-5300-6-4), and is privately owned. The Northeast Springtown population was reported to the Department in 2000 via a CNDDB field survey form and hand-drawn map, using a portion of a 7.5 minute topographic quadrangle map, and representing a polygon of about 11 acres. Livermore tarplant was reported “just up from where the water level would be during inundation, and continued upslope for approx 20-40 m.” Considering the soils and topography of the area, the Department concludes that the actual population may have occupied less than 11 acres.

Occurrence 4: East Valley. The East Valley population is located approximately 0.35 mile southeast of the Greenville Road population on the far side of a low prominence (717 feet in elevation). The East Valley population was reported to the Department in 2007 based on observations made in 2002 and 2003. The East Valley population is approximately 0.5 acre in size and located in a swale that leads to the Greenville Road population. The East Valley

population is located on private property within unincorporated Alameda County (Assessor's Parcel Number 99B-5600-4-24).

Occurrence 5: Dalton. The Dalton population is located west of Vasco Road and north of Dalton Avenue, and may have once been part of the larger Springtown population before the residential development on the west side of Vasco Road. The extent of the Dalton population was mapped based on the observations of Department staff from Vasco Road and Dalton Avenue in 2014 and 2015. The Dalton population is mapped as approximately nine acres; however, the accuracy of the mapping is low. The Dalton population occurs primarily on a privately owned parcel (Assessor's Parcel Number 99B-5300-5-5) within unincorporated Alameda County and may also occur on a parcel owned by the City of Livermore within the boundaries of the City (Assessor's Parcel Number 99B-8119-18). The Dalton population is separated from Occurrence 2 (the Springtown and Northeast Springtown populations) by roads and a residential subdivision.

The eastern portion of the Livermore Valley has been frequently visited by botanists and scientific plant collectors, including botanists specializing in tarplant species. Despite the past attention of scientific plant collectors there are few herbarium records for Livermore tarplant, which may reflect the rarity of the species (Baldwin 1999). Additional undocumented populations of Livermore tarplant may exist, particularly if they occur on private property that has not been surveyed. As described below under the heading, Habitat that May be Essential to the Continued Existence of the Species, and subheading, Geology and Soils, the mapped soil that is most closely associated with Livermore tarplant populations is Solano fine sandy loam. It is therefore reasonable to infer that any undiscovered Livermore tarplant populations would also be associated with Solano fine sandy loam. Figure 3 highlights the areas of the Livermore Valley that are mapped as having Solano fine sandy loam (Soil Survey Staff 2015b). There is one other area in California, not shown in Figure 3, that is mapped as Solano fine sandy loam and it is located approximately nine miles northeast of the known Livermore tarplant populations. Although properties owned by the City of Livermore have been surveyed by Department staff and others, the Department does not know whether or not other areas of Solano fine sandy loam have been surveyed.

Life History

Livermore tarplant is a tap-rooted summer annual plant, which means that it completes its life cycle within one year or growing season and goes through much of its growth cycle during the driest part of the year, after many other annual plants have died (Reever Morghan et al. 2007). The Department does not have any information on when Livermore tarplant seeds germinate, but because Livermore tarplant is a tap-rooted summer-flowering annual, seeds may geminate relatively late in the spring. After germination tap-rooted summer-flowering annual plants typically put most of their energy into growing a tap root that reaches relatively deep into soil to extract persistent moisture that is unavailable to other plants.

Livermore tarplant flowers can appear on plants between June and October (Baldwin 1999a, 2012; CNPS 2015). Though some members of the sunflower family are wind pollinated, species of the sunflower family with showy corollas and sticky, highly sculptured pollen, such as the echinate pollen grains of Livermore tarplant, are animal pollinated and generally receive many different visitors, typically insects, that may act as pollinators (Willmer 2011). Livermore tarplant is reported to be self-incompatible, meaning that it does not effectively self-pollinate (Baldwin and Strother 2006). Department staff have observed unidentified beetles (Figure 4, Photo 1) and bees visiting Livermore tarplant flower heads. The Department does not have any additional

Comment [A1]: Strictly speaking, the ecological category of "summer annual" is an annual that germinates in the summer, after summer (monsoonal) rains, and has a very short life cycle, for example, in the CA desert. Annual tarplants germinate after winter or spring rains and therefore are in the broad category of "winter annual" but D. bacigalupii definitely is a summer-flowering annual, if not a summer annual.

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information on how Livermore tarplant flowers are pollinated; however, based on observations of other *Deinandra* species and related

[Insert Figure 3]

[Insert Figure 4]

taxa, Livermore tarplant flowers are presumed to be pollinated by insects. Livermore tarplant seed production occurs during summer and fall months (Bartosh 2014). The Department does not have any information about how the seed of Livermore tarplant is dispersed. Because the seed-producing ray flowers of Livermore tarplant do not have a pappus, it is unlikely that wind is the primary dispersal mechanism. Seeds may be dispersed by birds or other animals (together with their enveloping sticky phyllaries), gravity, water flow, by some other means, or by a combination of these mechanisms.

Similar-looking Plants

Livermore tarplant blooms in summer and early fall, after many other plant species have dried up. Several summer-flowering annual tap-rooted plants of the sunflower family with yellow flower heads may be observed in the same or similar habitats at the same time of year that Livermore tarplant blooms. Such plants include narrow tarplant (*Holocarpha virgata* ssp. *virgata*), three-ray tarplant (*Deinandra lobbii*) and common spikeweed (*Centromadia pungens* ssp. *pungens*). Narrow tarplant is different from Livermore tarplant in that it has phyllaries (small leaf-like structures below the flowers of the flower head) that are pit-gland tipped and look knobby, and flower heads with dark anthers. In contrast, the phyllaries of Livermore tarplant are smooth and not knobby in appearance from a distance, and the flower heads are uniformly yellow, without dark anthers (Figure 4, Photo 2). Three-ray tarplant is easily distinguished from Livermore tarplant because it has three, or occasionally four, ray flowers and the plant has thinner, more delicate-looking stems, whereas Livermore tarplant has 3-35 ray flowers and thicker stems. Common spikeweed is easily distinguished from Livermore tarplant because the plant has sharp spines that are painful if the plant is handled, whereas Livermore tarplant does not have painful spines. Narrow tarplant, three-ray tarplant, and common spikeweed all have a much broader distribution than Livermore tarplant.

Habitat that may be Essential to the Continued Existence of the Species

Livermore tarplant grows in poorly-drained, seasonally-dry alkaline meadows in the vicinity of barren alkali scalds, alkali vernal pools and playa-like pools, and is associated with Solano fine sandy loam soil (Baldwin 1999, CNDDB 2015, Soil Survey Staff 2015b).

Vegetation Communities

Livermore tarplant occurs in the Upper Arroyo Las Positas Watershed.

Livermore tarplant is commonly observed growing with the non-native grasses ripgut brome (*Bromus diandrus*) and soft chess (*Bromus hordeaceus*), along with the native herbs alkali heath (*Frankenia salina*) and narrow tarplant (Bartosh 2010). Other plant species associated with Livermore tarplant include iodine bush (*Allenrolfea occidentalis*), brittlescale (*Atriplex depressa*), spikeweed, salt dodder (*Cuscuta salina*), three-ray tarplant, annual hair grass (*Deschampsia danthonioides*), salt grass (*Distichlis spicata*), brome fescue (*Festuca bromoides*), small fescue (*Festuca microstachys*), rattail sixweeks grass (*Festuca myuros*), alkali barley (*Hordeum depressum*), Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*), toad rush (*Juncus bufonius* var. *bufonius*), goldfields (*Lasthenia californica*), narrowflower flaxflower (*Leptosiphon liniflorus*), sickle grass (*Parapholis incurva*), sticky sand-spurrey (*Spergularia macrotheca* var. *longistyla*) and small-head clover (*Trifolium microcephalum*) (Baldwin 1999, Department observation).

The vegetation communities of the Upper Arroyo Las Positas Watershed were mapped by Aerial Information Systems in 2008 for the University of California, Berkeley. Some areas of the watershed were mapped in detail to the alliance level of classification using the National Vegetation Classification Standard (FGDC 2008) (NVCS), and A Manual of California Vegetation (Sawyer and Keeler-Wolf 1995), and other areas were mapped in a more generalized way (AIS 2008). The NVCS is hierarchical, with the most granular level being the association. Associations make up alliances, alliances make up groups, and groups make up macrogroups. The vegetation communities at the Springtown population of Livermore tarplant were mapped in detail, while the vegetation communities at the other Livermore tarplant populations (Northeast Springtown, Dalton, Greenville Road, and East Valley) were mapped in a more generalized way, and therefore the two maps cannot be compared directly.

The vegetation mapping was done before A Manual of California Vegetation (Sawyer et al. 2009) and the NVCS was revised, and also before the advent of higher resolution aerial imagery. Having such imagery would have enabled a more detailed delineation of the different types of sub- shrub, perennial, and annual herbaceous vegetation in the area. Furthermore, the mapping of vegetation was done in one instance, and fluctuations in weather, soil moisture, and other factors may change the locations where plants, particularly annual plants, are observed in the watershed from year to year.

The Springtown population is the largest known population of Livermore tarplant and is within the area that was mapped in more detail. Several vegetation types were mapped within the boundaries of the Springtown population, but due to the patchy distribution of Livermore tarplant in much of the mapped polygon, not all vegetation mapped within it is associated with Livermore tarplant (Bainbridge pers. comm. 2015). Livermore tarplant can occur in vegetation types mapped as:

- Mediterranean California Naturalized Annual & Perennial Grassland & Meadow Macro Group,
- *Distichlis spicata*,
- *Bromus diandrus* – *B. hordaeceous* – Clover mix, and
- *Hordeum* spp. – *B. hordaeceous* mix.

Livermore tarplant can occur along the edges of vegetation types mapped as:

- *Downingia pulchella*,
- Alkali Scalds,
- Western North American Vernal Pools & Other Seasonally Flooded Macro Group,
- *Juncus balticus* – *Eleocharis* spp.,
- *Lasthenia fremontii*,
- *Frankenia salina,*
- Western North American Interior Alkali-Saline Wetland, and
- Water

The Greenville Road and Northeast Springtown populations were mapped as Mediterranean California Naturalized Grassland and Meadow. The Dalton population was also mapped predominately as Mediterranean California Naturalized Grassland and Meadow, with small areas of *Lasthenia fremontii* and *Distichlis spicata* vegetation mapped nearby. The East Valley population was mapped as Mediterranean California Naturalized Grassland and Meadow and Alkali Scalds. Due to the general way in which the vegetation in these areas was mapped, these

vegetation types do not provide precise characterization of the habitat that may be essential to the continued existence of the species.

The habitat for Livermore tarplant would likely be classified as Alkali Meadow (Element Code 45310) under Robert Holland's Preliminary Descriptions of the Terrestrial Natural Communities of California (1986). The Holland classification system was used by the Department in the past to classify natural communities within California. The Holland system for classifying natural communities is no longer supported by the Department; however, records of Holland rare natural community classifications are still maintained in the Department's CNDDB and represent the best available information on rare natural communities in California. Occurrences of Holland rare community types will be maintained in the CNDDB until the entire state has been classified and mapped, at which time a new analysis of rare types will be performed.

Alkali Meadow is described as having relatively few plant species, dense to fairly open growth of perennial grasses and sedges that are usually low growing, a growing and flowering season from late spring to early fall, and fine-textured, more or less permanently moist alkaline soils (Holland 1986). Alkali Meadow has a natural heritage global rarity rank of G3 (Vulnerable) and a state rarity rank of S2.1 (Imperiled and very threatened) in the CNDDB. A rank of G3 means that an element is at moderate risk of global extinction or elimination due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors (CNDDB 2015). A state rank of 2 means that an element is imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state, and the ".1" signifies that the element is "very threatened" (CNDDB 2015).

Geology and Soils

Livermore tarplant populations occur in the Livermore Valley, which dates from the Neogene geologic period between 23 million and 2.6 million years ago (Alexander 2009). To the northeast of the Springtown Alkali Sink are the Altamont uplands, comprised of marine shale and sandstone. Groundwater and springs from these sedimentary rocks are high in soluble salts and are probably the source of salts that have accumulated in the alkali sink (Coats et al. 1988, Nomad Ecology 2008). Although the sediments are still accumulating in the Livermore Valley, the major soils of the Springtown area have horizons that likely took tens of thousands of years to develop (Alexander 2009). The Springtown population of Livermore tarplant occurs on an alluvial plain.

As discussed above, the soil mapped by Natural Resources Conservation Service that is most closely associated with the known Livermore tarplant populations is Solano fine sandy loam (Figure 3, Appendix A, Soil Survey Staff 2015b). The soil maps used to make this determination were made at a scale of 1:20,000 and therefore do not show small areas of contrasting soils.

Solano soils occur on nearly level low terraces and in valley plains with a slightly irregular or hummocky surface, and were formed in mixed, moderately fine textured, sedimentary alluvium. Solano soils are classified within the Typic Natrixeralfs subgroup of soils. Solano soils have a thermic soil temperature regime class, with a difference in soil temperature of greater than 6°C (11°F) between summer and winter and a mean annual soil temperature of approximately 15°C (60°F) to 18°C (65°F) (Soil Survey Staff 2014, 2015a). Solano soils also have a superactive cation-exchange activity class which means that they have a relatively high ratio of cation-exchange capacity (in a standard solution) to percent clay by weight (Soil Survey Staff 2014). Solano soil is usually dry between the depths of about 4 and 12 inches by May and usually

remains dry until October, with some or all of this profile moist for the rest of the year (Soil Survey Staff 2015a). Solano soils are described as typically having light brownish gray and light gray, strongly acid to very strongly acid, loam A2 (topsoil) horizons, and brown and light yellowish brown, neutral to strongly alkaline clay loam Bt (subsoil) horizons (Soil Survey Staff 2015a). Solano soils are somewhat poorly drained with slow or very slow runoff and very slow permeability (Soil Survey Staff 2015a).

Gaviota rocky sandy loam, Pescadero clay, and San Ysidro loam are also mapped within the vicinity of Livermore tarplant populations, or within poorly mapped areas of Livermore tarplant populations; however, it is not clear whether or not Livermore tarplant grows on these soil series. The Gaviota soil series occurs on hills and mountains and consists of shallow to very shallow well drained soils that formed in material weathered from hard sandstone or meta-sandstone (Soil Survey Staff 2015a), and it is unlikely that Gaviota soil supports significant populations of Livermore tarplant. The Pescadero soil series occurs in basins and consists of very deep, poorly drained soils that formed in alluvium from sedimentary rocks. San Ysidro series soils occur on old, low terraces and consist of deep, moderately well drained soils that formed in alluvium from sedimentary rocks.

Underground mammal burrows are common at the Springtown population (Department staff observation). A detailed report on the soils of Springtown Alkali Sink is provided as Appendix 3 of a 2010 report on Baseline Mapping, Habitat Mapping and Modeling for Palmate-Bracted Bird's-Beak at Springtown Alkali Sink (Bainbridge 2010).

Hydrology

The hydrologic system at Livermore tarplant populations starts with the Altamont and Tassajara uplands, where rainfall generates surface runoff or shallow subsurface flow that moves rapidly to well-defined channels (Coats et al. 1988). These channels deliver runoff to the bases of hills where much of the surface runoff infiltrates into the soils and the stream channels become less well defined. During intense or prolonged storms surface runoff may reach the Springtown Alkali Sink; however, the relative importance of surface versus subsurface flow at the site is unknown (Coats et al. 1988). There are two aquifers beneath the Springtown Alkali Sink: there is a shallow aquifer at a depth of 5 to 10 feet (1.5 to 3 meters), and a deeper groundwater body at a depth of over 100 feet (30 meters) (DWR 1974). The shallow aquifer and characteristics of Natrixeralfs soils (Pescadero and Solano soils) may allow moisture and dissolved salts to migrate to the soil surface through capillary action, allowing salts to accumulate on the surface.

Alkali scalds, and other habitat features at the Springtown population such as alkali vernal pools and playa-like pools are evident from aerial photography. The pattern and timing of water flow through the Springtown Alkali Sink and other areas of Livermore has been significantly altered by human activity, particularly through installation of storm drainage systems and realignment and deepening of Altamont Creek.

Climate

Livermore tarplant populations occur in an area with a Mediterranean climate, which consists of cool, wet winters and warm, dry summers. Using PRISM weather data from 1895 to 2014 in the vicinity of the Springtown population, the average minimum temperature is 8°C (46°F), the average maximum temperature is 23°C (73°F), the average temperature is 15 °C (59°F), and the average precipitation is 14 inches (35.6 centimeters) per year (PRISM 2015).

POPULATION TRENDS

Little is known about the population trends of Livermore tarplant. Livermore tarplant populations have either not been monitored regularly or have not been monitored at all, and to date, only one statistical population estimate has been made at one population, for one year. Most observations of population size have been rough, visual estimates that are not typically useful for year-to-year comparisons, or documenting trends. The visual population estimates that have been made are documented in the Department's CNDDB (2015).

The Department recognizes that annual plant populations can have high annual variability depending upon environmental conditions and are thus very difficult to monitor directly to detect population trends. Annual plant numbers can fluctuate wildly from year-to-year, depending on the seed production in previous years, germination of seedlings and environmental conditions (e.g., timing and amount of rainfall) (Fischer and Matthies 1998; Harrison et al. 1999). Aerial extent of populations is sometimes used as a rough indicator of population size; however, it is often more effective to focus on a habitat factor or significant threat when trying to monitor or understand trends (Elzinga et al. 1998).

Information regarding the population trends of Livermore tarplant is presented below.

Occurrence 1: Greenville Road. Livermore tarplant was collected from the Greenville Road population by Robert E. Preston and Bruce Baldwin between 1996 and 1999. In 2009, Heath Bartosh visually estimated the Greenville Road population to have approximately 1,600 Livermore tarplant individuals. Department staff visited the Greenville Road population on September 19, 2014, and observed that it was completely or almost completely buried by piles of dirt and/or trampled by heavy equipment, and no Livermore tarplants were observed (Figure 5, Photos 3 and 4). Department staff visited the Greenville Road population again on September 8, 2015, and observed two Livermore tarplant individuals, one on the outside of a fence surrounding the site (Figure 5, Photo 5) and one growing inside the fence on the side of a pile of recently-moved dirt. Through evaluation of aerial photographs and direct observation of the site, the Department infers that a severe decline in the Livermore tarplant population has taken place at Greenville Road, and this population may become extripated in the near future. Figure 6 shows the progression of habitat destruction that has taken place at the Greenville Road population from road construction, earthmoving and soil storage activities.

Occurrence 2: Springtown. The Springtown population was observed in 1966, 1969, 1976, and 1999, as documented by voucher specimens collected in those years. The Springtown population was also observed in 2000, and a field survey form submitted to the CNDDB reported that plants were more dense in the northeastern portion of the population, and became less dense in the southwestern portion of the population. The number of plants at the Springtown population was sampled in 2009, and was estimated to consist of between 237,690 and 365,552 individuals, with a 95 percent confidence interval (Bartosh 2010). The Springtown population has not been estimated via sampling again, therefore a population trend cannot be documented. The Springtown population was also observed in 2010 (CNDDB 2015). Department staff visited the Springtown population in 2014 and 2015, and although no quantitative data were collected, Livermore tarplant was observed to be present in both years, and appeared more abundant in 2015 than in 2014 (Figure 5, Photo 6). Although population data have not been collected in a systematic way, the Springtown population has been regularly observed over a span of almost 50 years.

[Insert Figure 5]

Occurrence 2: Northeast Springtown. A population estimate of greater than 100 individuals was reported to the CNDDB for the Northeast Springtown population in 2000, and a voucher collection from the population was made. Heath Bartosh reported in the Petition that the Northeast Springtown population is no longer considered extant. Mr. Bartosh later clarified that this determination was made because Mr. Bartosh has not observed Livermore tarplant at the location and the population is grazed by horses (H. Bartosh pers. comm. 2014). Department staff was unable to see any Livermore tarplant individuals at the Northeast Springtown population in 2015; however, buildings, fences, and the topography of the property obscured the view, and a survey of the property was not conducted. The Northeast Springtown population of Livermore tarplant population may now be extirpated, however additional surveys should be conducted to confirm whether or not the population remains.

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Occurrence 4: East Valley. The East Valley population was reported to have "many plants" in 2002, and a voucher specimen was collected from this population (CNPS 2005). The population was observed by CNPS again in 2003. CDFW could not view the East Valley population because it is on private property and far from the road. The status of the East Valley population has not been reported since 2003, and its current status is therefore unknown.

Occurrence 5: Dalton. The Dalton population was observed in 2004, and again in 2009 when Mr. Bartosh visually estimated the population to consist of roughly 500 individuals (Bartosh 2014, CNDDB 2015). Department staff observed Livermore tarplant at the Dalton population from adjacent roads in 2014 and 2015, but did not visually estimate the size of the population.

Scientific information on Livermore tarplant's population trends is limited, and while there is no scientifically-measured or statistical information available regarding the general population trends of Livermore tarplant, the Department nonetheless concludes that there is sufficient information to reasonably infer that the Greenville Road and Northeast Springtown populations of Livermore tarplant have declined substantially and have possibly been extirpated, respectively.

FACTORS AFFECTING THE ABILITY TO SURVIVE AND REPRODUCE

Habitat Modification and Destruction

All populations of Livermore tarplant are threatened either directly or indirectly by development, changes in land use, or other habitat modification or destruction. Development or changes in land use could directly destroy plants or destroy both occupied and potential habitat. Indirect threats to Livermore tarplant may occur from development or changes in land use near Livermore tarplant populations. Development or land use changes may alter the hydrologic regime, change water quality, alter soil chemistry, introduce non-native species, create conditions that are favorable for the spread of non-native species, increase the number of human visitors, cause soil disturbance and compaction, and increase garbage and pollution.

Past modification and destruction of habitat may also be a factor affecting the ability of Livermore tarplant to survive and reproduce. Habitat destruction that has already taken place may lead to an "extinction debt," where species that appear abundant disappear over time (Tilman et al. 1994, Kuussaari et al. 2009). Extinction processes often occur with a time delay and populations living close to their extinction threshold might survive for long time periods before they go extinct (Hanski & Ovaskainen 2002, Lindborg & Eriksson 2004, Helm et al. 2006, Vellend et al. 2006). Habitat specialist species may be more sensitive to changes in habitat and

thus more prone to local extinction than generalist species (Helm et al. 2006, Krauss et al. 2010, Cousins and Vanhoenacker 2011, Guardiola et al. 2013).

Past Modification and Destruction of Habitat

Livermore tarplant habitat was likely destroyed by development and land use changes in the Livermore Valley. Barren areas, alkali scalds and vernal pools are all associated with Livermore tarplant. These landscape features are visible in historic aerial images of the Upper Arroyo Las Positas Watershed, in areas that are now developed or under more intensive land use (Bainbridge 2010, Historic Aerials 2015). Some of these landscape features also previously occurred on Solano fine sandy loam soil, which is the soil series most closely associated with Livermore tarplant. The Department estimates that approximately 55 percent of the Solano fine sandy loam soil in the Livermore Valley has been developed (Figure 3). Therefore, Livermore tarplant may have occurred within or near to some of these areas, and some of its habitat was likely destroyed by the development of Livermore Valley.

Furthermore, all known populations of Livermore tarplant occur adjacent to or in the immediate vicinity of residential, industrial or other intensive land use. Considering the extent of Solano fine sandy loam soil in the vicinity of known Livermore tarplant populations and using historic aerial imagery, the existing Livermore tarplant populations may have once extended into areas that are now developed, such as the Proud Country subdivision developed in the late 1960s, the Greenville North subdivision developed in the 1960s and 1970s, the Saddleback subdivision developed in the late 1990s, and the industrial area to the west of Greenville Road developed beginning in the 1980s, with impacts continuing into 2015. Since 1962, the Springtown area has been disked, used as a landfill, used for placement of fill, and its main tributary (Altamont Creek) has been realigned and widened for flood control purposes (Bartosh et al. 2010).

The pattern and timing of water flow through the Springtown and larger Livermore area has also been significantly altered by human activity, particularly through installation of hardscape and storm drainage systems related to development. Because extinction processes often occur with a time delay, these past changes may affect the ability of Livermore tarplant to survive and reproduce.

Comparisons of current vegetation conditions in the Springtown area with conditions shown in historic aerial imagery also suggest that many areas that were barren or with alkali scalds in 1940 have been replaced with mesic annual grassland dominated by annual grasses and/or saltgrass (Bainbridge 2010). Such a decline in barren areas is consistent with altered hydrology, including diminishing salt concentrations (Bainbridge 2010).

Recent and Future Modification and Destruction of Habitat

Occurrence 1: Greenville Road. The Greenville Road population has recently been permanently damaged by habitat loss and degradation resulting from soil deposition activities, excavation of the western portion of the property, and the construction of a roadway accompanied by grading and gravelling of natural habitat. These activities occurred intermittently over several years, beginning before 2002, and culminating with severe habitat degradation and loss in 2014.

The Greenville Road population occurs on property with an agricultural ("A") zoning designation and there are no pending projects or anticipated zoning changes for the property (McElligott pers. comm. 2015). According to the Alameda County Planning Department, the current land use at the property is a landscape business with the majority of the parcel vacant. According to

the website for the business, the company transforms yard trimmings, wood debris and food waste into compost, mulch, decorative bark and soil amendment, and in 2013 a new Livermore facility was opened on property already owned by the business (Vision Recycling 2015).

The Alameda County zoning ordinance lists uses and accessory uses allowed in agricultural zones, and also provides a list of conditional uses allowed with a conditional use permit (Table 2). The agricultural conditional uses from Table 2 that most closely match the activities taking place at the Greenville Road population are:

- Composting Facility, and
- Administrative offices accessory to the principal use on the premises including activities by the same occupancy which are not related to the principal use providing such activities not so related are accessory to the administrative office activity.

The Alameda County Planning Commission issued a conditional use permit for the property with the Greenville Road population as a chip and grind facility in November of 2013. A California Environmental Quality Act initial study and mitigated negative declaration was prepared by BSK Associates for the action; however, environmental impacts to Livermore tarplant were not disclosed or evaluated in the initial study and mitigated negative declaration, and therefore no avoidance, minimization and/or mitigation measures were implemented for Livermore tarplant (Alameda County Planning Commission 2013, BSK Associates 2013).

Department staff visited the Greenville Road population on September 19, 2014 and observed that the population had been completely encroached upon by soil deposition activities and the habitat was largely destroyed. A large volume of dirt/fill had been deposited directly upon the former known location of the population, and related operation of heavy equipment had compacted and disturbed remaining areas of the Greenville Road population. Aerial imagery shows the habitat of the Greenville Road population to be relatively intact on March 31, 2014; however, the area was heavily disturbed by September 13, 2014 (Figure 6). From the vantage point of Department staff on the shoulder of Greenville Road, there was no evidence of any living Livermore tarplant on the site on September 19, 2014. Department staff visited the Greenville Road population again on September 8, 2015, and observed two Livermore tarplant individuals, one on the outside of a fence surrounding the site (Figure 5, Photo 6), and one growing inside the fence on the side of a pile of dirt. It is likely that the functionality of the habitat at the Greenville Road population is now permanently degraded or destroyed. The soil deposition activities may also cause indirect impacts to the population by facilitating establishment and expansion of non-native plant populations, changing hydrologic conditions, or changing soil chemistry from application of herbicides, fertilizers or pesticides. It is also unlikely that the few remaining plants at the Greenville Road population will be sufficient to sustain the population without a significant and immediate restoration effort and habitat protection. The Greenville Road population, therefore, has a high likelihood of becoming extripated from recent habitat modification and destruction.

Occurrence 2: Springtown. The Springtown population is mapped on one parcel (Assessor's Parcel Number 902-3-3-1) owned by and within the boundaries of the City of Livermore. The Springtown population is zoned as open space-agriculture, a zone designation applied to areas that are appropriate for permanent or semi-permanent open space, which the City of Livermore has determined to meet one or more of the following criteria (Stewart pers. comm. 2015, Livermore Development Code 3.03.180):

[Insert Table 2]

[Insert Figure 6]

- Represents the actual use of the land,
- Establishes the best use of the land,
- Indicates land intended by the City of Livermore not to be converted to urban use in the foreseeable future,
- Indicates land having resources found to be in the public interest to preserve, or
- Indicates land found not suitable for urban use due to natural or other hazards associated with the land.

Properties with an open space-agriculture zoning designation are considered unsuitable for development by the City of Livermore, and are limited to open space uses such as parks, trailways, recreation areas, recreation corridors, and protected areas, such as creeks and arroyos, or similar appropriate open space uses (Stewart pers. comm. 2015). The City of Livermore does not anticipate any zoning designation changes at or near Livermore tarplant populations in the future; however, the City is investigating the feasibility of a mitigation bank on properties owned by the City in the Springtown area (Stewart pers. comm. 2015). A draft prospectus for the mitigation bank is currently under review by an interagency review team (WRA 2015). According to the draft prospectus, the mitigation bank would protect and manage for the exceptional resources of the site while restoring degraded habitats and potentially establishing, re-establishing, rehabilitating, and/or enhancing wetlands and waters. Establishment of a mitigation bank may provide resources for the management and protection of Livermore tarplant populations. However, Livermore tarplant populations may be directly or indirectly impacted by actions to establish, re-establish, rehabilitate, and/or enhance wetlands and waters through destruction of habitat, alteration of surface hydrology, introduction of non-native plant species or creation of conditions that are favorable for the spread of non-native plant species.

Although the property on which the Springtown population occurs is currently zoned as open space agriculture, it is not permanently protected by a conservation easement or similar restriction. The zoning designation could, therefore, be changed by the Livermore City Council at some time in the future in a way that allows for more intensive use of all or a portion of the property.

Occurrence 2: Northeast Springtown. As previously noted, the Northeast Springtown population was likely once part of the larger Springtown population and may now be extirpated. If the Northeast Springtown population is still present, it may be impacted by future habitat modification and destruction.

The Northeast Springtown population occurs on property with an agricultural ("A") zoning designation and there are no pending projects or anticipated zoning changes for the property (McElligott pers. comm. 2015). According to the County of Alameda, the current land uses at the property are a utility tower and vacant/agriculture. The Alameda County zoning ordinance lists uses allowed in agricultural zones, and also provides a list of conditional uses allowed with a conditional use permit (Table 2). The agricultural conditional uses from Table 2 that most closely match the activities taking place at the Northeast Springtown population are:

- Grazing, breeding or training of horses or cattle; and
- Public utility building or uses, excluding such uses as a business office, storage garage, repair shop or corporation yard.

Although the utility tower has already been built, maintenance or reconstruction of the tower may impact Livermore tarplant in the future. Agricultural zoning could allow significant changes in land use, possibly without the issuance of a conditional use permit by the County of Alameda, or an environmental review under the California Environmental Quality Act. Significant modification or destruction of habitat may take place in the future to accommodate a change to one of the land use activities identified in Table 2. Agricultural zoning at the Northeast Springtown population could, therefore, allow land use changes that result in the complete destruction of the Northeast Springtown population, if one is extant.

Occurrence 4: East Valley. The East Valley population is considered extant and may be impacted by future habitat modification and destruction. The property on which the East Valley population occurs is currently within a Planned Development (PD) heavy industrial district. However, with the passage of the Alameda County Save Agriculture and Open Space Lands Initiative (Measure D) in November 2000, the Alameda County General Plan was amended to include limitations on development outside of city urban growth boundaries. This change limited the land use at the East Valley population by changing the Alameda County General Plan land use designation; however, the zoning designation for the property has not yet been changed. The parcel will need to be rezoned to correct this inconsistency prior to or in conjunction with any development project being conducted on the property in the future, but there are no immediate plans to do so (McElligott pers. comm. 2015). According to the Alameda County Planning Department, there are no pending projects for the property with the East Valley population.

If the property on which the East Valley population occurs is rezoned to Agriculture (A), as may be eventually required due to the passage of Measure D, then land uses identified in Table 2 would be permitted. Agricultural zoning could allow for significant changes in land use, possibly without the issuance of a conditional use permit by the County of Alameda or an environmental review under the California Environmental Quality Act. Significant modification or destruction of habitat may take place in the future to accommodate a change to one of the land use activities identified in Table 2. Agricultural zoning at the East Valley population could, therefore, allow land use changes that result in the complete destruction of the East Valley population.

Occurrence 5: Dalton. The Dalton population is considered extant and may be impacted by future habitat modification and destruction. The property on which the Dalton population occurs is within a Single Family Residential with Limited Agricultural Uses (R1-L-BE) district, and there are no pending projects or anticipated zoning changes for the property (McElligott pers. comm. 2015). According to the Alameda County Planning Department, the current land use at the property is vacant/agriculture. The Alameda County zoning ordinance lists uses allowed in R1-L-BE districts, and also provides a list of conditional uses allowed with a conditional use permit (Table 2). There are no structures or other obvious developments on the property. The property is partially surrounded by a barbed wire fence; however, the fence separating the property from the Vasco Road right-of-way was observed to be damaged in 2015.

Agricultural zoning at the Dalton population could allow significant changes in land use, possibly without the issuance of a conditional use permit by the County of Alameda or an environmental review under the California Environmental Quality Act. Significant modification or destruction of habitat may take place in the future to accommodate a change to one of the permitted uses identified in Table 2. Agricultural zoning at the Dalton population could, therefore, allow land use changes that result in the complete destruction of the Dalton population.

Impacts from Invasive Species (Competition and other Factors)

Invasive species are often cited as the second greatest threat to biodiversity behind habitat loss (Wilcove et al. 1998, Levine et al. 2003, Pimentel et al. 2004) and North America has accumulated the largest number of naturalized plants in the world (van Kleunen et al. 2015). Many studies hypothesize or suggest that competition is the process responsible for observed invasive species impacts to biodiversity; however, invasive species may impact native species in different ways (Levine et al. 2003). Invasive species may threaten native populations through competition for light, water or nutrients; allelopathic mechanisms; alteration of soil chemistry; thatch accumulation that inhibits seed germination and seedling recruitment; changes in natural fire frequency; disruptions to pollination or seed-dispersal mutualisms; changes in soil microorganisms or other mechanisms. The magnitude of invasive species impacts in Mediterranean habitats, such as those in California, largely depends on the characteristics of the invading species and the habitat being invaded (Fried et al. 2014). The invader's life form and ability to form very dense stands have an effect on the magnitude of impacts, with creeping plant species having greater effect (Gaertner et al. 2009, Fried et al. 2014). Greater invasive species impacts also have been recorded in areas with high soil moisture (Reever Morghan and Rice 2006, Fried et al. 2014). Invasive species may also influence native species colonization rates, and may thus lead to declines in local diversity over longer timescales (Yurkonis and Meiners 2004). Studies have not been conducted on the impact of invasive species on Livermore tarplant specifically; however, the negative impacts of plant invasions on Mediterranean ecosystems have been well demonstrated (Gaertner et al. 2009, Fried et al. 2014).

Mediterranean grasses and other aggressive invaders such as perennial pepperweed (*Lepidium latifolium*) and stinkwort (*Dittrichia graveolens*) occur within and/or in the vicinity of Livermore tarplant populations. Comparisons of current vegetation conditions in the Springtown area with conditions shown in historic aerial imagery suggest that many areas that were barren or with alkali scalds in 1940 have been replaced with mesic annual grassland, dominated by annual grasses and/or saltgrass (Bainbridge 2010). Nitrogen deposition from air pollution may increase the suitability of previously nutrient-poor habitats for invasive species, allowing such habitats to become more easily invaded (Weiss 1999).

Livermore tarplant populations are likely to be subject to ongoing and/or increasing inputs of invasive plant propagules from nearby populations and other sources. All populations of Livermore tarplant occur adjacent to transportation corridors which provide ongoing sources of invasive plant propagule introductions. The areas south of the Springtown population are heavily used by pedestrians and bicycle riders, which are both vectors for invasive species into the area. The area south of the Springtown population has also been used as a place to illegally dump garbage, which provides an additional vector for invasive species introduction. Grazing of the Springtown population may introduce invasive species via livestock and/or ranching operations. Habitat disturbances resulting from the close proximity of Livermore tarplant populations to urban development are also likely to provide opportunities for invasive species populations to establish and expand.

Ripgut brome, ryegrass (*Festuca perennis*), and/or other invasive annual grasses that are present at all Livermore tarplant populations may inhibit germination and suppress seedling recruitment of plant species through thatch accumulation and reduced soil disturbance in areas that have been heavily invaded (Bergelson 1990, Thomson 2005). In areas with established annual grass populations, carefully managed grazing may reduce some of the negative effects of thatch accumulation.

Perennial pepperweed is an erect perennial plant that grows up to six feet tall and is able to grow in many different areas and habitats including wetlands, meadows, vernal pools, and roadsides. Perennial pepperweed occurs most typically on moist or seasonally wet sites, tolerates saline and alkaline conditions, and can rapidly form dense stands that displace desirable vegetation and wildlife (DiTomaso et al. 2013). Perennial pepperweed reproduces from seed and vegetatively from vigorously underground rhizomes or pieces of rootstock. Once established, perennial pepperweed is persistent and difficult to control. Department staff have observed stands of perennial pepperweed on the east and west sides of Ames Street, in the immediate vicinity of Livermore tarplant.

Stinkwort is a fall-flowering annual plant that grows up to three feet tall and is able to grow in roadsides, washes, margins of vernal pools and other habitats. Stinkwort is rapidly expanding its range; thrives in areas with hot, dry summers; and can grow in serpentine, saline and metal-contaminated soils (DiTomaso et al. 2013). Stinkwort is a prolific seeder, with seeds distributed by wind, water or by sticking to fur or clothing, allowing populations of the plant to spread easily. The impacts of stinkwort to natural habitats are not known, but it may pose an emerging threat.

Invasive species may threaten Livermore tarplant populations through competition for light, water or nutrients; allelopathic mechanisms; alteration of soil chemistry; thatch accumulation that inhibits seed germination and seedling recruitment; disruptions to pollination or seed-dispersal mutualisms; or changes in soil microorganisms.

Recreation Activities

Recreation activities threaten the Springtown population, and may threaten other Livermore tarplant populations. Recreation activities such as off-road vehicle use, bicycle riding, construction of bicycle ramps and tracks, and pedestrian foot traffic result in direct trampling of Livermore tarplant, disturbance and compaction of soil, and introduction of invasive species.

Most of the property where the Springtown population occurs is fenced with barbed wire, which limits the amount of trespassing that occurs in the fenced area (East Pasture in Figure 7). There is an old county road to the south of the fenced area of the Springtown population and north of a privately-owned unfenced property. This road provides pedestrian and bicycle access to the area via the surrounding neighborhoods. The unfenced, publicly-accessible area is heavily used by pedestrians and bicycle riders. Many trails have developed and the landscape has been modified for use as bicycle or off-road vehicle ramps and tracks. The impacts of these use trails can be clearly seen in aerial imagery of the area (Figure 7). In 2015, no Livermore tarplant was observed in the unfenced, heavily-used area south of the fenceline, although plants were observed north of the fence. This observation could be a result of a natural gradient in the Livermore tarplant population density, combined with heavy use of the unfenced area.

The Department is not aware of any impacts from recreation activities at the other Livermore tarplant populations, but recreation impacts may impact these other populations in the future. The Dalton population may be at particular risk of impacts from recreation activities in the future, due to its proximity to residential neighborhoods.

Grazing

Since Spanish settlement in California in 1769, the introduction of livestock and alien plants has had profound consequences for native biodiversity. Impacts from livestock have contributed to

[Insert Figure 7]

the degradation of many habitats, particularly in California's Central Valley (Mack 1989). Although poorly managed grazing can significantly damage native habitats, carefully managed grazing can be a useful tool for the management of habitat to support native species by reducing some negative effects from non-native plants (Weiss 1999, Marty 2005).

Livestock may avoid direct consumption of tarplants; therefore, tarplants have been considered undesirable components of rangelands by rangeland managers in the past, and have been the target of control or elimination efforts (Perrier et al. 1981). Although consumption of Livermore tarplant by livestock may not be a significant threat, livestock presence in Livermore tarplant habitat may nevertheless result in negative impacts from plant trampling, disturbance of soil, the spread of invasive species, or the creation of conditions that are favorable for the establishment of invasive species. Grazing may support the continued existence of Livermore tarplant in areas with a history of heavy disturbance and established invasive plant populations by reducing negative impacts from competition or thatch accumulation.

The Greenville Road population is not grazed, the Springtown population appears to be grazed intermittently, and the Department does not have any information on whether or not, or to what extent the Northeast Springtown, East Valley and Dalton populations are grazed.

The Springtown population occurs within a pasture labeled "East Pasture", shown in Figure 7. The City of Livermore currently has grazing leases to manage properties owned by the City for biological resources, fuel reduction and to maintain fences. The City of Livermore's Springtown Preserve has been grazed by the same operator for approximately 20 to 30 years, but the grazing lease expired in 2015, so there may be a new grazing operator in 2016 (Stewart pers. comm. 2015). Mr. Stewart speculated that there were 10-20 animals on the Springtown Preserve in 2015, however the City of Livermore did not have any additional information on grazing of the property. During site visits in 2014 and 2015, Department staff observed evidence of grazing on the East Pasture that likely took place prior to 2014. Department staff observed evidence of recent grazing in the pasture labeled "West Pasture", shown in Figure 7, and a water trough is visible in aerial photography of the West Pasture to the northwest of a decommissioned landfill. Grazing operations in 2014 and 2015 may have been limited to the West Pasture, and therefore the Springtown population may not have been grazed recently.

The Department does not have any information on how grazing affects Livermore tarplant, specifically; however, the Department recognizes that excessive or inappropriate grazing has the potential to degrade Livermore tarplant habitat. Any grazing of Livermore tarplant habitat should, therefore, be monitored closely under an adaptive management program. Monitoring for such an adaptive management program should focus on Livermore tarplant and/or an appropriate habitat indicator such as residual dry matter, and the program should ensure that monitoring results trigger appropriate management responses such as changing the timing or intensity of grazing or implementing other measures. The data and reports from any monitoring and adaptive management programs should also be made available to resource agencies and the public.

Inappropriate grazing is considered to be a threat to the continued existence of Livermore tarplant. The lack of carefully managed grazing may also be a threat to Livermore tarplant in areas that have been negatively affected by the accumulation of thatch.

Climate Change

Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia (IPCC 2014). Climate change is a major challenge to the conservation of California's natural resources, and it will amplify existing risks and create new risks to natural systems.

Department staff conducted an assessment of the vulnerability of Livermore tarplant to climate change using the NatureServe Climate Change Vulnerability Index Version 3.0. However, some ecological and life history information used for the climate change vulnerability assessment is not yet known for Livermore tarplant. In particular, the Department does not know the species and/or mechanisms required for effective pollination of Livermore tarplant, the mechanisms used by Livermore tarplant for seed dispersal, or Livermore tarplant's seed dispersal distance. If more information on the ecology and life history of Livermore tarplant becomes available, the Department's assessment may change.

Based upon the Department's assessment, Livermore tarplant likely has a climate change vulnerability index value of Less Vulnerable (LV), indicating that available evidence does not suggest that abundance and/or range extent within the geographical area of the species will change (increase/decrease) substantially by the year 2050, though actual range boundaries may change.

If the Department learns that the seed dispersal mechanisms for Livermore tarplant are limited, or that there are a limited number of effective pollinator species for Livermore tarplant, then the vulnerability index value will likely change to Moderately Vulnerable (MV), indicating that abundance and/or range extent within the geographical area assessed is likely to decrease by the year 2050. If the Department learns that the seed dispersal mechanisms for Livermore tarplant are not limited, or that there are many effective pollinator species for Livermore tarplant, then the vulnerability index value will likely remain Less Vulnerable.

Vulnerability of Small Populations

The Department recognizes that species with small numbers of populations and small population sizes are highly vulnerable to extinction due to stochastic (chance) demographic and environmental and/or genetic events (Shaffer 1981, 1987; Primack 2006; Groom et al. 2006). Species with small numbers of populations or small populations may also be subject to increased genetic drift and inbreeding (Menges 1991, Ellstrand and Elam 1993). Livermore tarplant has a narrow distribution and few populations, with three of the four known populations occupying relatively small areas. Due to the vulnerability and rarity of Livermore tarplant, the loss of all or a significant portion of any Livermore tarplant population would represent the loss of a significant portion of Livermore tarplant's total range.

Herbicide Use and Right-of-way Maintenance

All known populations of Livermore tarplant occur adjacent to transportation corridors. Transportation corridors are subject to right-of-way maintenance activities and often subject to discing or herbicide treatments.

Department staff observed Livermore tarplant growing immediately beneath the barbed-wire fence that delineates the Dalton population from the Dalton Avenue right-of-way. The right-of-way, and some areas of the private property adjacent to the right-of-way, were observed to only

have dead vegetation, clearly a result of herbicide application. Several dead Livermore tarplants were found in these areas that appeared to have been killed by the herbicide treatment. Herbicide treatments may also directly impact other Livermore tarplant populations, particularly in areas adjacent to transportation corridors.

Disease and Parasites

The Department does not have any information on diseases or parasites affecting Livermore tarplant.

Predation

The Department does not have any information on predation affecting Livermore tarplant that is not related to grazing.

Overexploitation

The Department does not have any information on overexploitation affecting Livermore tarplant.

REGULATORY AND LISTING STATUS

Federal

Livermore tarplant is not protected pursuant to the federal Endangered Species Act.

State

On April 24, 2015, the Commission published its Notice of Findings for Livermore tarplant in the California Regulatory Notice Register, designating Livermore tarplant a candidate species pursuant to CESA. The provisions of CESA apply to Livermore tarplant while it is a candidate species (Fish & G. Code, § 2085). CESA prohibits the import, export, take, possession, purchase or sale of Livermore tarplant, or any part or product of Livermore tarplant, except in limited circumstances, such as through a permit or agreement issued by the Department under the authority of the Fish and Game Code. For example, the Department may issue permits that allow the incidental take of listed and candidate species if the take is minimized and fully mitigated, the activity will not jeopardize the continued existence of the species, and other conditions are met (Fish & G. Code § 2081(b)). The Department may also authorize the take and possession of Livermore tarplant for scientific, educational, or management purposes (Fish & G. Code § 2081(a)).

Natural Heritage Program Ranking

All natural heritage programs, such as the CNDDB, use the same ranking methodology originally developed by The Nature Conservancy and now maintained by NatureServe. This ranking methodology consists of a global rank describing the rank for a given taxon over its entire distribution, and a state rank describing the rank for the taxon over its state distribution. Both global and state ranks reflect a combination of rarity, threat and trend factors. Livermore tarplant has been assigned a global rank of G1 and a state rank of S1, indicating that the species is critically imperiled both within California and throughout its range, with a very high

risk of extinction due to extreme rarity (often five or fewer populations), very steep declines, or other factors.

California Rare Plant Rank

Some plants in California are assigned a California Rare Plant Rank (CRPR) to identify them as species of conservation concern. The Department works in collaboration with the California Native Plant Society and botanical experts throughout the state to assign rare and endangered plants a CRPR reflective of their status. Livermore tarplant has been assigned a CRPR of 1B.2.

Plants with a CRPR of 1B are rare throughout their range with the majority of them endemic to California. Most of the plants that are ranked 1B have declined significantly over the last century. The threat code extension of ".2" indicates that the species is moderately threatened in California, with 20 to 80 percent of occurrences threatened and/or a moderate degree and immediacy of threat.

City of Livermore General Plan

The Open Space and Conservation Element of the City of Livermore's General Plan contains policies and objectives related to the preservation and protection of rare and endangered species and alkali habitat (City of Livermore 2004). These objectives do not provide specific regulatory protection for Livermore tarplant, but are likely to be considered by the City of Livermore during planning and while making other decisions that may affect Livermore tarplant.

EXISTING MANAGEMENT EFFORTS

Resource Management Plans

The Department is not aware of any resource management plans prepared for Livermore tarplant, but activities by the City of Livermore and a Springtown Alkali Sink Working Group may provide some short-term management actions at the Springtown population that may benefit Livermore tarplant.

The City of Livermore Planning Department convened a Springtown Alkali Sink Working Group to work on issues related to the management of parcels owned by the City of Livermore in the Springtown area. The Springtown Alkali Sink Working Group works on issues such as establishing and maintaining signage, fundraising, outreach, weed control, additional fencing, and enhancing long-term protection and management. The Springtown Alkali Sink Working Group does not work specifically on Livermore tarplant management, but management activities in the Springtown area are likely to benefit Livermore tarplant. Funding may be acquired for near-term fencing, signage and noxious weed removal in the vicinity of the Springtown population through the mitigation requirements of a federal biological opinion (BO) that is unrelated to Livermore tarplant (Stewart pers. comm. 2015).

The East Alameda County Conservation Strategy provides guidance for open space and habitat acquisition, covers 19 focal species of plants and animals, including Livermore tarplant, and includes landscape-level conservation maps (ICF International 2010). Although the East Alameda County Conservation Strategy is not a resource management plan, and does not provide Livermore tarplant with any management or formal protection, it does describe goals and objectives related to protection and enhancement of alkali meadow and scalds, which are

important habitats for Livermore tarplant. The purpose of the East Alameda County Conservation Strategy is to streamline permitting and to be helpful for planning public agency projects by providing more certainty with regard to mitigation ratios, while promoting the protection of the covered species. There is a federal programmatic BO for federally-listed species associated with the East Alameda County Conservation Strategy.

Monitoring and Research

The Department is not aware of any ongoing Livermore tarplant research, or monitoring of Livermore tarplant populations.

Comment [A2]: My lab is continuing to study the evolution of D. bacigalupii as part of a large-scale analysis of Deinandra and other tarweed genera.

Habitat Restoration Projects

The Department is not aware of any Livermore tarplant habitat restoration projects. The Department does not have any information indicating that Livermore tarplant seed has been banked for restoration, or any other purposes.

Impacts of Existing Management Efforts

As discussed above, the Springtown population has been grazed by cattle in the past, but the Department does not have any information on the current grazing regime, such as the timing, duration or intensity.

SCIENTIFIC DETERMINATIONS REGARDING THE STATUS OF LIVERMORE TARPLANT IN CALIFORNIA

CESA directs the Department to prepare this report regarding the status of Livermore tarplant based upon the best scientific information available to the Department. CESA's implementing regulations identify key factors that are relevant to the Department's analyses. Specifically, a "species shall be listed as endangered or threatened ... if the Commission determines that its continued existence is in serious danger or is threatened by any one or any combination of the following factors: (1) present or threatened modification or destruction of its habitat; (2) overexploitation; (3) predation; (4) competition; (5) disease; or (6) other natural occurrences or human-related activities." (Cal. Code Regs., tit. 14, § 670.1, subd. (i)(1)(A)).

The definitions of endangered and threatened species in the Fish and Game Code provide key guidance to the Department's scientific determination. An endangered species under CESA is one "which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, over exploitation, predation, competition, or disease" (Fish & G. Code, § 2062). A threatened species under CESA is one "that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts required by [CESA]" (*Id.*, § 2067).

The preceding sections of this Status Review report describe the best scientific information available to the Department, with respect to the key factors identified in the regulations.

Present or Threatened Modification or Destruction of Habitat

The habitats in the Livermore Valley have been impacted by a history of modification and destruction from development, grazing, and other land use. Evaluation of soil maps and aerial imagery show that these activities have almost certainly resulted in the loss of Livermore tarplant habitat. Current land use practices, zoning and designations have led to recent and severe habitat modification and destruction that is likely to lead to the extirpation of a significant portion of Livermore tarplant's range, and the modification and destruction of habitat is likely to continue into the future. In addition, recreation activities within and in the vicinity of Livermore tarplant populations have resulted in habitat degradation that is evident on the ground and visible from aerial imagery. The Department considers modification and destruction of habitat to be a significant threat to the continued existence of Livermore tarplant.

Overexploitation

The Department does not consider overexploitation to be a significant threat to the continued existence of Livermore tarplant.

Predation

The Department does not consider predation to be a significant threat to the continued existence of Livermore tarplant.

Competition

Invasive plant species have been documented to pose serious threats to biodiversity around the world, and are a particularly pervasive problem in Mediterranean-type habitats like those in California. Invasive thatch-forming grasses, and other invasive plants such as perennial pepperweed, occur within and in close proximity to all Livermore tarplant populations. The Department considers invasive plant species to be a significant threat to the continued existence of Livermore tarplant.

Disease

There are no diseases known to be threats to the continued existence of Livermore tarplant. The Department does not consider disease to be a significant threat to the continued existence of Livermore tarplant.

Other Natural Occurrences or Human-related Activities

The climate of California is certain to change due to warming of the global climate system; however, it is unclear how such changes will affect Livermore tarplant. Livermore tarplant has a narrow distribution and few populations, with three of the four known populations occupying relatively small areas. Livermore tarplant's rarity and extremely limited distribution, and its occurrence only in and near developed areas, make the species very vulnerable to stochastic (chance) events such as droughts, wildfires, and accidents, and to all other threats. Therefore, the loss of all or a significant portion of any Livermore tarplant population would represent the loss of a significant portion of Livermore tarplant's total range. Both inappropriate grazing and the lack of appropriate grazing are considered to be threats to the continued existence of Livermore tarplant, and Livermore tarplant is also threatened by herbicide application and other right-of-way maintenance activities.

SUMMARY OF KEY FINDINGS

Livermore tarplant is a very rare species that is known from only four populations, all located within or less than 0.5 mile from the City of Livermore. All Livermore tarplant populations occur in close proximity to urban or other intensive land uses, and have been either directly or indirectly impacted by modification or destruction of habitat. Based upon current land use practices, zoning and designations, the modification or destruction of Livermore tarplant habitat is likely to continue into the future. Livermore tarplant populations have also been, and continue to be subject to ongoing impacts from invasive plant species, recreation activities, inappropriate grazing regimes, and herbicide use and right-of-way maintenance. It is unclear how climate change will affect Livermore tarplant. Compounding the threats to the species is the inherent vulnerability of small populations to extirpation due to stochastic (chance) events. Due to the limited distribution of Livermore tarplant, the loss of any Livermore tarplant population or a significant portion thereof would be considered the loss of a significant portion of the species total range.

Deleted: and

The information available to the Department regarding the status of Livermore tarplant indicates that there are significant threats to the continued existence of the species.

RECOMMENDATION FOR PETITIONED ACTION

CESA directs the Department to prepare this report regarding the status of Livermore tarplant in California based upon the best scientific information available to the Department. CESA also directs the Department to indicate in this Status Review whether the petitioned action is warranted (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)). The Department includes and makes its recommendation in this Status Review as submitted to the Commission in an advisory capacity based on the best available science. [Department recommendation will be added in the final report]

PROTECTION AFFORDED BY LISTING

It is the policy of the state to conserve, protect, restore and enhance any endangered or any threatened species and its habitat (Fish & G. Code, § 2052). If listed as an endangered or threatened species, unauthorized "take" of Livermore tarplant will be prohibited, making the conservation, protection, and enhancement of the species and its habitat an issue of statewide concern. As noted earlier, CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (*Id.*, § 86). Any person violating the take prohibition would be punishable under state law. The Fish and Game Code provides the Department with related authority to authorize "take" under certain circumstances (*Id.*, §§ 2081, 2081.1, 2086, 2087, 2089.6, 2089.10 and 2835). As authorized through an incidental take permit, however, impacts of the taking on Livermore tarplant caused by the activity must be minimized and fully mitigated according to state standards.

Additional protection of Livermore tarplant following listing would also occur with required public agency environmental review under CEQA, and its federal counter-part, the National Environmental Policy Act (NEPA). CEQA and NEPA both require affected public agencies to analyze and disclose project-related environmental effects, including potentially significant impacts on endangered, rare, and threatened special status species. Under CEQA's

"substantive mandate," for example, state and local agencies in California must avoid or substantially lessen significant environmental effects to the extent feasible. With that mandate, and the Department's regulatory jurisdiction generally, the Department expects related CEQA and NEPA review will likely result in increased information regarding the status of Livermore tarplant in California as a result of, among other things, updated occurrence and abundance information for individual projects. Where significant impacts are identified under CEQA, the Department expects project-specific required avoidance, minimization and mitigation measures will also benefit the species. While both CEQA and NEPA would require analysis of potential impacts to Livermore tarplant regardless of their listing status under CESA, the acts contain specific requirements for analyzing and mitigating impacts to listed species. In common practice, potential impacts to listed species are examined more closely in CEQA and NEPA documents than potential impacts to unlisted species. State listing, in this respect, and required consultation with the Department during state and local agency environmental review under CEQA, is also expected to benefit the species in terms of related impacts for individual projects that might otherwise occur absent listing.

If Livermore tarplant is listed under CESA, it may increase the likelihood that state and federal land and resource management agencies will allocate funds towards protection and recovery actions. However, funding for species recovery and management is limited, and there is a growing list of threatened and endangered species.

MANAGEMENT RECOMMENDATIONS AND RECOVERY MEASURES

The utility of current data on Livermore tarplant is limited by being largely anecdotal and qualitative. Studies designed to provide quantitative data on Livermore tarplant populations, and the factors that affect the potential for Livermore tarplant to survive and reproduce, are necessary for species management. The following list of recommended management actions was generated by Department staff with considerations from local agencies, non-profits, and interested parties:

- Permanently protect all Livermore tarplant habitat from modification and destruction via fee title acquisition, conservation easements or similar protective measures;
- Restrict public access to portions of the Springtown Preserve that support Livermore tarplant and other species of conservation concern;
- Restore degraded Livermore tarplant habitat at the Springtown, Northeast Springtown and Greenville Road populations;
- Implement monitoring and adaptive management programs for all Livermore tarplant populations. Focus monitoring on Livermore tarplant, indicator species (if identified), and/or an appropriate habitat indicator such as residual dry matter or evidence of impacts from recreation activities. Ensure that monitoring results trigger appropriate management responses such as changing the timing or intensity of grazing, implementing other measures to control invasive species, or controlling recreational activities. Make the data and reports from monitoring and adaptive management programs available to resource agencies and the public;
- Research the life history characteristics of Livermore tarplant, including factors related to pollination, seed dispersal, seed longevity, and microhabitat requirements for germination and recruitment;
- Bank seeds of Livermore tarplant from all extant populations for conservation purposes;
- Survey for additional populations of Livermore tarplant; and

- Implement a program to detect Livermore tarplant population trends using statistically valid population estimates.

PUBLIC RESPONSE

Comments were invited in response to the Petition in a Department press release dated September 16, 2015, and in letters mailed on November 17, 2015 to owners of land with Livermore tarplant populations. The Department received three e-mail messages in response to the press release, which are included in Appendix B. Additionally, one landowner contacted the Department via e-mail message to request information about the Livermore tarplant population on his property. Another landowner contacted the Department via telephone to express concern about limitations on property development options, and ask about the possibility of the State of California purchasing his property.

PEER REVIEW

Independent botany experts were invited to review the Status Review report before submission to the Fish and Game Commission. The letters of invitation and all comments received are included in Appendix C.

ACKNOWLEDGEMENTS

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APPENDIX A: Soils in the Vicinity of Livermore Tarplant Populations

APPENDIX B: Comments from Affected and Interested Parties on the Petitioned Action

APPENDIX C: Comments from Peer Reviewers on the Livermore tarplant Status Review Report

Peer Review Comments from Dr. Bruce Baldwin and Department Responses

Page	Line	Reviewer Comment	Department Response
2	24	Added text: “between the ray and disc flowers”	Text updated
7	37	Changed terminology from “summer annual” to “summer-flowering annual”. Comment: Strictly speaking, the ecological category of “summer annual” is an annual that germinates in the summer, after summer (monsoonal) rains, and has a very short life cycle, for example, in the CA desert. Annual tarplants germinate after winter or spring rains and therefore are in the broad category of “winter annual” but *D. bacigalupii* definitely is a summer-flowering annual, if not a summer annual.	Terminology changed throughout document
7	43-45	Revised text to: “Though some members of the sunflower family are wind pollinated, species of the sunflower family with showy corollas and sticky, highly sculptured pollen, such as the echinate pollen grains of Livermore tarplant, are animal pollinated and generally receive many different visitors, typically insects, that may act as pollinators (Willmer 2011)	Text updated, however the word “bristly” used instead of the more technical word “echinate”
10	5-6	Added text: “(together with their enveloping sticky phyllaries)”	Text updated
11	36	Corrected spelling of *Downingia*	Text updated
16	10	Corrected spelling of extirpated	Text updated
30	8-9	Comment: “My lab is continuing to study the evolution of D. bacigalupii as part of a large-scale analysis of Deinandra and other tarweed genera.”	Text updated: “The Baldwin Lab at University of California, Berkeley is continuing to study the evolution of Livermore tarplant as part of a large-scale analysis of the genus *Deinandra* and other tarweed genera.”
32	10	Deleted “and” to correct typo	Text updated

State of California – Natural Resources Agency
DEPARTMENT OF FISH AND WILDLIFE
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EDMUND G. BROWN JR., Governor
CHARLTON H. BONHAM, Director

January 14, 2016

Robert E. Preston, Ph.D.
Botanist/Wetlands Ecologist
ICF International
630 K Street, Suite 400
Sacramento, CA 95814

Dear Dr. Preston:

LIVERMORE TARPLANT (*DEINANDRA BACIGALUPII*); DEPARTMENT OF FISH AND WILDLIFE, PEER REVIEW STATUS REPORT

Thank you for agreeing to serve as a scientific peer reviewer for the California Department of Fish and Wildlife Status Review of Livermore tarplant (*Deinandra bacigalupii*). Please review the copy of the Department of Fish and Wildlife's (Department) peer review draft report dated January 14, 2016 that is included with this letter. The Department seeks your expert analysis and input regarding the scientific validity of the report and its assessment of the status of Livermore tarplant in California based on the best scientific information currently available. The Department respectfully requests that you focus your peer review effort on the body of relevant scientific information and the Department's related assessment of the population and life history elements prescribed in the California Endangered Species Act (CESA). **The Department would appreciate receiving your peer review input on or before February 11, 2016**.

The Department seeks your scientific peer review as part of formal proceedings pending before the California Fish and Game Commission under CESA. As you may know, the Commission is a constitutionally established entity distinct from the Department, exercising exclusive statutory authority under CESA to list species as endangered or threatened (Fish & G. Code, § 2070). The Department serves in an advisory capacity during CESA listing proceedings, charged by the Fish and Game Code to focus on the best scientific information available to make related recommendations to the Commission (Fish & G. Code, § 2074.6).

The Commission received the petition to list Livermore tarplant under CESA on August 26, 2014. On April 24, 2015, the Commission published findings formally designating Livermore tarplant as a candidate for listing as threatened or endangered under CESA. Livermore tarplant is currently protected under CESA in California in that capacity.

The peer review draft report forwarded to you today reflects the Department's effort to identify and analyze the best scientific information available regarding the status of Livermore tarplant in California. At this time, the Department believes that the best

available science indicates that listing the species as endangered under CESA is warranted. We underscore, however, that scientific peer review plays a critical role in the Department's effort to develop and finalize its recommendation to the Commission as required by the Fish and Game Code. Our expected recommendation to the Commission at this point may change following your input.

We ask you to focus your peer review on the best scientific information available regarding the status of Livermore tarplant in California. As with our own effort to date, your peer review of the science and analysis regarding each of the population and life history categories prescribed in CESA are particularly important (Cal. Code Regs., tit. 14, § 670.1(i)(1)(A)) (i.e., present or threatened habitat modification, overexploitation, predation, competition, disease, and other natural occurrences or human-related activities that could affect the species) as well as whether it indicates, in your opinion, that Livermore tarplant is at serious risk of becoming extinct throughout all or a significant portion of its range in California, or whether the species is likely to become so in California in the foreseeable future. Please note that the Department releases this peer review report to you solely as part of the peer review process, and it is not yet public.

A Microsoft Word version and a PDF version of the report are included with this letter; however, only the PDF version includes figures and appendices. For ease of review, you may submit your comments in "track changes" format, or in list form by page and line number. Please submit your comments electronically to Ms. Cherilyn Burton, Senior Environmental Scientist (Specialist) at cherilyn.burton@wildlife.ca.gov. Ms. Burton may also be reached at (916) 651-6508. If there is anything the Department can do to facilitate your review, please let us know.

Following receipt and consideration of peer review comments, the Department will prepare and submit its final report and related recommendation to the Commission. After at least a 30 day public review period, the Commission will consider the petition to list Livermore tarplant, the Department's report and related recommendations including peer review, and public testimony during a regularly scheduled Commission meeting prior to making their decision.

Thank you again for your contribution to the status review effort and the important input it provides during the Commission's related proceedings.

Sincerely,

Richard Macedo, Chief
Habitat Conservation Planning Branch

ec: Department of Fish and Wildlife

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January 28, 2016

Richard Macedo, Chief
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SUBJECT: Livermore Tarplant (*Deinandra bacigalupii*) Status Report Peer Review

Dear Mr. Macedo,

Thank you for the opportunity to review the "Status Review of Livermore Tarplant (*Deinandra bacigalupii*". I am a botanist and plant ecologist with over 25 years of experience working with threatened and endangered plant species, including impact analysis, mitigation and habitat conservation planning, and population monitoring. I have written many species accounts for special-status plants for various types of environmental documents, including EIRs, HCPs, and incidental take permits. I am familiar with Livermore tarplant through project work in the Livermore area, and I am among the first persons to have recognized that this plant might be an undescribed species.

Overall, the review is thorough and well written, and in most sections it accurately describes the best scientific information currently available. The review provides information on the species' taxonomy, biology, distribution, and habitat parameters, and it summarizes factors affecting the species' ability to persist under its present circumstances. To the best of my knowledge, this information appears to be complete, and I have no additional specific information to add. Therefore, my comments on the review focus on three areas where the report could be improved for clarity or by the additional of some relevant general information.

First, there are a number of small editorial-type changes that should be made, such as typographic errors or corrections to a few references cited in the text. I have annotated a copy of the review indicating where these revisions should be made. None of these changes would substantially change the discussion or conclusion. There are two other more substantial revisions that should be made to clarify the discussion; again, however, neither of these would alter the results or conclusion.

Very little is presented about Livermore tarplant seed dispersal or germination, because little is known. However, information on the seed biology is relevant to the feasibility of habitat management and restoration and seed banking. Because Livermore tarplant is an annual species, it must maintain a soil seed bank to persist during years where climatic conditions are unfavorable to growth or reproduction, and seed dormancy is a likely mechanism for maintaining a soil seed bank. Despite the lack of specific information available for Livermore tarplant, information is available for a number of related tarplant species, including several studies that examined seed germination and dormancy, and it seems reasonable to infer that similar mechanisms are present in Livermore tarplant. I added a comment to the review citing a fairly recent paper that also references previous work on this topic, and I also annotated paragraphs in the review that would benefit from discussing this information.

In addition, the habitat section does not clearly articulate the vegetation communities in which Livermore tarplant occurs. Information on the vegetation community is crucial for long-term monitoring,

restoration activities, and searches for additional populations. The review states that the vegetation maps available for the study area did not provide comparable levels of resolution, which made it difficult to determine the precise association between Livermore tarplant and the vegetation. I acknowledge the need to characterize the differences between the previous vegetation maps. However, the discussion, as currently written, is confusing, partly because of inconsistencies in the community nomenclature used, partly because the data is not fully synthesized, and partly because some of the information provided appears to be superfluous to the discussion. Despite these problems, the discussion ultimately correctly characterizes the habitat as alkali meadow. I have placed comments in the review text with suggestions to help clarify the discussion by standardizing the nomenclature, reorganizing the text, and removing extraneous text.

I concur with the assessment that habitat for Livermore tarplant continues to be degraded, with the consequence that the species is likely to become extinct in the foreseeable future unless actions are taken to protect and manage the habitat. Consequently, I believe that the logical conclusion to be drawn from the evidence summarized by the review is that that Livermore tarplant warrants State listing as "endangered."

Sincerely,

Robert E. Preston, Ph.D.
Botanist/Wetlands Ecologist
ICF International
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State of California
Natural Resources Agency
Department of Fish and Wildlife

REPORT TO THE FISH AND GAME COMMISSION

STATUS REVIEW OF LIVERMORE TARPLANT (*Deinandra bacigalupii*)

Peer Review Draft
January 14, 2016

Deinandra bacigalupii, photo by Jeb McKay Bjerke

Charlton H. Bonham, Director
Department of Fish and Wildlife

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LIST OF ABBREVIATIONS, ACRONYMS AND TERMS

BO – Biological Opinion

CEQA – California Environmental Quality Act

CESA – California Endangered Species Act

CNDDB – California Natural Diversity Database

CNPS – California Native Plant Society

Commission – California Fish and Game Commission

CRPR – California Rare Plant Rank

Department – California Department of Fish and Wildlife

Occurrence – Element Occurrence

et al. – "and others"

Evaluation – Initial Evaluation of Petition to List the Livermore tarplant (*Deinandra bacigalupii*) as Endangered under the California Endangered Species Act

Id. – "the same"

NEPA – National Environmental Policy Act

NVCS – National Vegetation Classification Standard

Petition - Petition to the State of California Fish and Game Commission from Mr. Heath Bartosh, Cosponsored by the California Native Plant Society to List Livermore Tarplant as an Endangered Species Pursuant to the California Endangered Species Act

ssp. – Subspecies

var. – Variety

EXECUTIVE SUMMARY

This Status Review of Livermore Tarplant (*Deinandra bacigalupii* B.G. Baldwin) (Status Review) has been prepared by the California Department of Fish and Wildlife (Department) for the California Fish and Game Commission (Commission) pursuant to the requirements of the California Endangered Species Act (CESA). This Status Review has been independently reviewed by scientific peers, and is based upon the best scientific information available to the Department.

Livermore tarplant is an herbaceous plant of the sunflower family (Asteraceae) that was described as a new species in 1999. There are four known occurrences of Livermore tarplant, all restricted to the eastern portion of the Livermore Valley, within the City of Livermore and unincorporated Alameda County, California. Livermore tarplant grows in poorly-drained, seasonally-dry, alkaline meadows in the vicinity of barren alkali scalds, alkali vernal pools and playa-like pools.

All populations of Livermore tarplant occur within the immediate vicinity of urban development. Livermore tarplant is threatened, both directly and indirectly, by recent and ongoing development and changes in land use, impacts from invasive species, trampling and recreation activities, inappropriate grazing or lack of grazing, and perhaps also by herbicide treatments and the effects of climate change. Livermore tarplant is also vulnerable to extinction due to the small number of Livermore tarplant populations and the relatively small sizes of those populations. Because of the rarity of Livermore tarplant, the loss of all or a significant portion of any Livermore tarplant population would represent the loss of a significant portion of Livermore tarplant's total range.

[Department recommendation will be added in the final report]

INTRODUCTION

This Status Review addresses Livermore tarplant (*Deinandra bacigalupii* B.G. Baldwin).

Petition History

On August 26, 2014 the Commission received a petition (Petition) from Mr. Heath Bartosh, cosponsored by the California Native Plant Society (CNPS), to list Livermore tarplant as an endangered species pursuant to CESA (Fish & G. Code § 2050 *et seq*.).

On August 28, 2014 the Commission referred the Petition to the Department for evaluation.

On September 12, 2014, as required by Fish and Game Code, section 2073.3, the Commission published notice of receipt of the Petition in the California Notice Register (Cal. Reg. Notice Register 2014, Vol. 37-Z, p.1627).

On January 14, 2015, the Department provided the Commission with a report, "Initial Evaluation of the Petition to List the Livermore tarplant (*Deinandra bacigalupii*) as Endangered under the California Endangered Species Act" (Evaluation). Based upon the information contained in the Petition, the Department concluded, pursuant to Fish and Game Code, section 2073.5, subdivision (a), that sufficient information exists to indicate that the petitioned action may be warranted, and recommended to the Commission that the Petition should be accepted and considered.

On April 9, 2015, at its scheduled public meeting in Santa Rosa, California, the Commission considered the Petition, the Department's Evaluation and recommendation, and comments received. The Commission found that sufficient information existed to indicate the petitioned action may be warranted and accepted the Petition for consideration.

Subsequently, on April 24, 2015, the Commission published its Notice of Findings for Livermore tarplant in the California Regulatory Notice Register, designating Livermore tarplant as a candidate species (Cal. Reg. Notice Register 2015, No. 17-Z, p. 656, http://www.oal.ca.gov/res/docs/pdf/notice/17z-2015.pdf).

Department of Fish and Wildlife Review

Following the Commission's action to designate Livermore tarplant as a candidate species, the Department notified affected and interested parties and solicited data and comments on the petitioned action pursuant to Fish and Game Code section 2074.4 (see also Cal. Code Regs., tit. 14, § 670.1, subd. (f)(2)). All comments received are included in Appendix B to this report. The Department promptly commenced its review of the status of the species as required by Fish and Game Code section 2074.6, which has now concluded with this Status Review document.

The Department sought independent and competent peer review on its draft Status Review report by scientists with expertise relevant to the status of Livermore tarplant. Appendix C contains the specific input provided to the Department by the individual peer reviewers, as well as a brief explanation of the evaluation and response to the input and any amendments made to the draft Status Review report (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)(2)).

BIOLOGY

Species Description

The information below is paraphrased from the original species description of Livermore tarplant (Baldwin 1999a) and from the Jepson Manual, 2nd Edition (Baldwin 2012).

Livermore tarplant is an herbaceous plant of the sunflower family (Asteraceae) that grows to a height of 3.9 to 15.7 inches (10 to 40 centimeters). The leaves and parts of the stems, flowers and flower heads of Livermore tarplant have minutely-stalked yellowish or clear glands that are sticky and give the plant a strong odor. Livermore tarplant has erect stems that are shiny near the base, and the stems have coarse, longish hairs. Its leaves have continuous and smooth margins or irregular lobes, and do not have leaf stalks. Leaves are evenly distributed along the stem, except at the base of the stem where the leaves form a rosette. The blades of the primary stem leaves are less than or equal to ten centimeters long, and the blades of leaves that are closer to the ends of stem branches are less than or equal to one cm long. The flower heads of Livermore tarplant usually have eight bright yellow ray flowers, each resembling a spreading petal with three lobes at the end. These ray flowers are pistillate, meaning that they only have female flower parts (pistils), and are capable of producing seed. The ray flowers of Livermore tarplant do not have a pappus, which is a structure that sometimes aids in seed dispersal in some plants of the sunflower family. There is a bract, called a phyllary, on the outside of the flower head for each of the ray flowers. There are usually 15-18 disc flowers near the center of the flower head which each have a pappus made of irregular scales. The disc flowers are bright yellow and are functionally staminate, meaning that typically only the male flower parts (stamens) are functional. The flower heads of Livermore tarplant also have one peripheral series of about 8-11 scale-like bracts. The dry, one-seeded fruits of Livermore tarplant are called achenes, and are less than 1/10 of an inch (2-2.5 millimeters) long, black and somewhat four-angled with a corrugated appearance. Livermore tarplant has a chromosome number of 2n= 12.

Taxonomy

A type specimen is the specimen, or group of specimens of an organism used to describe and name that organism. The type specimen of Livermore tarplant was collected by Robert F. Hoover on August 31, 1966 from the "junction of Ames St. and Raymond Road, north of Livermore… in sandy alkaline soil" (Hoover 1966). Hoover labeled the collection as only *Hemizonia* at the time, without identification to species. On April 26, 1967 Rimo Bacigalupi annotated the type specimen with the statement: "Does not seem to match any thus far published species of *Hemizonia*" (Baldwin 1999a). Dale E. Johnson annotated the type specimen as *Hemizonia paniculata* in 1978. In 1982 Barry Tanowitz included Livermore tarplant specimens as *Hemizonia increscens* ssp. *increscens*, and this inclusion was reflected in the treatment of *Hemizonia* in The Jepson Manual (Tanowitz 1982, 1993). In 1999, Bruce Baldwin proposed revisions in the taxonomy of North American tarplants based on phylogenetic, biosystematic and cytogenetic studies (Baldwin 1999b). Baldwin reinstated the genus *Deinandra* to accommodate many plants that were previously considered to be in the genus *Hemizonia,* including *H. increscens* ssp. *increscens*.

Comment [A1]: Correct/consistent citation is Tanowitz 1993

Deleted: Hickman

Dean K. Kelch first alerted Bruce Baldwin to the existence of Livermore tarplant, and Robert E. Preston informed Bruce Baldwin of an additional population near Greenville Road (Baldwin 1999a). Based on morphological, ecological, and phylogenetic considerations, Bruce Baldwin described Livermore tarplant as a new species (Baldwin 1999a). Baldwin noted that Livermore

tarplant is morphologically similar to *D. increscens*, but different in that it has (1) yellow and not dark-purple anthers, (2) a shorter and more irregular disc flower pappus, and (3) mostly entire or irregularly lobed leaves towards the base of the stem (rather than leaves that are pinnately divided, but not divided all the way down to the central axis of the leaf). Baldwin also noted that the results of molecular phylogenetic analyses of nuclear rDNA spacer sequences place Livermore tarplant closer to *D. corymbosa* than to *D. increscens* (Baldwin 1999a).

The word *Deinandra* means "terrible man" or "fierce man" in Greek, which was probably selected as a replacement for the name *Hartmannia*, which means "stag man", with stags being fiercely territorial (Borror 1960, Baldwin 2012). Livermore tarplant (*D. bacigalupii*) is named for Rimo Bacigalupi, the first curator of the Jepson Herbarium at University of California, Berkeley.

Comment [A2]: I suggest the following clarification: The botanist E. L. Greene coined the name *Deinandra* as a replacement for the genus name *Hartmannia*, which had been previously been used for a different genus of plants (Greene 1891, Flora Franciscana). *Deinandra*, which means "terrible man" or "fierce man" in Greek, appears to have been a play of words on the name Hartmann (German for "stag man", with stags being fiercely territorial) (Borror 1960, Baldwin 2012).

Range and Distribution

Range is considered to be the general geographical area in which an organism occurs. Distribution is considered to be the actual sites where individuals and populations of the species occur within the species' range.

Based on historical collections and other observational records, all known populations of Livermore tarplant are restricted to the eastern portion of the Livermore Valley within the City of Livermore and in unincorporated Alameda County, California (Figure 1). The Diablo Range is to the south of the Livermore Valley and Mt. Diablo is to the north. All Livermore tarplant populations occur in the Upper Arroyo Las Positas Watershed, which drains into Laguna Creek, Alameda Creek and ultimately the San Francisco Bay. Livermore tarplant occurs near the northern distributional limit of the genus *Deinandra* (Baldwin 1999a, CCH 2015). Livermore tarplant has been reported growing at elevations from approximately 520 to 650 feet above mean sea level (CNDDB 2015).

The distribution of Livermore tarplant is documented within the California Natural Diversity Database (CNDDB). Plant taxa, animal taxa, and natural communities that are documented within the CNDDB are of conservation concern within California and are referred to as "elements." An "element occurrence" (occurrence) is a location record for a site which contains an individual, population, nest site, den, or stand of a special status element. Populations, individuals, or colonies that are located within 1/4 mile of each other generally constitute a single occurrence, sometimes with multiple "parts" (Bittman 2001).

The Department updated the CNDDB occurrences for Livermore tarplant in October 2015 in conjunction with preparation of this Status Review. This update involved entering all information on Livermore tarplant that had been submitted to the Department, and checking for additional information on Livermore tarplant from online resources such as the Consortium of California Herbaria, Calflora.org, and CalPhotos.Berkeley.edu.

There are currently four occurrences for Livermore tarplant that are documented in the CNDDB; however, one of these occurrences consists of two separately-mapped parts that are bisected by a road. To make it easier to refer to the different occurrences and their parts in this Status Review, each occurrence or part of an occurrence has been named as a separate "population" in Table 1, below. A map of all of the known Livermore tarplant populations is presented in Figure 2. All Livermore tarplant populations are located within a three mile radius of each other.

[Insert Figure 1]

[Insert Figure 2]

Comment [A3]: Note: In box listing the status of each population, the Northeast Springtown population is more appropriately listed as “possibly extirpated”, not “possibly extinct”.

Table 1. Livermore Tarplant Populations

Occurrence Number	*Population Name*	*Parcel Number(s)*	*Location (City or County)*	*Ownership*
Occurrence 1	Greenville Road	99B-5700-2-9	County	Private
Occurrence 2	Springtown	902-3-3-1	City	City
	Northeast	99B-5300-7	County	Public Utility
	Springtown	99B-5300-6-4	County	Private
Occurrence 4	East Valley	99B-5600-4-24	County	Private
Occurrence 5	Dalton	99B-5300-5-5	County	Private

Comment [A4]: Does EO #2 include former EO #3? Why there is an occurrence #5 but only four occurrences needs to be explained.

The locations of Livermore tarplant populations are shown in Figure 2 and described as follows:

Occurrence 1: Greenville Road. The Greenville Road population is located on private property (Assessor's Parcel Number 99B-5700-2-9) within unincorporated Alameda County, south of Interstate 580 and immediately east of Greenville Road south of its intersection with Las Positas Road. The Department estimates that the Greenville Road population was approximately 0.4 acre in area based on information reported to the CNDDB in 2013; however, the population has been largely destroyed as described below.

Occurrence 2: Springtown. The Springtown population is located within the boundaries of the City of Livermore, south of Raymond Road, west of Ames Street and north of Arabian Road. The western edge of the population is approximately halfway between Lorraine Road and Ames Street. The Springtown population is located on a parcel of land owned by the City of Livermore (Assessor's Parcel Number 902-3-3-1). The extent of the Springtown population was reported to the Department in 2000 via a CNDDB field survey form with the extent of the population hand-drawn onto a 7.5 minute topographic quadrangle map as a rectangle. On September 18, 2015 Department staff re-mapped the northern and western extents of the population based on field observations. The Department estimates that the outermost extent of the Springtown population occupies approximately 92 acres; however, the distribution of plants within the area is patchy, and there are large areas that are unsuitable as habitat that do not support Livermore tarplant. The Springtown population is the largest known population of Livermore tarplant.

Occurrence 2: Northeast Springtown. The Northeast Springtown population is located to the northeast of the turn in the road where Raymond Road and Ames Street meet, and was likely once part of the larger Springtown population. The Northeast Springtown population occurs on two parcels; one small parcel (Assessor's Parcel Number 99B-5300-7) is owned by a public utility and has a utility substation on it; the other parcel is much larger (Assessor's Parcel Number 99B-5300-6-4), and is privately owned. The Northeast Springtown population was reported to the Department in 2000 via a CNDDB field survey form and hand-drawn map, using a portion of a 7.5 minute topographic quadrangle map, and representing a polygon of about 11 acres. Livermore tarplant was reported "just up from where the water level would be during inundation, and continued upslope for approx 20-40 m." Considering the soils and topography of the area, the Department concludes that the actual population may have occupied less than 11 acres.

Occurrence 4: East Valley. The East Valley population is located approximately 0.35 mile southeast of the Greenville Road population on the far side of a low prominence (717 feet in elevation). The East Valley population was reported to the Department in 2007 based on observations made in 2002 and 2003. The East Valley population is approximately 0.5 acre in size and located in a swale that leads to the Greenville Road population. The East Valley

population is located on private property within unincorporated Alameda County (Assessor's Parcel Number 99B-5600-4-24).

Occurrence 5: Dalton. The Dalton population is located west of Vasco Road and north of Dalton Avenue, and may have once been part of the larger Springtown population before the residential development on the west side of Vasco Road. The extent of the Dalton population was mapped based on the observations of Department staff from Vasco Road and Dalton Avenue in 2014 and 2015. The Dalton population is mapped as approximately nine acres; however, the accuracy of the mapping is low. The Dalton population occurs primarily on a privately owned parcel (Assessor's Parcel Number 99B-5300-5-5) within unincorporated Alameda County and may also occur on a parcel owned by the City of Livermore within the boundaries of the City (Assessor's Parcel Number 99B-8119-18). The Dalton population is separated from Occurrence 2 (the Springtown and Northeast Springtown populations) by roads and a residential subdivision.

The eastern portion of the Livermore Valley has been frequently visited by botanists and scientific plant collectors, including botanists specializing in tarplant species. Despite the past attention of scientific plant collectors there are few herbarium records for Livermore tarplant, which may reflect the rarity of the species (Baldwin 1999a). Additional undocumented populations of Livermore tarplant may exist, particularly if they occur on private property that has not been surveyed. As described below under the heading, Habitat that May be Essential to the Continued Existence of the Species, and subheading, Geology and Soils, the mapped soil that is most closely associated with Livermore tarplant populations is Solano fine sandy loam. It is therefore reasonable to infer that any undiscovered Livermore tarplant populations would also be associated with Solano fine sandy loam. Figure 3 highlights the areas of the Livermore Valley that are mapped as having Solano fine sandy loam (Soil Survey Staff 2015b). There is one other area in California, not shown in Figure 3, that is mapped as Solano fine sandy loam and it is located approximately nine miles northeast of the known Livermore tarplant populations. Although properties owned by the City of Livermore have been surveyed by Department staff and others, the Department does not know whether or not other areas of Solano fine sandy loam have been surveyed.

Life History

Livermore tarplant is a tap-rooted summer annual plant, which means that it completes its life cycle within one year or growing season and goes through much of its growth cycle during the driest part of the year, after many other annual plants have died (Reever Morghan et al. 2007). The Department does not have any information on when Livermore tarplant seeds germinate, but because Livermore tarplant is a tap-rooted summer annual, seeds may geminate relatively late in the spring. After germination tap-rooted summer annual plants typically put most of their energy into growing a tap root that reaches relatively deep into soil to extract persistent moisture that is unavailable to other plants.

Livermore tarplant blooms between June and October (Baldwin 1999a, 2012; CNPS 2015). Though some members of the sunflower family are wind pollinated, plants of the sunflower family generally receive many different visitors, typically insects, that may act as pollinators (Willmer 2011). Livermore tarplant is reported to be self-incompatible, meaning that it does not effectively self-pollinate (Baldwin and Strother 2006). Department staff have observed unidentified beetles (Figure 4, Photo 1) and bees visiting Livermore tarplant flower heads. The Department does not have any additional information on how Livermore tarplant flowers are pollinated; however, based on observations of other *Deinandra* species and related

Comment [A5]: But other tarplants germinate in midwinter - see Gregory et al 2001 (Madroño 48: 272-295), which also cites other papers on tarplant germination.

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[Insert Figure 3]

[Insert Figure 4]

taxa, Livermore tarplant flowers are presumed to be pollinated by insects. Livermore tarplant seed production occurs during summer and fall months (Bartosh 2014 pers. comm.). The Department does not have any information about how the seed of Livermore tarplant is dispersed. Because the seed-producing ray flowers of Livermore tarplant do not have a pappus, it is unlikely that wind is the primary dispersal mechanism. Seeds may be dispersed by birds or other animals, gravity, water flow, by some other means, or by a combination of these mechanisms.

Comment [A6]: Seeds of Livermore tarplant may, like other species of tarplants, experience dormancy, which would promote the presence of a soil seed bank. (Gregory et al 2001).

Similar-looking Plants

Livermore tarplant blooms in summer and early fall, after many other plant species have dried up. Several summer annual tap-rooted plants of the sunflower family with yellow flower heads may be observed in the same or similar habitats at the same time of year that Livermore tarplant blooms. Such plants include narrow tarplant (*Holocarpha virgata* ssp. *virgata*), three-ray tarplant (*Deinandra lobbii*) and common spikeweed (*Centromadia pungens* ssp. *pungens*). Narrow tarplant is different from Livermore tarplant in that it has phyllaries (small leaf-like structures below the flowers of the flower head) that are pit-gland tipped and look knobby, and flower heads with dark anthers. In contrast, the phyllaries of Livermore tarplant are smooth and not knobby in appearance from a distance, and the flower heads are uniformly yellow, without dark anthers (Figure 4, Photo 2). Three-ray tarplant is easily distinguished from Livermore tarplant because it has three, or occasionally four, ray flowers and the plant has thinner, more delicate-looking stems, whereas Livermore tarplant has 3-35 ray flowers and thicker stems. Common spikeweed is easily distinguished from Livermore tarplant because the plant has sharp spines that are painful if the plant is handled, whereas Livermore tarplant does not have spines. Narrow tarplant, three-ray tarplant, and common spikeweed all have a much broader distribution than Livermore tarplant.

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Habitat that may be Essential to the Continued Existence of the Species

Livermore tarplant grows in poorly-drained, seasonally-dry alkaline meadows in the vicinity of barren alkali scalds, alkali vernal pools and playa-like pools, and is associated with Solano fine sandy loam soil (Baldwin 1999a, CNDDB 2015, Soil Survey Staff 2015b).

Vegetation Communities

Livermore tarplant is commonly observed growing with the non-native grasses ripgut brome (*Bromus diandrus*) and soft chess (*Bromus hordeaceus*), along with the native herbs alkali heath (*Frankenia salina*) and narrow tarplant (Bartosh 2010). Other plant species associated with Livermore tarplant include iodine bush (*Allenrolfea occidentalis*), brittlescale (*Atriplex depressa*), spikeweed, salt dodder (*Cuscuta salina*), three-ray tarplant, annual hair grass (*Deschampsia danthonioides*), salt grass (*Distichlis spicata*), brome fescue (*Festuca bromoides*), small fescue (*Festuca microstachys*), rattail sixweeks grass (*Festuca myuros*), alkali barley (*Hordeum depressum*), Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*), toad rush (*Juncus bufonius* var. *bufonius*), goldfields (*Lasthenia californica*), narrowflower flaxflower (*Leptosiphon liniflorus*), sickle grass (*Parapholis incurva*), sticky sand-spurrey (*Spergularia macrotheca* var. *longistyla*) and small-head clover (*Trifolium microcephalum*) (Baldwin 1999a, Department observation).

Comment [A7]: This is distributional info that was stated in a prior section.

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Comment [A8]: Based on the vegetation communities listed below, I would also include saltgrass as a common associate.

The vegetation communities of the Upper Arroyo Las Positas Watershed were mapped by Aerial Information Systems in 2008 for the University of California, Berkeley. Some areas of the

watershed were mapped in detail to the alliance level of classification using the National Vegetation Classification Standard (FGDC 2008) (NVCS) and A Manual of California Vegetation (Sawyer and Keeler-Wolf 1995), and other areas were mapped in a more generalized way (AIS 2008). The NVCS is hierarchical, with the most granular level being the association. Associations make up alliances, alliances make up groups, and groups make up macrogroups. The vegetation communities at the Springtown population of Livermore tarplant were mapped in detail, while the vegetation communities at the other Livermore tarplant populations (Northeast Springtown, Dalton, Greenville Road, and East Valley) were mapped in a more generalized way, and therefore the two maps cannot be compared directly.

The vegetation mapping was done before A Manual of California Vegetation (Sawyer et al. 2009) and the NVCS was revised, and also before the advent of higher resolution aerial imagery. Having such imagery would have enabled a more detailed delineation of the different types of sub- shrub, perennial, and annual herbaceous vegetation in the area. Furthermore, the mapping of vegetation was done in one instance, and fluctuations in weather, soil moisture, and other factors may change the locations where plants, particularly annual plants, are observed in the watershed from year to year.

The Springtown population is the largest known population of Livermore tarplant and is within the area that was mapped in more detail. Several vegetation types were mapped within the boundaries of the Springtown population, but due to the patchy distribution of Livermore tarplant in much of the mapped polygon, not all vegetation mapped within it is associated with Livermore tarplant (Bainbridge pers. comm. 2015). Livermore tarplant can occur in vegetation types mapped as:

- Mediterranean California Naturalized Annual & Perennial Grassland & Meadow Macro Group,
- *Distichlis spicata*,
- *Bromus diandrus* – *B. hordaeceous* – Clover mix, and
- *Hordeum* spp. – *B. hordaeceous* mix.

Livermore tarplant can occur along the edges of vegetation types mapped as:

- *Downingia pulchella*,
- Alkali Scalds,
- Western North American Vernal Pools & Other Seasonally Flooded Macro Group,
- *Juncus balticus* – *Eleocharis* spp.,
- *Lasthenia fremontii*,
- *Frankenia salina,*
- Western North American Interior Alkali-Saline Wetland, and
- Water

The Greenville Road and Northeast Springtown populations were mapped as Mediterranean California Naturalized Grassland and Meadow. The Dalton population was also mapped predominately as Mediterranean California Naturalized Grassland and Meadow, with small areas of *Lasthenia fremontii* and *Distichlis spicata* vegetation mapped nearby. The East Valley population was mapped as Mediterranean California Naturalized Grassland and Meadow and Alkali Scalds. Due to the general way in which the vegetation in these areas was mapped, these vegetation types do not provide precise characterization of the habitat that may be essential to the continued existence of the species.

Comment [A9]: The vegetation types listed below aren't alliances; some are associations, and some are macrogroups; however, the macrogroup names used differ from those used in the NVCS and MCV. I recommend not using macrogroups - see comments 13 & 14. If it is necessary to use a macrogroup name for the grasslands, please use the "California Annual and Perennial Grassland" macrogroup, per the MCV.

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Comment [A10]: Is this really relevant to the following discussion?

Comment [A11]: Actually, we can make some reasonable extrapolations!

Comment [A12]: Isn't this just hand-waving? Seems to me that it would be simpler just to state that the information from the different maps was not mapped at the same resolution or using the same classification systems but was sufficient to characterize the habitat.

Comment [A13]: These aren't standard names; if you want to use MCV terminology, should be 2 alliances: Distichis spicata herbaceous alliance and Bromus (diandrus, hordeaceus)-Brachypodium distachyon semi-natural herbaceous stands. I don't recommend using macrogroups because the D spicata alliance is problematic; it is placed in a coastal salt marsh macrogroup in MCV, whereas it actually could be placed in several different macrogroups, based on the geographic subdivisions in which it occurs.

Comment [A14]: Again, these aren't standard names. This data can be better synthesized -- I recommend using 2 alliances: Lasthenia fremontii-Distichlis spicata herbaceous alliance and Allenrolfea occidentalis shrubland alliance. (The Allenrolfea alliance is placed in a desert macrogroup in MCV, so again, I don't recommend using macrogroups.)

Comment [A15]: Granted that this are less-resolved mapping units, I believe that Springtown veg types would apply to these as well.

The habitat for Livermore tarplant would likely be classified as Alkali Meadow (Element Code 45310) under Robert Holland's Preliminary Descriptions of the Terrestrial Natural Communities of California (1986). The Holland classification system was used by the Department in the past to classify natural communities within California. The Holland system for classifying natural communities is no longer supported by the Department; however, records of Holland rare natural community classifications are still maintained in the Department's CNDDB and represent the best available information on rare natural communities in California. Occurrences of Holland rare community types will be maintained in the CNDDB until the entire state has been classified and mapped, at which time a new analysis of rare types will be performed.

Alkali Meadow is described as having relatively few plant species, dense to fairly open growth of perennial grasses and sedges that are usually low growing, a growing and flowering season from late spring to early fall, and fine-textured, more or less permanently moist alkaline soils (Holland 1986). Alkali Meadow has a natural heritage global rarity rank of G3 (Vulnerable) and a state rarity rank of S2.1 (Imperiled and very threatened) in the CNDDB. A rank of G3 means that an element is at moderate risk of global extinction or elimination due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors (CNDDB 2015). A state rank of 2 means that an element is imperiled in the state because of rarity due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state, and the ".1" signifies that the element is "very threatened" (CNDDB 2015).

Geology and Soils

Livermore tarplant populations occur in the Livermore Valley, which dates from the Neogene geologic period between 23 million and 2.6 million years ago (Alexander 2009). To the northeast of the Springtown Alkali Sink are the Altamont uplands, comprised of marine shale and sandstone. Groundwater and springs from these sedimentary rocks are high in soluble salts and are probably the source of salts that have accumulated in the alkali sink (Coats et al. 1988, Nomad Ecology 2008). Although the sediments are still accumulating in the Livermore Valley, the major soils of the Springtown area have horizons that likely took tens of thousands of years to develop (Alexander 2009). The Springtown population of Livermore tarplant occurs on an alluvial plain.

As discussed above, the soil mapped by Natural Resources Conservation Service that is most closely associated with the known Livermore tarplant populations is Solano fine sandy loam (Figure 3, Appendix A, Soil Survey Staff 2015b). The soil maps used to make this determination were made at a scale of 1:20,000 and therefore do not show small areas of contrasting soils.

Solano soils occur on nearly level low terraces and in valley plains with a slightly irregular or hummocky surface, and were formed in mixed, moderately fine textured, sedimentary alluvium. Solano soils are classified within the Typic Natrixeralfs subgroup of soils. Solano soils have a thermic soil temperature regime class, with a difference in soil temperature of greater than 6°C (11°F) between summer and winter and a mean annual soil temperature of approximately 15°C (60°F) to 18°C (65°F) (Soil Survey Staff 2014, 2015a). Solano soils also have a superactive cation-exchange activity class which means that they have a relatively high ratio of cation-exchange capacity (in a standard solution) to percent clay by weight (Soil Survey Staff 2014). Solano soil is usually dry between the depths of about 4 and 12 inches by May and usually remains dry until October, with some or all of this profile moist for the rest of the year (Soil Survey Staff 2015a). Solano soils are described as typically having light brownish gray and light

Comment [A16]: I agree; this is how I classified the Springtown habitat in my field notes from a 2013 site visit.

Comment [A17]: Recommended revision to: ... within California but has been superseded by the Manual of California of Vegetation. However, Alkali Meadow is considered a rare plant community, and the CNDDB continues to maintain records of the community occurrences.

Comment [A18]: To keep with the logical flow between these paragraphs, I recommend moving this sentence up to the previous para as the second sentence.

Comment [A19]: I recommend adding a concluding statement emphasizing that Livermore tarplant is restricted to an imperiled habitat.

gray, strongly acid to very strongly acid, loam A2 (topsoil) horizons, and brown and light yellowish brown, neutral to strongly alkaline clay loam Bt (subsoil) horizons (Soil Survey Staff 2015a). Solano soils are somewhat poorly drained with slow or very slow runoff and very slow permeability (Soil Survey Staff 2015a).

Gaviota rocky sandy loam, Pescadero clay, and San Ysidro loam are also mapped within the vicinity of Livermore tarplant populations, or within poorly mapped areas of Livermore tarplant populations; however, it is not clear whether or not Livermore tarplant grows on these soil series. The Gaviota soil series occurs on hills and mountains and consists of shallow to very shallow well drained soils that formed in material weathered from hard sandstone or meta-sandstone (Soil Survey Staff 2015a), and it is unlikely that Gaviota soil supports significant populations of Livermore tarplant. The Pescadero soil series occurs in basins and consists of very deep, poorly drained soils that formed in alluvium from sedimentary rocks. San Ysidro series soils occur on old, low terraces and consist of deep, moderately well drained soils that formed in alluvium from sedimentary rocks.

Underground mammal burrows are common at the Springtown population (Department staff observation). A detailed report on the soils of Springtown Alkali Sink is provided as Appendix 3 of a 2010 report on Baseline Mapping, Habitat Mapping and Modeling for Palmate-Bracted Bird's-Beak at Springtown Alkali Sink (Bainbridge 2010).

Comment [A20]: This sentence seems out of place here; perhaps it should be moved to the section on habitat disturbance? What role might burrowing mammals play in providing openings in the grassland for Livermore tarplant (competitive escape)?

Hydrology

The hydrologic system at Livermore tarplant populations starts with the Altamont and Tassajara uplands, where rainfall generates surface runoff or shallow subsurface flow that moves rapidly to well-defined channels (Coats et al. 1988). These channels deliver runoff to the bases of hills where much of the surface runoff infiltrates into the soils and the stream channels become less well defined. During intense or prolonged storms surface runoff may reach the Springtown Alkali Sink; however, the relative importance of surface versus subsurface flow at the site is unknown (Coats et al. 1988). There are two aquifers beneath the Springtown Alkali Sink: there is a shallow aquifer at a depth of 5 to 10 feet (1.5 to 3 meters), and a deeper groundwater body at a depth of over 100 feet (30 meters) (DWR 1974). The shallow aquifer and characteristics of Natrixeralfs soils (Pescadero and Solano soils) may allow moisture and dissolved salts to migrate to the soil surface through capillary action, allowing salts to accumulate on the surface.

Alkali scalds, and other habitat features at the Springtown population such as alkali vernal pools and playa-like pools are evident from aerial photography. The pattern and timing of water flow through the Springtown Alkali Sink and other areas of Livermore has been significantly altered by human activity, particularly through installation of storm drainage systems and realignment and deepening of Altamont Creek.

Climate

Livermore tarplant populations occur in an area with a Mediterranean climate, which consists of cool, wet winters and warm, dry summers. Using PRISM weather data from 1895 to 2014 in the vicinity of the Springtown population, the average minimum temperature is 8°C (46°F), the average maximum temperature is 23°C (73°F), the average temperature is 15 °C (59°F), and the average precipitation is 14 inches (35.6 centimeters) per year (PRISM 2015).

POPULATION TRENDS

Little is known about the population trends of Livermore tarplant. Livermore tarplant populations have either not been monitored regularly or have not been monitored at all, and to date, only one statistical population estimate has been made at one population, for one year. Most observations of population size have been rough, visual estimates that are not typically useful for year-to-year comparisons, or documenting trends. The visual population estimates that have been made are documented in the Department's CNDDB (2015).

The Department recognizes that annual plant populations can have high annual variability depending upon environmental conditions and are thus very difficult to monitor directly to detect population trends. Annual plant numbers can fluctuate wildly from year-to-year, depending on the seed production in previous years, germination of seedlings and environmental conditions (e.g., timing and amount of rainfall) (Fischer and Matthies 1998; Harrison et al. 1999). Aerial extent of populations is sometimes used as a rough indicator of population size; however, it is often more effective to focus on a habitat factor or significant threat when trying to monitor or understand trends (Elzinga et al. 1998).

Information regarding the population trends of Livermore tarplant is presented below.

Occurrence 1: Greenville Road. Livermore tarplant was collected from the Greenville Road population by Robert E. Preston and Bruce Baldwin between 1996 and 1999. In 2009, Heath Bartosh visually estimated the Greenville Road population to have approximately 1,600 Livermore tarplant individuals. Department staff visited the Greenville Road population on September 19, 2014, and observed that it was completely or almost completely buried by piles of dirt and/or trampled by heavy equipment, and no Livermore tarplants were observed (Figure 5, Photos 3 and 4). Department staff visited the Greenville Road population again on September 8, 2015, and observed two Livermore tarplant individuals, one on the outside of a fence surrounding the site (Figure 5, Photo 5) and one growing inside the fence on the side of a pile of recently-moved dirt. Through evaluation of aerial photographs and direct observation of the site, the Department infers that a severe decline in the Livermore tarplant population has taken place at Greenville Road, and this population may become extirpated in the near future. Figure 6 shows the progression of habitat destruction that has taken place at the Greenville Road population from road construction, earthmoving and soil storage activities.

Occurrence 2: Springtown. The Springtown population was observed in 1966, 1969, 1976, and 1999, as documented by voucher specimens collected in those years. The Springtown population was also observed in 2000, and a field survey form submitted to the CNDDB reported that plants were more dense in the northeastern portion of the population, and became less dense in the southwestern portion of the population. The number of plants at the Springtown population was sampled in 2009, and was estimated to consist of between 237,690 and 365,552 individuals, with a 95 percent confidence interval (Bartosh 2010). The Springtown population has not been estimated via sampling again, therefore a population trend cannot be documented. The Springtown population was also observed in 2010 (CNDDB 2015). Department staff visited the Springtown population in 2014 and 2015, and although no quantitative data were collected, Livermore tarplant was observed to be present in both years, and appeared more abundant in 2015 than in 2014 (Figure 5, Photo 6). Although population data have not been collected in a systematic way, the Springtown population has been regularly observed over a span of almost 50 years.

Comment [A21]: Here's where info about seed dormancy/seed banking is important. Possibly there could be a chance to recover the population, if there are dormant seeds present and the site were restored.

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[Insert Figure 5]

Occurrence 2: Northeast Springtown. A population estimate of greater than 100 individuals was reported to the CNDDB for the Northeast Springtown population in 2000, and a voucher collection from the population was made. Heath Bartosh reported in the Petition that the Northeast Springtown population is no longer considered extant. Mr. Bartosh later clarified that this determination was made because Mr. Bartosh has not observed Livermore tarplant at the location and the population is grazed by horses (H. Bartosh pers. comm. 2014). Department staff was unable to see any Livermore tarplant individuals at the Northeast Springtown population in 2015; however, buildings, fences, and the topography of the property obscured the view, and a survey of the property was not conducted. The Northeast Springtown population of Livermore tarplant population may now be extirpated, however additional surveys should be conducted to confirm whether or not the population remains.

Occurrence 4: East Valley. The East Valley population was reported to have "many plants" in 2002, and a voucher specimen was collected from this population (CNPS 2005). The population was observed by CNPS again in 2003. CDFW could not view the East Valley population because it is on private property and far from the road. The status of the East Valley population has not been reported since 2003, and its current status is therefore unknown.

Occurrence 5: Dalton. The Dalton population was observed in 2004, and again in 2009 when Mr. Bartosh visually estimated the population to consist of roughly 500 individuals (Bartosh 2014, CNDDB 2015). Department staff observed Livermore tarplant at the Dalton population from adjacent roads in 2014 and 2015, but did not visually estimate the size of the population.

Scientific information on Livermore tarplant's population trends is limited, and while there is no scientifically-measured or statistical information available regarding the general population trends of Livermore tarplant, the Department nonetheless concludes that there is sufficient information to reasonably infer that the Greenville Road and Northeast Springtown populations of Livermore tarplant have declined substantially and have possibly been extirpated, respectively.

Comment [A22]: Again, here's another spot that info on seed dormancy/seed bank may be important. If habitat and the seed bank remains, the population may not be extirpated.

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Comment [A23]: Although recent Google Earth images indicate that the habitat is intact.

FACTORS AFFECTING THE ABILITY TO SURVIVE AND REPRODUCE

Habitat Modification and Destruction

All populations of Livermore tarplant are threatened either directly or indirectly by development, changes in land use, or other habitat modification or destruction. Development or changes in land use could directly destroy plants or destroy both occupied and potential habitat. Indirect threats to Livermore tarplant may occur from development or changes in land use near Livermore tarplant populations. Development or land use changes may alter the hydrologic regime, change water quality, alter soil chemistry, introduce non-native species, create conditions that are favorable for the spread of non-native species, increase the number of human visitors, cause soil disturbance and compaction, and increase garbage and pollution.

Past modification and destruction of habitat may also be a factor affecting the ability of Livermore tarplant to survive and reproduce. Habitat destruction that has already taken place may lead to an "extinction debt," where species that appear abundant disappear over time (Tilman et al. 1994, Kuussaari et al. 2009). Extinction processes often occur with a time delay and populations living close to their extinction threshold might survive for long time periods before they go extinct (Hanski & Ovaskainen 2002, Lindborg & Eriksson 2004, Helm et al. 2006, Vellend et al. 2006). Habitat specialist species may be more sensitive to changes in habitat and

thus more prone to local extinction than generalist species (Helm et al. 2006, Krauss et al. 2010, Cousins and Vanhoenacker 2011, Guardiola et al. 2013).

Past Modification and Destruction of Habitat

Livermore tarplant habitat was likely destroyed by development and land use changes in the Livermore Valley. Barren areas, alkali scalds and vernal pools are all associated with Livermore tarplant. These landscape features are visible in historic aerial images of the Upper Arroyo Las Positas Watershed, in areas that are now developed or under more intensive land use (Bainbridge 2010, Historic Aerials 2015). Some of these landscape features also previously occurred on Solano fine sandy loam soil, which is the soil series most closely associated with Livermore tarplant. The Department estimates that approximately 55 percent of the Solano fine sandy loam soil in the Livermore Valley has been developed (Figure 3). Therefore, Livermore tarplant may have occurred within or near to some of these areas, and some of its habitat was likely destroyed by the development of Livermore Valley.

Comment [A24]: Is what you mean to say, "Livermore tarplant is likely have been present to a greater extent historically but has undergone habitat loss through development ..."?

Furthermore, all known populations of Livermore tarplant occur adjacent to or in the immediate vicinity of residential, industrial or other intensive land use. Considering the extent of Solano fine sandy loam soil in the vicinity of known Livermore tarplant populations and using historic aerial imagery, the existing Livermore tarplant populations may have once extended into areas that are now developed, such as the Proud Country subdivision developed in the late 1960s, the Greenville North subdivision developed in the 1960s and 1970s, the Saddleback subdivision developed in the late 1990s, and the industrial area to the west of Greenville Road developed beginning in the 1980s, with impacts continuing into 2015. Since 1962, the Springtown area has been disked, used as a landfill, used for placement of fill, and its main tributary (Altamont Creek) has been realigned and widened for flood control purposes (Bartosh et al. 2010).

The pattern and timing of water flow through the Springtown and larger Livermore area has also been significantly altered by human activity, particularly through installation of hardscape and storm drainage systems related to development. Because extinction processes often occur with a time delay, these past changes may affect the ability of Livermore tarplant to survive and reproduce.

Comparisons of current vegetation conditions in the Springtown area with conditions shown in historic aerial imagery also suggest that many areas that were barren or with alkali scalds in 1940 have been replaced with mesic annual grassland dominated by annual grasses and/or saltgrass (Bainbridge 2010). Such a decline in barren areas is consistent with altered hydrology, including diminishing salt concentrations (Bainbridge 2010).

Recent and Future Modification and Destruction of Habitat

Occurrence 1: Greenville Road. The Greenville Road population has recently been permanently damaged by habitat loss and degradation resulting from soil deposition activities, excavation of the western portion of the property, and the construction of a roadway accompanied by grading and gravelling of natural habitat. These activities occurred intermittently over several years, beginning before 2002, and culminating with severe habitat degradation and loss in 2014.

The Greenville Road population occurs on property with an agricultural ("A") zoning designation and there are no pending projects or anticipated zoning changes for the property (McElligott pers. comm. 2015). According to the Alameda County Planning Department, the current land use at the property is a landscape business with the majority of the parcel vacant. According to

the website for the business, the company transforms yard trimmings, wood debris and food waste into compost, mulch, decorative bark and soil amendment, and in 2013 a new Livermore facility was opened on property already owned by the business (Vision Recycling 2015).

The Alameda County zoning ordinance lists uses and accessory uses allowed in agricultural zones, and also provides a list of conditional uses allowed with a conditional use permit (Table 2). The agricultural conditional uses from Table 2 that most closely match the activities taking place at the Greenville Road population are:

- Composting Facility, and
- Administrative offices accessory to the principal use on the premises including activities by the same occupancy which are not related to the principal use providing such activities not so related are accessory to the administrative office activity.

The Alameda County Planning Commission issued a conditional use permit for the property with the Greenville Road population as a chip and grind facility in November of 2013. A California Environmental Quality Act initial study and mitigated negative declaration was prepared by BSK Associates for the action; however, environmental impacts to Livermore tarplant were not disclosed or evaluated in the initial study and mitigated negative declaration, and therefore no avoidance, minimization and/or mitigation measures were implemented for Livermore tarplant (Alameda County Planning Commission 2013, BSK Associates 2013).

Department staff visited the Greenville Road population on September 19, 2014 and observed that the population had been completely encroached upon by soil deposition activities and the habitat was largely destroyed. A large volume of dirt/fill had been deposited directly upon the former known location of the population, and related operation of heavy equipment had compacted and disturbed remaining areas of the Greenville Road population. Aerial imagery shows the habitat of the Greenville Road population to be relatively intact on March 31, 2014; however, the area was heavily disturbed by September 13, 2014 (Figure 6). From the vantage point of Department staff on the shoulder of Greenville Road, there was no evidence of any living Livermore tarplant on the site on September 19, 2014. Department staff visited the Greenville Road population again on September 8, 2015, and observed two Livermore tarplant individuals, one on the outside of a fence surrounding the site (Figure 5, Photo 6), and one growing inside the fence on the side of a pile of dirt. It is likely that the functionality of the habitat at the Greenville Road population is now permanently degraded or destroyed. The soil deposition activities may also cause indirect impacts to the population by facilitating establishment and expansion of non-native plant populations, changing hydrologic conditions, or changing soil chemistry from application of herbicides, fertilizers or pesticides. It is also unlikely that the few remaining plants at the Greenville Road population will be sufficient to sustain the population without a significant and immediate restoration effort and habitat protection. The Greenville Road population, therefore, has a high likelihood of becoming extirpated from recent habitat modification and destruction.

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Occurrence 2: Springtown. The Springtown population is mapped on one parcel (Assessor's Parcel Number 902-3-3-1) owned by and within the boundaries of the City of Livermore. The Springtown population is zoned as open space-agriculture, a zone designation applied to areas that are appropriate for permanent or semi-permanent open space, which the City of Livermore has determined to meet one or more of the following criteria (Stewart pers. comm. 2015, Livermore Development Code 3.03.180):

[Insert Table 2]

[Insert Figure 6]

- Represents the actual use of the land,
- Establishes the best use of the land,
- Indicates land intended by the City of Livermore not to be converted to urban use in the foreseeable future,
- Indicates land having resources found to be in the public interest to preserve, or
- Indicates land found not suitable for urban use due to natural or other hazards associated with the land.

Properties with an open space-agriculture zoning designation are considered unsuitable for development by the City of Livermore, and are limited to open space uses such as parks, trailways, recreation areas, recreation corridors, and protected areas, such as creeks and arroyos, or similar appropriate open space uses (Stewart pers. comm. 2015). The City of Livermore does not anticipate any zoning designation changes at or near Livermore tarplant populations in the future; however, the City is investigating the feasibility of a mitigation bank on properties owned by the City in the Springtown area (Stewart pers. comm. 2015). A draft prospectus for the mitigation bank is currently under review by an interagency review team (WRA 2015). According to the draft prospectus, the mitigation bank would protect and manage for the exceptional resources of the site while restoring degraded habitats and potentially establishing, re-establishing, rehabilitating, and/or enhancing wetlands and waters. Establishment of a mitigation bank may provide resources for the management and protection of Livermore tarplant populations. However, Livermore tarplant populations may be directly or indirectly impacted by actions to establish, re-establish, rehabilitate, and/or enhance wetlands and waters through destruction of habitat, alteration of surface hydrology, introduction of non-native plant species or creation of conditions that are favorable for the spread of non-native plant species.

Although the property on which the Springtown population occurs is currently zoned as open space agriculture, it is not permanently protected by a conservation easement or similar restriction. The zoning designation could, therefore, be changed by the Livermore City Council at some time in the future in a way that allows for more intensive use of all or a portion of the property.

Occurrence 2: Northeast Springtown. As previously noted, the Northeast Springtown population was likely once part of the larger Springtown population and may now be extirpated. If the Northeast Springtown population is still present, it may be impacted by future habitat modification and destruction.

The Northeast Springtown population occurs on property with an agricultural ("A") zoning designation and there are no pending projects or anticipated zoning changes for the property (McElligott pers. comm. 2015). According to the County of Alameda, the current land uses at the property are a utility tower and vacant/agriculture. The Alameda County zoning ordinance lists uses allowed in agricultural zones, and also provides a list of conditional uses allowed with a conditional use permit (Table 2). The agricultural conditional uses from Table 2 that most closely match the activities taking place at the Northeast Springtown population are:

- Grazing, breeding or training of horses or cattle; and
- Public utility building or uses, excluding such uses as a business office, storage garage, repair shop or corporation yard.

Although the utility tower has already been built, maintenance or reconstruction of the tower may impact Livermore tarplant in the future. Agricultural zoning could allow significant changes in land use, possibly without the issuance of a conditional use permit by the County of Alameda, or an environmental review under the California Environmental Quality Act. Significant modification or destruction of habitat may take place in the future to accommodate a change to one of the land use activities identified in Table 2. Agricultural zoning at the Northeast Springtown population could, therefore, allow land use changes that result in the complete destruction of the Northeast Springtown population, if one is extant.

Occurrence 4: East Valley. The East Valley population is considered extant and may be impacted by future habitat modification and destruction. The property on which the East Valley population occurs is currently within a Planned Development (PD) heavy industrial district. However, with the passage of the Alameda County Save Agriculture and Open Space Lands Initiative (Measure D) in November 2000, the Alameda County General Plan was amended to include limitations on development outside of city urban growth boundaries. This change limited the land use at the East Valley population by changing the Alameda County General Plan land use designation; however, the zoning designation for the property has not yet been changed. The parcel will need to be rezoned to correct this inconsistency prior to or in conjunction with any development project being conducted on the property in the future, but there are no immediate plans to do so (McElligott pers. comm. 2015). According to the Alameda County Planning Department, there are no pending projects for the property with the East Valley population.

Comment [A25]: Based on recent Google Earth imagery, the habitat is intact, although there appears to have been some hydrological modifications in the upper part of the watershed.

If the property on which the East Valley population occurs is rezoned to Agriculture (A), as may be eventually required due to the passage of Measure D, then land uses identified in Table 2 would be permitted. Agricultural zoning could allow for significant changes in land use, possibly without the issuance of a conditional use permit by the County of Alameda or an environmental review under the California Environmental Quality Act. Significant modification or destruction of habitat may take place in the future to accommodate a change to one of the land use activities identified in Table 2. Agricultural zoning at the East Valley population could, therefore, allow land use changes that result in the complete destruction of the East Valley population.

Occurrence 5: Dalton. The Dalton population is considered extant and may be impacted by future habitat modification and destruction. The property on which the Dalton population occurs is within a Single Family Residential with Limited Agricultural Uses (R1-L-BE) district, and there are no pending projects or anticipated zoning changes for the property (McElligott pers. comm. 2015). According to the Alameda County Planning Department, the current land use at the property is vacant/agriculture. The Alameda County zoning ordinance lists uses allowed in R1-L-BE districts, and also provides a list of conditional uses allowed with a conditional use permit (Table 2). There are no structures or other obvious developments on the property. The property is partially surrounded by a barbed wire fence; however, the fence separating the property from the Vasco Road right-of-way was observed to be damaged in 2015.

Agricultural zoning at the Dalton population could allow significant changes in land use, possibly without the issuance of a conditional use permit by the County of Alameda or an environmental review under the California Environmental Quality Act. Significant modification or destruction of habitat may take place in the future to accommodate a change to one of the permitted uses identified in Table 2. Agricultural zoning at the Dalton population could, therefore, allow land use changes that result in the complete destruction of the Dalton population.

Impacts from Invasive Species (Competition and other Factors)

Invasive species are often cited as the second greatest threat to biodiversity behind habitat loss (Wilcove et al. 1998, Levine et al. 2003, Pimentel et al. 2004) and North America has accumulated the largest number of naturalized plants in the world (van Kleunen et al. 2015). Many studies hypothesize or suggest that competition is the process responsible for observed invasive species impacts to biodiversity; however, invasive species may impact native species in different ways (Levine et al. 2003). Invasive species may threaten native populations through competition for light, water or nutrients; allelopathic mechanisms; alteration of soil chemistry; thatch accumulation that inhibits seed germination and seedling recruitment; changes in natural fire frequency; disruptions to pollination or seed-dispersal mutualisms; changes in soil microorganisms or other mechanisms. The magnitude of invasive species impacts in Mediterranean habitats, such as those in California, largely depends on the characteristics of the invading species and the habitat being invaded (Fried et al. 2014). The invader's life form and ability to form very dense stands have an effect on the magnitude of impacts, with creeping plant species having greater effect (Gaertner et al. 2009, Fried et al. 2014). Greater invasive species impacts also have been recorded in areas with high soil moisture (Reever Morghan and Rice 2006, Fried et al. 2014). Invasive species may also influence native species colonization rates, and may thus lead to declines in local diversity over longer timescales (Yurkonis and Meiners 2004). Studies have not been conducted on the impact of invasive species on Livermore tarplant specifically; however, the negative impacts of plant invasions on Mediterranean ecosystems have been well demonstrated (Gaertner et al. 2009, Fried et al. 2014).

Mediterranean grasses and other aggressive invaders such as perennial pepperweed (*Lepidium latifolium*) and stinkwort (*Dittrichia graveolens*) occur within and/or in the vicinity of Livermore tarplant populations. Comparisons of current vegetation conditions in the Springtown area with conditions shown in historic aerial imagery suggest that many areas that were barren or with alkali scalds in 1940 have been replaced with mesic annual grassland, dominated by annual grasses and/or saltgrass (Bainbridge 2010). Nitrogen deposition from air pollution may increase the suitability of previously nutrient-poor habitats for invasive species, allowing such habitats to become more easily invaded (Weiss 1999).

Livermore tarplant populations are likely to be subject to ongoing and/or increasing inputs of invasive plant propagules from nearby populations and other sources. All populations of Livermore tarplant occur adjacent to transportation corridors which provide ongoing sources of invasive plant propagule introductions. The areas south of the Springtown population are heavily used by pedestrians and bicycle riders, which are both vectors for invasive species into the area. The area south of the Springtown population has also been used as a place to illegally dump garbage, which provides an additional vector for invasive species introduction. Grazing of the Springtown population may introduce invasive species via livestock and/or ranching operations. Habitat disturbances resulting from the close proximity of Livermore tarplant populations to urban development are also likely to provide opportunities for invasive species populations to establish and expand.

Ripgut brome, ryegrass (*Festuca perennis*), and/or other invasive annual grasses that are present at all Livermore tarplant populations may inhibit germination and suppress seedling recruitment of plant species through thatch accumulation and reduced soil disturbance in areas that have been heavily invaded (Bergelson 1990, Thomson 2005). In areas with established annual grass populations, carefully managed grazing may reduce some of the negative effects of thatch accumulation.

Perennial pepperweed is an erect perennial plant that grows up to six feet tall and is able to grow in many different areas and habitats including wetlands, meadows, vernal pools, and roadsides. Perennial pepperweed occurs most typically on moist or seasonally wet sites, tolerates saline and alkaline conditions, and can rapidly form dense stands that displace desirable vegetation and wildlife (DiTomaso et al. 2013). Perennial pepperweed reproduces from seed and vegetatively from vigorously underground rhizomes or pieces of rootstock. Once established, perennial pepperweed is persistent and difficult to control. Department staff have observed stands of perennial pepperweed on the east and west sides of Ames Street, in the immediate vicinity of Livermore tarplant.

Stinkwort is a fall-flowering annual plant that grows up to three feet tall and is able to grow in roadsides, washes, margins of vernal pools and other habitats. Stinkwort is rapidly expanding its range; thrives in areas with hot, dry summers; and can grow in serpentine, saline and metal-contaminated soils (DiTomaso et al. 2013). Stinkwort is a prolific seeder, with seeds distributed by wind, water or by sticking to fur or clothing, allowing populations of the plant to spread easily. The impacts of stinkwort to natural habitats are not known, but it may pose an emerging threat.

Invasive species may threaten Livermore tarplant populations through competition for light, water or nutrients; allelopathic mechanisms; alteration of soil chemistry; thatch accumulation that inhibits seed germination and seedling recruitment; disruptions to pollination or seed-dispersal mutualisms; or changes in soil microorganisms.

Recreation Activities

Recreation activities threaten the Springtown population, and may threaten other Livermore tarplant populations. Recreation activities such as off-road vehicle use, bicycle riding, construction of bicycle ramps and tracks, and pedestrian foot traffic result in direct trampling of Livermore tarplant, disturbance and compaction of soil, and introduction of invasive species.

Most of the property where the Springtown population occurs is fenced with barbed wire, which limits the amount of trespassing that occurs in the fenced area (East Pasture in Figure 7). There is an old county road to the south of the fenced area of the Springtown population and north of a privately-owned unfenced property. This road provides pedestrian and bicycle access to the area via the surrounding neighborhoods. The unfenced, publicly-accessible area is heavily used by pedestrians and bicycle riders. Many trails have developed and the landscape has been modified for use as bicycle or off-road vehicle ramps and tracks. The impacts of these use trails can be clearly seen in aerial imagery of the area (Figure 7). In 2015, no Livermore tarplant was observed in the unfenced, heavily-used area south of the fenceline, although plants were observed north of the fence. This observation could be a result of a natural gradient in the Livermore tarplant population density, combined with heavy use of the unfenced area.

The Department is not aware of any impacts from recreation activities at the other Livermore tarplant populations, but recreation impacts may impact these other populations in the future. The Dalton population may be at particular risk of impacts from recreation activities in the future, due to its proximity to residential neighborhoods.

Grazing

Since Spanish settlement in California in 1769, the introduction of livestock and alien plants has had profound consequences for native biodiversity. Impacts from livestock have contributed to

[Insert Figure 7]

the degradation of many habitats, particularly in California's Central Valley (Mack 1989). Although poorly managed grazing can significantly damage native habitats, carefully managed grazing can be a useful tool for the management of habitat to support native species by reducing some negative effects from non-native plants (Weiss 1999, Marty 2005).

Livestock may avoid direct consumption of tarplants; therefore, tarplants have been considered undesirable components of rangelands by rangeland managers in the past, and have been the target of control or elimination efforts (Perrier et al. 1981). Although consumption of Livermore tarplant by livestock may not be a significant threat, livestock presence in Livermore tarplant habitat may nevertheless result in negative impacts from plant trampling, disturbance of soil, the spread of invasive species, or the creation of conditions that are favorable for the establishment of invasive species. Grazing may support the continued existence of Livermore tarplant in areas with a history of heavy disturbance and established invasive plant populations by reducing negative impacts from competition or thatch accumulation.

The Greenville Road population is not grazed, the Springtown population appears to be grazed intermittently, and the Department does not have any information on whether or not, or to what extent the Northeast Springtown, East Valley and Dalton populations are grazed.

The Springtown population occurs within a pasture labeled "East Pasture", shown in Figure 7. The City of Livermore currently has grazing leases to manage properties owned by the City for biological resources, fuel reduction and to maintain fences. The City of Livermore's Springtown Preserve has been grazed by the same operator for approximately 20 to 30 years, but the grazing lease expired in 2015, so there may be a new grazing operator in 2016 (Stewart pers. comm. 2015). Mr. Stewart speculated that there were 10-20 animals on the Springtown Preserve in 2015, however the City of Livermore did not have any additional information on grazing of the property. During site visits in 2014 and 2015, Department staff observed evidence of grazing on the East Pasture that likely took place prior to 2014. Department staff observed evidence of recent grazing in the pasture labeled "West Pasture", shown in Figure 7, and a water trough is visible in aerial photography of the West Pasture to the northwest of a decommissioned landfill. Grazing operations in 2014 and 2015 may have been limited to the West Pasture, and therefore the Springtown population may not have been grazed recently.

The Department does not have any information on how grazing affects Livermore tarplant, specifically; however, the Department recognizes that excessive or inappropriate grazing has the potential to degrade Livermore tarplant habitat. Any grazing of Livermore tarplant habitat should, therefore, be monitored closely under an adaptive management program. Monitoring for such an adaptive management program should focus on Livermore tarplant and/or an appropriate habitat indicator such as residual dry matter, and the program should ensure that monitoring results trigger appropriate management responses such as changing the timing or intensity of grazing or implementing other measures. The data and reports from any monitoring and adaptive management programs should also be made available to resource agencies and the public.

Inappropriate grazing is considered to be a threat to the continued existence of Livermore tarplant. The lack of carefully managed grazing may also be a threat to Livermore tarplant in areas that have been negatively affected by the accumulation of thatch.

Climate Change

Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia (IPCC 2014). Climate change is a major challenge to the conservation of California's natural resources, and it will amplify existing risks and create new risks to natural systems.

Department staff conducted an assessment of the vulnerability of Livermore tarplant to climate change using the NatureServe Climate Change Vulnerability Index Version 3.0. However, some ecological and life history information used for the climate change vulnerability assessment is not yet known for Livermore tarplant. In particular, the Department does not know the species and/or mechanisms required for effective pollination of Livermore tarplant, the mechanisms used by Livermore tarplant for seed dispersal, or Livermore tarplant's seed dispersal distance. If more information on the ecology and life history of Livermore tarplant becomes available, the Department's assessment may change.

Based upon the Department's assessment, Livermore tarplant likely has a climate change vulnerability index value of Less Vulnerable (LV), indicating that available evidence does not suggest that abundance and/or range extent within the geographical area of the species will change (increase/decrease) substantially by the year 2050, though actual range boundaries may change.

If the Department learns that the seed dispersal mechanisms for Livermore tarplant are limited, or that there are a limited number of effective pollinator species for Livermore tarplant, then the vulnerability index value will likely change to Moderately Vulnerable (MV), indicating that abundance and/or range extent within the geographical area assessed is likely to decrease by the year 2050. If the Department learns that the seed dispersal mechanisms for Livermore tarplant are not limited, or that there are many effective pollinator species for Livermore tarplant, then the vulnerability index value will likely remain Less Vulnerable.

Vulnerability of Small Populations

The Department recognizes that species with small numbers of populations and small population sizes are highly vulnerable to extinction due to stochastic (chance) demographic and environmental and/or genetic events (Shaffer 1981, 1987; Primack 2006; Groom et al. 2006). Species with small numbers of populations or small populations may also be subject to increased genetic drift and inbreeding (Menges 1991, Ellstrand and Elam 1993). Livermore tarplant has a narrow distribution and few populations, with three of the four known populations occupying relatively small areas. Due to the vulnerability and rarity of Livermore tarplant, the loss of all or a significant portion of any Livermore tarplant population would represent the loss of a significant portion of Livermore tarplant's total range.

Herbicide Use and Right-of-way Maintenance

All known populations of Livermore tarplant occur adjacent to transportation corridors. Transportation corridors are subject to right-of-way maintenance activities and often subject to discing or herbicide treatments.

Department staff observed Livermore tarplant growing immediately beneath the barbed-wire fence that delineates the Dalton population from the Dalton Avenue right-of-way. The right-of-way, and some areas of the private property adjacent to the right-of-way, were observed to only

have dead vegetation, clearly a result of herbicide application. Several dead Livermore tarplants were found in these areas that appeared to have been killed by the herbicide treatment. Herbicide treatments may also directly impact other Livermore tarplant populations, particularly in areas adjacent to transportation corridors.

Disease and Parasites

The Department does not have any information on diseases or parasites affecting Livermore tarplant.

Predation

The Department does not have any information on predation affecting Livermore tarplant that is not related to grazing.

Overexploitation

The Department does not have any information on overexploitation affecting Livermore tarplant.

REGULATORY AND LISTING STATUS

Federal

Livermore tarplant is not protected pursuant to the federal Endangered Species Act.

State

On April 24, 2015, the Commission published its Notice of Findings for Livermore tarplant in the California Regulatory Notice Register, designating Livermore tarplant a candidate species pursuant to CESA. The provisions of CESA apply to Livermore tarplant while it is a candidate species (Fish & G. Code, § 2085). CESA prohibits the import, export, take, possession, purchase or sale of Livermore tarplant, or any part or product of Livermore tarplant, except in limited circumstances, such as through a permit or agreement issued by the Department under the authority of the Fish and Game Code. For example, the Department may issue permits that allow the incidental take of listed and candidate species if the take is minimized and fully mitigated, the activity will not jeopardize the continued existence of the species, and other conditions are met (Fish & G. Code § 2081(b)). The Department may also authorize the take and possession of Livermore tarplant for scientific, educational, or management purposes (Fish & G. Code § 2081(a)).

Natural Heritage Program Ranking

All natural heritage programs, such as the CNDDB, use the same ranking methodology originally developed by The Nature Conservancy and now maintained by NatureServe. This ranking methodology consists of a global rank describing the rank for a given taxon over its entire distribution, and a state rank describing the rank for the taxon over its state distribution. Both global and state ranks reflect a combination of rarity, threat and trend factors. Livermore tarplant has been assigned a global rank of G1 and a state rank of S1, indicating that the species is critically imperiled both within California and throughout its range, with a very high

risk of extinction due to extreme rarity (often five or fewer populations), very steep declines, or other factors.

California Rare Plant Rank

Some plants in California are assigned a California Rare Plant Rank (CRPR) to identify them as species of conservation concern. The Department works in collaboration with the California Native Plant Society and botanical experts throughout the state to assign rare and endangered plants a CRPR reflective of their status. Livermore tarplant has been assigned a CRPR of 1B.2.

Plants with a CRPR of 1B are rare throughout their range with the majority of them endemic to California. Most of the plants that are ranked 1B have declined significantly over the last century. The threat code extension of ".2" indicates that the species is moderately threatened in California, with 20 to 80 percent of occurrences threatened and/or a moderate degree and immediacy of threat.

City of Livermore General Plan

The Open Space and Conservation Element of the City of Livermore's General Plan contains policies and objectives related to the preservation and protection of rare and endangered species and alkali habitat (City of Livermore 2004). These objectives do not provide specific regulatory protection for Livermore tarplant, but are likely to be considered by the City of Livermore during planning and while making other decisions that may affect Livermore tarplant.

EXISTING MANAGEMENT EFFORTS

Resource Management Plans

The Department is not aware of any resource management plans prepared for Livermore tarplant, but activities by the City of Livermore and a Springtown Alkali Sink Working Group may provide some short-term management actions at the Springtown population that may benefit Livermore tarplant.

The City of Livermore Planning Department convened a Springtown Alkali Sink Working Group to work on issues related to the management of parcels owned by the City of Livermore in the Springtown area. The Springtown Alkali Sink Working Group works on issues such as establishing and maintaining signage, fundraising, outreach, weed control, additional fencing, and enhancing long-term protection and management. The Springtown Alkali Sink Working Group does not work specifically on Livermore tarplant management, but management activities in the Springtown area are likely to benefit Livermore tarplant. Funding may be acquired for near-term fencing, signage and noxious weed removal in the vicinity of the Springtown population through the mitigation requirements of a federal biological opinion (BO) that is unrelated to Livermore tarplant (Stewart pers. comm. 2015).

The East Alameda County Conservation Strategy provides guidance for open space and habitat acquisition, covers 19 focal species of plants and animals, including Livermore tarplant, and includes landscape-level conservation maps (ICF International 2010). Although the East Alameda County Conservation Strategy is not a resource management plan, and does not provide Livermore tarplant with any management or formal protection, it does describe goals and objectives related to protection and enhancement of alkali meadow and scalds, which are

important habitats for Livermore tarplant. The purpose of the East Alameda County Conservation Strategy is to streamline permitting and to be helpful for planning public agency projects by providing more certainty with regard to mitigation ratios, while promoting the protection of the covered species. There is a federal programmatic BO for federally-listed species associated with the East Alameda County Conservation Strategy.

Monitoring and Research

The Department is not aware of any ongoing Livermore tarplant research, or monitoring of Livermore tarplant populations.

Habitat Restoration Projects

The Department is not aware of any Livermore tarplant habitat restoration projects. The Department does not have any information indicating that Livermore tarplant seed has been banked for restoration, or any other purposes.

Impacts of Existing Management Efforts

As discussed above, the Springtown population has been grazed by cattle in the past, but the Department does not have any information on the current grazing regime, such as the timing, duration or intensity.

SCIENTIFIC DETERMINATIONS REGARDING THE STATUS OF LIVERMORE TARPLANT IN CALIFORNIA

CESA directs the Department to prepare this report regarding the status of Livermore tarplant based upon the best scientific information available to the Department. CESA's implementing regulations identify key factors that are relevant to the Department's analyses. Specifically, a "species shall be listed as endangered or threatened ... if the Commission determines that its continued existence is in serious danger or is threatened by any one or any combination of the following factors: (1) present or threatened modification or destruction of its habitat; (2) overexploitation; (3) predation; (4) competition; (5) disease; or (6) other natural occurrences or human-related activities." (Cal. Code Regs., tit. 14, § 670.1, subd. (i)(1)(A)).

The definitions of endangered and threatened species in the Fish and Game Code provide key guidance to the Department's scientific determination. An endangered species under CESA is one "which is in serious danger of becoming extinct throughout all, or a significant portion, of its range due to one or more causes, including loss of habitat, change in habitat, over exploitation, predation, competition, or disease" (Fish & G. Code, § 2062). A threatened species under CESA is one "that, although not presently threatened with extinction, is likely to become an endangered species in the foreseeable future in the absence of special protection and management efforts required by [CESA]" (*Id.*, § 2067).

The preceding sections of this Status Review report describe the best scientific information available to the Department, with respect to the key factors identified in the regulations.

Present or Threatened Modification or Destruction of Habitat

The habitats in the Livermore Valley have been impacted by a history of modification and destruction from development, grazing, and other land use. Evaluation of soil maps and aerial imagery show that these activities have almost certainly resulted in the loss of Livermore tarplant habitat. Current land use practices, zoning and designations have led to recent and severe habitat modification and destruction that is likely to lead to the extirpation of a significant portion of Livermore tarplant's range, and the modification and destruction of habitat is likely to continue into the future. In addition, recreation activities within and in the vicinity of Livermore tarplant populations have resulted in habitat degradation that is evident on the ground and visible from aerial imagery. The Department considers modification and destruction of habitat to be a significant threat to the continued existence of Livermore tarplant.

Overexploitation

The Department does not consider overexploitation to be a significant threat to the continued existence of Livermore tarplant.

Predation

The Department does not consider predation to be a significant threat to the continued existence of Livermore tarplant.

Competition

Invasive plant species have been documented to pose serious threats to biodiversity around the world, and are a particularly pervasive problem in Mediterranean-type habitats like those in California. Invasive thatch-forming grasses, and other invasive plants such as perennial pepperweed, occur within and in close proximity to all Livermore tarplant populations. The Department considers invasive plant species to be a significant threat to the continued existence of Livermore tarplant.

Disease

There are no diseases known to be threats to the continued existence of Livermore tarplant. The Department does not consider disease to be a significant threat to the continued existence of Livermore tarplant.

Other Natural Occurrences or Human-related Activities

The climate of California is certain to change due to warming of the global climate system; however, it is unclear how such changes will affect Livermore tarplant. Livermore tarplant has a narrow distribution and few populations, with three of the four known populations occupying relatively small areas. Livermore tarplant's rarity and extremely limited distribution, and its occurrence only in and near developed areas, make the species very vulnerable to stochastic (chance) events such as droughts, wildfires, and accidents, and to all other threats. Therefore, the loss of all or a significant portion of any Livermore tarplant population would represent the loss of a significant portion of Livermore tarplant's total range. Both inappropriate grazing and the lack of appropriate grazing are considered to be threats to the continued existence of Livermore tarplant, and Livermore tarplant is also threatened by herbicide application and other right-of-way maintenance activities.

SUMMARY OF KEY FINDINGS

Livermore tarplant is a very rare species that is known from only four populations, all located within or less than 0.5 mile from the City of Livermore. All Livermore tarplant populations occur in close proximity to urban or other intensive land uses, and have been either directly or indirectly impacted by modification or destruction of habitat. Based upon current land use practices, zoning and designations, the modification or destruction of Livermore tarplant habitat is likely to continue into the future. Livermore tarplant populations have also been, and continue to be subject to ongoing impacts from invasive plant species, recreation activities, inappropriate grazing regimes, and herbicide use and right-of-way maintenance. It is unclear how climate change and will affect Livermore tarplant. Compounding the threats to the species is the inherent vulnerability of small populations to extirpation due to stochastic (chance) events. Due to the limited distribution of Livermore tarplant, the loss of any Livermore tarplant population or a significant portion thereof would be considered the loss of a significant portion of the species total range.

The information available to the Department regarding the status of Livermore tarplant indicates that there are significant threats to the continued existence of the species.

RECOMMENDATION FOR PETITIONED ACTION

CESA directs the Department to prepare this report regarding the status of Livermore tarplant in California based upon the best scientific information available to the Department. CESA also directs the Department to indicate in this Status Review whether the petitioned action is warranted (Fish & G. Code, § 2074.6; Cal. Code Regs., tit. 14, § 670.1, subd. (f)). The Department includes and makes its recommendation in this Status Review as submitted to the Commission in an advisory capacity based on the best available science. [Department recommendation will be added in the final report]

PROTECTION AFFORDED BY LISTING

It is the policy of the state to conserve, protect, restore and enhance any endangered or any threatened species and its habitat (Fish & G. Code, § 2052). If listed as an endangered or threatened species, unauthorized "take" of Livermore tarplant will be prohibited, making the conservation, protection, and enhancement of the species and its habitat an issue of statewide concern. As noted earlier, CESA defines "take" as hunt, pursue, catch, capture, or kill, or attempt to hunt, pursue, catch, capture, or kill (*Id.*, § 86). Any person violating the take prohibition would be punishable under state law. The Fish and Game Code provides the Department with related authority to authorize "take" under certain circumstances (*Id.*, §§ 2081, 2081.1, 2086, 2087, 2089.6, 2089.10 and 2835). As authorized through an incidental take permit, however, impacts of the taking on Livermore tarplant caused by the activity must be minimized and fully mitigated according to state standards.

Additional protection of Livermore tarplant following listing would also occur with required public agency environmental review under CEQA, and its federal counter-part, the National Environmental Policy Act (NEPA). CEQA and NEPA both require affected public agencies to analyze and disclose project-related environmental effects, including potentially significant impacts on endangered, rare, and threatened special status species. Under CEQA's

"substantive mandate," for example, state and local agencies in California must avoid or substantially lessen significant environmental effects to the extent feasible. With that mandate, and the Department's regulatory jurisdiction generally, the Department expects related CEQA and NEPA review will likely result in increased information regarding the status of Livermore tarplant in California as a result of, among other things, updated occurrence and abundance information for individual projects. Where significant impacts are identified under CEQA, the Department expects project-specific required avoidance, minimization and mitigation measures will also benefit the species. While both CEQA and NEPA would require analysis of potential impacts to Livermore tarplant regardless of their listing status under CESA, the acts contain specific requirements for analyzing and mitigating impacts to listed species. In common practice, potential impacts to listed species are examined more closely in CEQA and NEPA documents than potential impacts to unlisted species. State listing, in this respect, and required consultation with the Department during state and local agency environmental review under CEQA, is also expected to benefit the species in terms of related impacts for individual projects that might otherwise occur absent listing.

If Livermore tarplant is listed under CESA, it may increase the likelihood that state and federal land and resource management agencies will allocate funds towards protection and recovery actions. However, funding for species recovery and management is limited, and there is a growing list of threatened and endangered species.

MANAGEMENT RECOMMENDATIONS AND RECOVERY MEASURES

The utility of current data on Livermore tarplant is limited by being largely anecdotal and qualitative. Studies designed to provide quantitative data on Livermore tarplant populations, and the factors that affect the potential for Livermore tarplant to survive and reproduce, are necessary for species management. The following list of recommended management actions was generated by Department staff with considerations from local agencies, non-profits, and interested parties:

- Permanently protect all Livermore tarplant habitat from modification and destruction via fee title acquisition, conservation easements or similar protective measures;
- Restrict public access to portions of the Springtown Preserve that support Livermore tarplant and other species of conservation concern;
- Restore degraded Livermore tarplant habitat at the Springtown, Northeast Springtown and Greenville Road populations;
- Implement monitoring and adaptive management programs for all Livermore tarplant populations. Focus monitoring on Livermore tarplant, indicator species (if identified), and/or an appropriate habitat indicator such as residual dry matter or evidence of impacts from recreation activities. Ensure that monitoring results trigger appropriate management responses such as changing the timing or intensity of grazing, implementing other measures to control invasive species, or controlling recreational activities. Make the data and reports from monitoring and adaptive management programs available to resource agencies and the public;
- Research the life history characteristics of Livermore tarplant, including factors related to pollination, seed dispersal, seed longevity, and microhabitat requirements for germination and recruitment;
- Bank seeds of Livermore tarplant from all extant populations for conservation purposes;
- Survey for additional populations of Livermore tarplant; and

- Implement a program to detect Livermore tarplant population trends using statistically valid population estimates.

PUBLIC RESPONSE

Comments were invited in response to the Petition in a Department press release dated September 16, 2015, and in letters mailed on November 17, 2015 to owners of land with Livermore tarplant populations. The Department received three e-mail messages in response to the press release, which are included in Appendix B. Additionally, one landowner contacted the Department via e-mail message to request information about the Livermore tarplant population on his property. Another landowner contacted the Department via telephone to express concern about limitations on property development options, and ask about the possibility of the State of California purchasing his property.

PEER REVIEW

Independent botany experts were invited to review the Status Review report before submission to the Fish and Game Commission. The letters of invitation and all comments received are included in Appendix C.

ACKNOWLEDGEMENTS

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APPENDIX A: Soils in the Vicinity of Livermore Tarplant Populations

APPENDIX B: Comments from Affected and Interested Parties on the Petitioned Action

APPENDIX C: Comments from Peer Reviewers on the Livermore tarplant Status Review Report

Peer Review Comments from Dr. Robert Preston and Department Responses

Page	Line	Reviewer Comment	Department Response
Letter		Very little is presented about Livermore tarplant seed dispersal or germination, because little is known. However, information on the seed biology is relevant to the feasibility of habitat management and restoration and seed banking. Because Livermore tarplant is an annual species, it must maintain a soil seed bank to persist during years where climatic conditions are unfavorable to growth or reproduction, and seed dormancy is a likely mechanism for maintaining a soil seed bank. Despite the lack of specific information available for Livermore tarplant, information is available for a number of related tarplant species, including several studies that examined seed germination and dormancy, and it seems reasonable to infer that similar mechanisms are present in Livermore tarplant. I added a comment to the review citing a fairly recent paper that also references previous work on this topic, and I also annotated paragraphs in the review that would benefit from discussing this information.	Text updated: a discussion of seed germination has been added to the Life History section and other sections of the report, and appropriate references have been added.
Letter		In addition, the habitat section does not clearly articulate the vegetation communities in which Livermore tarplant occurs. Information on the vegetation community is crucial for long-term monitoring, restoration activities, and searches for additional populations. The review states that the vegetation maps available for the study area did not provide comparable levels of resolution, which made it difficult to determine the precise association between Livermore tarplant and the vegetation. I acknowledge the need to characterize the differences between the previous vegetation maps. However, the discussion, as currently written, is confusing, partly because of inconsistencies in the community nomenclature used, partly because the data is not fully synthesized, and partly because some of the information provided appears to be superfluous to the discussion. Despite these problems, the discussion ultimately correctly characterizes the habitat as alkali meadow. I have placed comments in the review text with suggestions to help clarify the discussion by standardizing the nomenclature, reorganizing the text, and removing extraneous text.	Text updated: portions of the Vegetation Communities section has been re-written to clarify that non-standardized mapping units were used for the vegetation mapping and these are now referred to as “mapping units” in the text.
2	38	Comment: Correct/consistent citation is Tanowitz 1993	Text updated: citation corrected

3	8-11	Comment: I suggest the following clarification: The botanist E. L. Greene coined the name *Deinandra* as a replacement for the genus name *Hartmannia*, which had been previously been used for a different genus of plants (Greene 1891, Flora Franciscana). *Deinandra*, which means "terrible man" or "fierce man" in Greek, appears to have been a play of words on the name Hartmann (German for "stag man", with stags being fiercely territorial) (Borror 1960, Baldwin 2012).	Text updated: citation added
5	1	Note: In box listing the status of each population, the Northeast Springtown population is more appropriately listed as "possibly extirpated", not "possibly extinct".	Text updated
6	Table	Comment: Does EO #2 include former EO #3? Why there is an occurrence #5 but only four occurrences needs to be explained.	Text updated: explanation added to the table and text
7	19	Revision: Citation corrected to "Baldwin 1999a"	Text updated: citation corrected
7	38	Comment: But other tarplants germinate in midwinter - see Gregory et al 2001 (Madroño 48: 272-295), which also cites other papers on tarplant germination.	Text updated and citation added
7	42	Revision: Sentence changed to: "Livermore tarplant blooms between June and October (Baldwin 1999a, 2012; CNPS 2015)."	Text updated
10	2	Revision: Citation updated	Text updated
10	7	Comment: "Seeds of Livermore tarplant may, like other species of tarplants, experience dormancy, which would promote the presence of a soil seed bank. (Gregory et al 2001)."	Text updated
10	22	Revision: second instance of the word "painful" deleted	Text updated
10	28	Revision: Citation updated	Text updated
10	30	Deletion of "Livermore tarplant occurs in the Upper Arroyo Las Positas Watershed." with comment: This is distributional info that was stated in a prior section.	Text updated: sentence removed
10	33	Comment: Based on the vegetation communities listed below, I would also include saltgrass as a common associate.	Text updated
10	42	Revision: Citation updated	Text updated

11	1	Comment: The vegetation types listed below aren't alliances; some are associations, and some are macrogroups; however, the macrogroup names used differ from those used in the NVCS and MCV. I recommend not using macrogroups - see comments 13 & 14. If it is necessary to use a macrogroup name for the grasslands, please use the "California Annual and Perennial Grassland" macrogroup, per the MCV.	Text updated: the paragraph has been re-written to clarify that non-standardized mapping units were used for the vegetation mapping.
11	4	Comment: Is this really relevant to the following discussion?	Text updated: the paragraph has been re-written to clarify that non-standardized mapping units were used for the vegetation mapping.
11	9	Comment: Actually, we can make some reasonable extrapolations!	Text updated: the paragraph has been re-written to clarify that non-standardized mapping units were used for the vegetation mapping.
11	11-17	Comment: Isn't this just hand-waving? Seems to me that it would be simpler just to state that the information from the different maps was not mapped at the same resolution or using the same classification systems but was sufficient to characterize the habitat.	Text updated: the paragraph has been re-written to clarify that non-standardized mapping units were used for the vegetation mapping and also acknowledge the limitations of the vegetation mapping that was done.
11	26-30	Comment: These aren't standard names; if you want to use MCV terminology, should be 2 alliances: *Distichis spicata* herbaceous alliance and *Bromus* (*diandrus, hordeaceus*)-*Brachypodium distachyon* semi-natural herbaceous stands. I don't recommend using macrogroups because the *D. spicata* alliance is problematic; it is placed in a coastal salt marsh macrogroup in MCV, whereas it actually could be placed in several different macrogroups, based on the geographic subdivisions in which it occurs.	Text updated: the paragraph above the comment has been re-written to clarify that non-standardized mapping units were used for the vegetation mapping, and these are now referred to as "mapping units".
11	34-41	Comment: Again, these aren't standard names. This data can be better synthesized -- I recommend using 2 alliances*: Lasthenia fremontii-Distichlis spicata* herbaceous alliance *and Allenrolfea occidentalis* shrubland alliance. (The *Allenrolfea* alliance is placed in a desert macrogroup in MCV, so again, I don't recommend using macrogroups.)	Text updated: the paragraph above the comment has been re-written to clarify that non-standardized mapping units were used for the vegetation mapping, and these are now referred to as "mapping units".
11	43-50	Comment: Granted that this are less-resolved mapping units, I believe that Springtown veg types would apply to these as well.	Text updated to suggest that Livermore tarplant may occur in similar microhabitats at other populations.
12	2-4	Comment: I agree; this is how I classified the Springtown habitat in my field notes from a 2013 site visit.	No response needed

12	5-10	Comment: Recommended revision to: ... within California but has been superseded by the Manual of California of Vegetation. However, Alkali Meadow is considered a rare plant community, and the CNDDB continues to maintain records of the community occurrences.	Text updated
12	12-15	Comment: To keep with the logical flow between these paragraphs, I recommend moving this sentence up to the previous para as the second sentence.	Text updated
12	22	Comment: I recommend adding a concluding statement emphasizing that Livermore tarplant is restricted to an imperiled habitat.	Text updated: "Livermore tarplant is therefore restricted to an imperiled habitat." added
12	17-18	Comment: This sentence seems out of place here; perhaps it should be moved to the section on habitat disturbance? What role might burrowing mammals play in providing openings in the grassland for Livermore tarplant (competitive escape)?	Mammal burrows are not currently considered to be a threat to the species, and therefore the discussion will remain in the "Geology and Soils" section. Text that discusses the role that burrowing mammals may play for Livermore tarplant has been added, along with a citation to Hobbs and Mooney 1985. The citation to Hobbs and Mooney 1985 has been added to the "Literature Cited" section.
14	31	Typo correction and comment: Here's where info about seed dormancy/seed banking is important. Possibly there could be a chance to recover the population, if there are dormant seeds present and the site were restored.	Text updated: text revised to acknowledge that a dormant seed bank may remain in the soil
16	10	Typo correction and comment: Again, here's another spot that info on seed dormancy/seed bank may be important. If habitat and the seed bank remains, the population may not be extirpated.	Text updated: Text revised to acknowledge that a dormant seed bank may remain in the soil
16	17	Comment: Although recent Google Earth images indicate that the habitat is intact.	Text updated: citation added
17	4	Comment: Is what you mean to say, "Livermore tarplant is likely have been present to a greater extent historically but has undergone habitat loss through development ..."?	Text updated
18	41	Typo correction	Text updated
22	11	Comment: Based on recent Google Earth imagery, the habitat is intact, although there appears to have been some hydrological modifications in the upper part of the watershed.	Text updated
39	29	Revision: reference added.	Text updated