Appendix B

Biological Assessment & Arborist Report

Preliminary Biological Assessment

18545-18565 Monterey Road

Morgan Hill, Santa Clara County, California

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PRELIMINARY BIOLOGICAL ASSESSMENT

18545-18565 MONTEREY ROAD

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SECTION 1. INTRODUCTION

Johnson Marigot Consulting, LLC (JMC) has been retained to provide a biological constraints analysis for an approximately 4.7-acre property located at 18545 Monterey Road (Accessor Parcel Number (APN) 764-10-013) and 18565 Monterey Road (APN 764-10-015) in the City of Morgan Hill, Santa Clara County, California (Figure 1). It is within the coverage area of the Santa Clara Valley Habitat Plan (SCVHP). The purpose of this report is to qualitatively identify potential occurrences and/or habitat for special-status plant and wildlife species on the site and to identify local, state, and/or federal biological constraints and ordinances applicable to the development of the site. The site is proposed for residential development within the entirety of the parcel boundaries (Attachment 1), and as such, is presumed to include site grading and compaction with removal of existing vegetation within the entirety of the parcel boundaries. The site is located entirely within the Planning Limit of Urban Growth for the City of Morgan Hill, as defined in the SCVHP (Figure 2).

SECTION 2. METHODOLOGY

A literature review was conducted for special-status species known to occur in the vicinity of 18545-18565 Monterey Road. In addition to a literature review, the California Department of Fish and Wildlife (CDFW) California Natural Diversity Database (CNDDB) and the California Native Plant Society (CNPS) Rare Plant Inventory were queried for occurrences of special-status species in the vicinity of the site. A list of these special-status species has been compiled in Table 2, which also discusses listing/ranking status, required habitat components, proximity of records to 18545-18565 Monterey Road, and probability of occurrence within the site.

Additional research was conducted to identify local, state, and federal natural resource ordinances and laws that would be applicable to the development of 18545-18565 Monterey Road; these ordinances and laws are discussed below. It should be noted however that although some local entitlement requirements are addressed below (e.g., The Santa Clara Valley Habitat Plan), this report only summarizes local requirements pertaining to biological resources.

On September 17, 2021, Naomi Schowalter of JMC conducted a site visit to evaluate biological resources present on site. The site assessment included a reconnaissance level survey of 18545-18565 Monterey Road to characterize vegetation, topography, and current and historic uses of the site (as well as the surrounding properties), and to investigate potential presence of waters of the U.S./State. Observations made during site visits were used to determine the potential for the site to provide suitable habitat for special-status species (presence of habitat components necessary to support the species) and sensitive habitats.

SECTION 3. EXISTING SITE CONDITIONS

The approximately 4.7-acre property is comprised of two parcels and is located within the city limits of Morgan Hill, Santa Clara County, California (the approximate center of the site is 37.1429042°N, -121.6635127°W) (Figure 1). The roughly triangular site is located south of the intersection of Monterey Road and Jarvis Drive (Figure 1). The western boundary abuts an elevated railroad track, the eastern boundary is Monterey Road, and the northern boundary is a commercial development (gas station and Starbucks Coffee). Topography within the Study Area is flat to gently sloping. Vegetation in the Study Area consists of non-native annual grassland and seasonal wetland species with scattered native and non-native trees and shrubs, particularly along the edges of the property. Part of the Starbucks Coffee parking lot is within the project boundary. The undeveloped portion of the site is routinely disked and mowed for fuel reduction. Three depressional wetlands, three converging wetland drainage ditches, one stormwater detention basin, and a small patch of cattails associated with the stormwater detention basin are located in the project area (Figure 3). The property historically contained a single drainage ditch constructed in the late 1930s to improve drainage of the adjacent State Highway (now Monterey Road), spanning from three 24-inch culverts near Monterey Road on the eastern side of the property to the railroad tracks on the western side of the property. The other two short lengths of ditch and the stormwater detention basin were constructed in 2004-2005 as part of the commercial development bordering the northern edge of the project area.

3.1 LAND COVER TYPES

Per CDFW's California Wildlife Habitat Relationships (CWHR) System, the predominant vegetation communities within the Study Area are annual grassland, fresh emergent wetland, and urban (CDFW 2022a). Under the SCVHP, the equivalent land cover types are California annual grassland, seasonal wetlands, and ornamental woodland, respectively (Figure 3). Additionally, the Starbucks Coffee parking lot is considered urban-suburban land cover under the SCVHP. Herbaceous vegetation dominates the site, and trees and shrubs are primarily evenly spaced along the edges of the property and the detention basin. Vegetation communities on the site are altered due to routine mowing and disking, plantings, and constructed drainage features.

3.1.1 CALIFORNIA ANNUAL GRASSLAND

The California annual grassland vegetation community is most common across the project site. Plant species common throughout this community include oats (*Avena* sp.), ripgut brome (*Bromus diandrus*), soft brome (*Bromus hordeaceus*), and wild radish (*Raphanus* sp.). The annual grasslands in the project area are routinely mowed or plowed. Coyote brush (*Baccharis pilularis*) is scattered across the annual grassland.

The SCVHP indicates that this habitat type may constitute habitat components for covered species, including San Joaquin kit fox (*Vulpes macrotis mutica*), western burrowing owl (*Athene cunicularia hypugea*), California red-legged frog (*Rana draytonii*), California tiger salamander (*Ambystoma californiense*), western pond turtle (*Clemmys marmorata*), tricolored blackbird (*Agelaius tricolor*), and Bay checkerspot butterfly (*Euphydryas editha bayensis*). None of these species were observed, though California ground squirrel (*Spermophilius beecheyi*) burrows were found during the September 17 site visit; burrows represent potential nest sites for western burrowing owls.

3.1.2 Seasonal Wetland

Seasonal freshwater emergent wetlands cover approximately 0.52 acre of the Study Area. This community is relatively evenly distributed across the site. Plant species common within this vegetation community include seaside barley (*Hordeum marinum*), English plantain (*Plantago lanceolata*), rabbitsfoot grass (*Polypogon monspeliensis*), Italian rye grass (*Festua perennis*), curly dock (*Rumex crispus*), tall cypress (*Cyperus* eragrostis), rough cocklebur (*Xanthium stumarium*), and stinkwort (*Dittrichia graveolens*). The SCVHP indicates that this habitat type may constitute habitat components for covered species, including California tiger salamander, California red-legged frog, western pond turtle, western burrowing owl, tricolored blackbird, and San Joaquin kit fox.

3.1.3 Ornamental Woodland

Large established trees and shrubs are present along Monterey Road, the railroad tracks, and the edges of the detention basin, consisting of evenly spaced (i.e., planted) native and non-native species. Along the railroad tracks, willows (*Salix exigua*), coast live oak (*Quercus agrifolia*), valley oak (*Quercus lobata*), coast redwood (*Sequoia sempervirens*), and Northern California black walnut (*Jugluns hindsii*) are present at even intervals. To the east of the detention basin, silver wattle (*Acacia dealbata*) is present. Along Monterey Road, oleander (*Nerium oleander*), California black oak (*Quercus kelloggii*), California sycamore (*Platanus racemose*), valley oak (*Quercus lobata*), and deodar cedar (*Cedrus deodara*). These areas were likely historically described as California annual grasslands but currently meet the definition of “ornamental woodland” within the context of the SCVHP. The SCVHP identifies this habitat type is suitable for many wildlife species including, American robin (*Turdus migratorius*), mockingbird (*Mimus polyglottos*), American crow (*Corvus brachyrhynchos*), and European house sparrow (*Passer domesticus*). The SCVHP also indicates the potential for lizards and woodrats.

3.2 POTENTIAL WATERS OF THE U.S./STATE

A total of 0.52 acre of potential waters of the U.S./State were mapped in the project area, including six separate wetlands (JMC 2021). These wetlands consist of three interconnected drainage ditches with in-channel wetlands, a stormwater detention basin, three depressional wetlands, and a small wetland located at the detention basin discharge pipe. The U.S. Army Corps of Engineers (USACE) issued an Approved Jurisdictional Determination for the project site by letter of February 1, 2022, identifying only one 0.042-acre wetland as a water of the U.S.; the other five wetlands were determined to be isolated wetlands and therefore not waters of the U.S. The Regional Water Quality Control Board (RWQCB) is expected to consider all six wetlands on the site to be waters of the State.

3.3 SOILS

According to the Natural Resource Conservation Service, one soil map unit occurs within the Study Area: San Ysidro loam, 0 to 2 percent slopes, Major Land Resource Area (MLRA) 14 (Attachment 3; NRCS 2021). San Ysidro soils are found on terraces, alluvial fans, and valley floors, and consist of alluvium derived from sedimentary rock. They are moderately well drained and have a low runoff class. The available water supply is low, and the water table is more than 80 inches below the surface. A loamy claypan is present 16 to 24 inches below the surface, restricting water infiltration. Approximately 2% of soils in this map unit are rated as hydric.

Soils observed during the field survey were consistent across the site. The soils were highly compacted with a loamy/clayey texture. Soil matrix colors varied only slightly between sample points (10YR 3/2, 10YR 3/3, or 2.5Y 4/2). Redox concentrations were distinct and numerous around wetlands, and even samples in clearly upland locations contained small quantities of redox.

3.4 HYDROLOGY

The project area derives its hydrology from direct precipitation and off-site developments. The two smaller drainages ditches and the stormwater detention basin were constructed in 2004-2005. One of the ditches channels runoff from the eastern side of Monterey Road, and the other ditch and the detention basin were constructed in order to manage runoff from the development to the north of the project site. The two smaller ditches converge with the old drainage ditch spanning the width of the property from Monterey Road to the railroad tracks. The old drainage ditch receives its hydrology from the large off-site detention basin located southeast of the project area. During large storm events, water from the off-site detention basin flows into a 48-inch gravity overflow, discharging into the old ditch through three 24-inch pipes. Flow from the old drainage ditch leaves the property through a 36-inch culvert under the railroad tracks. Stormwater that is not detained in the detention basin leaves the property through another culvert under the railroad tracks and then flows north, converging with the old drainage ditch outside of the property boundary.

During the field survey, observed indicators of hydrology in the project area included drainage patterns, shallow aquitard, biotic crust, and oxidized rhizospheres along living roots. Some wetland sample points had saturation or inundation visible on aerial imagery. Conditions were dry during the site visit due to the time of year and severe drought conditions.

SECTION 4. BIOLOGICAL RESOURCE CONSTRAINTS

4.1 SPECIAL STATUS SPECIES

No special-status species were found during the site survey on September 17, 2021. Special-status species include those considered to be rare by state and federal resource agencies (CDFW and the United States Fish and Wildlife Service [USFWS]) and/or the scientific community (CNPS), and are accordingly legally protected via local, state, and/or federal law. For purposes of this assessment, special-status species are defined as plants or animals protected pursuant to:

1. Federal Endangered Species Act (FESA);
2. State Endangered Species Act (CESA);
3. California Fish and Game Codes that protect nesting birds (Section 3503), raptors (Section 3503.5), and "fully protected species" (Sections 3511, 4700, 5050, and 5515);
4. Migratory Bird Treaty Act;
5. CNPS "rare" designation - all of the plants constituting California Rare Plant Rank 1A, 1B, and 2 meet the definitions of Sec. 1901, Chapter 10 (Native Plant Protection Act), or Secs. 2062 and 2067 of the CESA of the California Department of Fish and Game Code, and are eligible for state listing (CNPS Inventory, 6th Edition, 2001); and/or
6. CDFW "species of special concern" (SSC) designation.

For a brief description of all special-status wildlife known to occur in the vicinity of 18545-18565 Monterey Road, see the attached Special-Status Plant/Wildlife Species Known to Occur in the Vicinity of the 18545-18565 Monterey Road (Tables 2 and 3).

4.2 PLANTS

According the CNPS Rare Plant Inventory and CNDDB, a total of 15 special-status plant species have been documented within the Morgan Hill U.S. Geological Survey (USGS) 7.5' topographic quadrangle, and 11 have been documented within three miles of 18545-18656 Monterey Road (Figure 5). Of the 15 species identified, 11 of these require or primarily occur on serpentine soils, which do not exist on the site; these include Tiburon paintbrush (*Castilleja affinis var. neglecta*), pink creamsacs (*Castilleja rubicundula var. rubicundula),* coyote ceanothus (*Ceanothys ferrisiae*), dwarf soaproot (*Chlorogalum pomeridianum var. minus*), Mt. Hamilton fountain thistle (*Cirsium fontinale var. campylon*), Santa Clara Valley dudleya (*Dudleya abramsii ssp. setchellii),* fragrant fritillary (*Fritillaria liliacea*), smooth lessingia (*Lessingia micradenia var. glabrata*), woodland wollythreads (*Monolopia gracilens*), Metcalf Canyon jewelflower (*Streptanthus albidus ssp. albidus*), and most beautiful jewelflower (*Streptanthus albidus ssp. peramoenus*). Additionally, San Francisco collinsia (*Collinsia multicolor*), arcuate bush-mallow (*Malacothamnus arcuatus*), Hall's Bush Mallow (*Malacothamnus hallii*), and

Loma Prieta hoita (*Hoita strobilina*) grow in coastal scrub or foothill woodland or chaparral, which is not present on the site (Table 2).

Given the lack of appropriate habitat and the on-going land management, none of these species are likely to occur on the site, and rare plant surveys will not be required.

MITIGATION MEASURES (Rare Plants): None

4.2.1 TREES

Pursuant to the Morgan Hill Heritage or Landmark Tree Ordinance, the removal of trees that have been designated as "significant" requires a permit. Indigenous trees measuring 18 inches at a height of 4.5 feet and any street tree is defined as a "significant" tree. Multiple trees meet this definition and would therefore require permitting for removal.

MITIGATION MEASURES (Trees): Project must comply with City Ordinance

4.3 WILDLIFE

4.3.1 STATE AND FEDERALLY LISTED WILDLIFE

CNDDB records for 11 special-status wildlife species are documented within three miles of the site (Figure 6). These include Opler's longhorn moth (*Adela oplerella*), the Central California Distinct Population Segment (DPS) of California tiger salamander (*Ambystoma californiense*), burrowing owl (*Athene* cunicularia), western bumble bee (*Bombus* occidentalis), white-tailed kite (*Elanus leucurus*), western pond turtle (*Emys marmorata*), Bay checkerspot butterfly (*Euphydryas editha bayensis*), San Francisco dusky-footed woodrat (*Neotoma fuscipes annectens*), coast horned lizard (*Phrynosoma coronatum*), California red-legged frog (*Rana draytonii*), and American badger (*Taxidea taxus*). Historic records for California tiger salamander, western bumble bee, and coast horned lizard overlap 18545-18565 Monterey Road. The September 2021 survey did not identify any evidence of special-status wildlife species.

According to CNDDB, California tiger salamander is presumed to be extirpated from the project area. The project area is surrounded by urban development on all sides. Though there are periodically or seasonally ponded areas both on the project site and across Monterey Road at the Bufferfield Retention Basin, these features are unlikely to provide habitat for California tiger salamander because it is isolated from known populations of this species (there are no habitat corridors to existing populations). The same is true to California red-legged frog and western pond turtle, both of which require ponded water for survival. Known populations of these species are currently restricted to the undeveloped foothills surrounding the City of Morgan Hill, and the project area is isolated from these populations by dense urban development. Therefore, development of the project site is not expected to result in any effect to California tiger salamander, California red-legged frog, or western pond turtle

Two species of bumble bees that may occur regionally have been petitioned to be added to the California Endangered Species Act and are currently under consideration by CDFW (Attachment 4), including the crotch bumble bee (*Bombus crotchii*) and the western bumble bee. Neither species currently has State listing status, but they are included in this analysis in the event that the listing request is granted. Both species have colonial nests in underground cavities and are unlikely to occur on the site due to current management practices (routine and regular discing). Discing has the effect of removing potential flowering plants required as a food source to these species, as well as regularly disturbing upper horizons of soils (i.e., not conducive to supporting underground cavities). A historic (1940) record of western bumble bee is recorded in the CNDDB within the "vicinity of Morgan Hill," and both species may occur regionally. However, the site does not represent habitat for either species due to lack of underground nesting opportunities and lack of flowering plants; development of the site is not expected to result in any effect to these species and further survey is not necessary.

An historic record (1894) for the coast horned lizard (now referred to as Blainville's horned lizard [*Phrynosoma blainvillii*]) occurs in the "vicinity of Morgan Hill." This is the only record for this species within approximately nine miles of the project site. Due to the long-term, extensive development surrounding the project site, this species is not expected to occur onsite. Development of the project site is not expected to result in any effect to coast horned lizard.

Opler's longhorn moth and Bay checkerspot butterfly are found in association with serpentine soils, which the site does not contain. Therefore, development of the project site is not expected to result in any effect to Opler's longhorn moth or Bay checkerspot butterfly.

Two regionally-known special-status species, American badger and San Francisco dusky-footed woodrat, are highly unlikely to occur on the site due to a lack of connective corridor to habitat present in the foothills west of Hale Avenue. These two species are not covered under the Santa Clara Valley Habitat Plan but have a state ranking of vulnerable (American badger) and imperiled (woodrat). During the site survey, there were no noted middens for woodrats; these middens are usually obvious when present and consist of large collections of twigs and woody debris. Middens can range in size from approximately 3 cubic feet to approximately 1 cubic yard (27 cubic feet) and are typically located at the base of trees or shrubs. Similarly, there was no evidence of badgers on the site (no burrows or dens that could be utilized by this species), and regular site discing would prevent establishment of den sites and effectively reduce prey base. Further, neither San Francisco dusky footed woodrat, nor American badger is likely to emigrate to the site due to lack of habitat connectivity and proximity to development (i.e., the site is completely surrounded by urban development and has no natural corridors to existing habitat). Development of the project site is not expected to result in any effect to either American badger or San Francisco dusky-footed woodrat.

The two bird species identified by the CNDDB both have the potential to nest at the site. The verified presence of small mammal burrows during the November site visit constitutes potential nesting habitat for western burrowing owl, and the onsite trees represent potential nesting structure for white-tail kites. The closest documented occurrence for white-tailed kite is approximately 2.25 miles north of the project area. Burrowing owls have been documented within a mile of the project area, both this population is considered possibly extirpated (See Figure 6).

Onsite trees represent potential nesting habitat for white-tailed kites, and the majority of the site represents potential foraging habitat. "Condition 1 – Avoid Direct Impacts on Legally Protected Plant and Wildlife Species" within the SCVHP includes white-tailed kites. The SCVHP does not include specific survey requirements for this species; however, CDFW recommends preconstruction surveys for nesting white-tailed kites using the following protocol:

> "If construction activities occur between February 1 and August 31, the applicant will conduct surveys for Swainson's hawk and white tailed kite in accordance with the Swainson's Hawk Technical Advisory Committee 2000 guidelines (SHTAC 2000), or current guidance. Surveys will cover a minimum of a 0.5-mile radius around the construction area. If nesting Swainson's hawks or white tailed kites are detected, CDFW will establish a 0.5 mile no disturbance buffer. Buffers will be maintained until a qualified CDFW biologist has determined that the young have fledged and are no longer reliant upon the nest or parental care for survival.
>
> If potential nesting trees are to be removed during construction activities, removal will take place outside of Swainson's hawk and white tailed kite nesting season and CDFW will develop a plan to replace known nest trees at a ratio of 3:1. If replacement planting is implemented, monitoring will be conducted annually for 5 years to assess the mitigation's effectiveness. The performance standard for the mitigation will be 65% survival of all replacement plantings."

Potential nest trees will include those trees with current (at the time of the surveys) or documented historic use by white-tailed kites for nesting. The Swainson's Hawk Technical Advisory Committee additionally defines "survey periods" and recommends that survey efforts occur at least two survey periods prior to the initiation of the proposed project.

The site is not identified in the SCVHP as "Occupied Nesting Burrowing Owl Habitat," "Potential Burrowing Owl Nesting/Overwintering Habitat Depending on Site Conditions," or "Overwintering Only Habitat" (See Figure 5-11 in the SCVHP); however, the project site should be considered to represent "Potential Burrowing Owl Nesting/Overwintering Habitat Depending of Site-Specific Conditions" based on the site assessment. As such, protocol-level surveys are not required by the SCVHP, and the only requirement is for a preconstruction survey (Condition 15 in Chapter 6 of the SCVHP). This survey includes the following:

> "Prior to any ground disturbance related to covered activities, a qualified biologist will conduct preconstruction surveys in all suitable habitat areas as identified during

habitat surveys. The purpose of the preconstruction surveys is to document the presence or absence of burrowing owls on the project site, particularly in areas within 250 feet of construction activity.

> To maximize the likelihood of detecting owls, the preconstruction survey will last a minimum of three hours. The survey will begin 1 hour before sunrise and continue until 2 hours after sunrise (3 hours total) or begin 2 hours before sunset and continue until 1 hour after sunset. Additional time may be required for large project sites. A minimum of two surveys will be conducted (if owls are detected on the first survey, a second survey is not needed). All owls observed will be counted and their location will be mapped.
>
> Surveys will conclude no more than 2 calendar days prior to construction. Therefore, the project proponent must begin surveys no more than 4 days prior to construction (2 days of surveying plus up to 2 days between surveys and construction). To avoid last minute changes in schedule or contracting that may occur if burrowing owls are found, the project proponent may also conduct a preliminary survey up to 14 days before construction. This preliminary survey may count as the first of the two required surveys as long as the second survey concludes no more than 2 calendar days in advance of construction."

If preconstruction surveys find that the site is occupied by western burrowing owls, then avoidance measures must be implemented pursuant to the SCVHP. These include the establishment of an avoidance and minimization plan, approval by the Implementing Entity and the Wildlife Agencies, and onsite biological monitoring. In some cases, the project may be approved for relocation of onsite burrowing owls.

In addition, although not documented by the CNDDB, there exists the potential for two additional special-status bird species: Swainson's hawk (*Buteo swainsonii*) and tricolored blackbird (*Agelaius tricolor*). Onsite trees represent potential nest sites for Swainson's hawk, while tricolored blackbirds may encounter nesting habitat at the property located east of Monterey Road (Butterfield Retention Basin) and may forage at the project site. As such, in the absence of preconstruction nesting-bird surveys, the presence of nesting burrowing owls, white-tailed kite, Swainson's hawk, and foraging tricolored blackbirds cannot be ruled out.

The initial survey of the site has found that the southern end of the site is within 250 feet of the Butterfield Retention Basin, which represents potential nesting substrate. Therefore, the project has potential to affect tri-colored blackbirds. The SCVHP requires a preconstruction survey for any project that cannot avoid work within the 250-foot buffer zone (Condition 17 in Chapter 6 of the SCVHP), as outlined below:

> "If the project proponent chooses not to avoid the potential nesting habitat and the 250-foot buffer, additional nesting surveys are required. Prior to any ground disturbance related to covered activities, a qualified biologist will: 1. Make his/her best

effort to determine if there has been nesting at the site in the past 5 years. This includes checking the CNDDB, contacting local experts, and looking for evidence of historical nesting (i.e., old nests). 2. If no nesting in the past 5 years is evident, conduct a preconstruction survey in areas identified in the habitat survey as supporting potential tricolored blackbird nesting habitat. Surveys will be made at the appropriate times of year when nesting use is expected to occur. The surveys will document the presence or absence of nesting colonies of tricolored blackbird. Surveys will conclude no more than two calendar days prior to construction.

To avoid last minute changes in schedule or contracting that may occur if an active nest is found, the project proponent may also conduct a preliminary survey up to 14 days before construction. If a tricolored blackbird nesting colony is present (through step 1 or 2 above), a 250-foot buffer will be applied from the outer edge of all hydric vegetation associated with the site and the site plus buffer will be avoided (see below for additional avoidance and minimization details). The Wildlife Agencies will be notified immediately of nest locations. "

If preconstruction surveys find that the site is within 250 feet of a nesting tricolored blackbird colony, then avoidance and minimization measures must be implemented pursuant to the SCVHP. These include (in most cases) a prohibition of activities within 250 feet of the outer edge of all hydric vegetation associated with the colony and implementation of biological monitoring. In some cases, the buffer zone may be adjusted by the Wildlife Agencies or the Implementing Entity.

Onsite trees represent potential nesting habitat for Swainson's hawk, and the majority of the site represents potential foraging habitat. The SCVHP does not include specific survey requirements for this species; however, CDFW recommends preconstruction surveys for nesting Swainson's Hawk should be conducted using the following protocol:

"If construction activities occur between February 1 and August 31, the applicant will conduct surveys for Swainson's hawk and white tailed kite in accordance with the Swainson's Hawk Technical Advisory Committee 2000 guidelines (SHTAC 2000), or current guidance. Surveys will cover a minimum of a 0.5-mile radius around the construction area. If nesting Swainson's hawks or white tailed kites are detected, CDFW will establish a 0.5 mile no disturbance buffer. Buffers will be maintained until a qualified CDFW biologist has determined that the young have fledged and are no longer reliant upon the nest or parental care for survival.

If potential nesting trees are to be removed during construction activities, removal will take place outside of Swainson's hawk and white tailed kite nesting season and CDFW will develop a plan to replace known nest trees at a ratio of 3:1. If replacement planting is implemented, monitoring will be conducted annually for 5 years to assess the mitigation's effectiveness. The performance standard for the mitigation will be 65% survival of all replacement plantings."

Potential nest trees will include those trees with current (at the time of the surveys) or documented historic use by Swainson's hawks for nesting. The Swainson's Hawk Technical Advisory Committee additionally defines "survey periods" and recommends that survey efforts occur at least two survey periods prior to the initiation of the proposed project.

The project site is not within designated critical habitat for any federally-listed wildlife species (Figure 7).

MITIGATION MEASURES (California tiger salamander): None

MITIGATION MEASURES (California red-legged frog): None

MITIGATION MEASURES (western pond turtle): None

MITIGATION MEASURES (Bay checkerspot butterfly): None

MITIGATION MEASURES (coast horned lizard): None

MITIGATION MEASURES (American badger): None

MITIGATION MEASURES (San Francisco dusky-footed woodrat): None

MITIGATION MEASURES (white-tailed kite): Preconstruction survey per Swainson's Hawk Technical Advisory Committee 2000 guidelines

MITIGATION MEASURES (western burrowing owl): Preconstruction survey per SCVHP

MITIGATION MEASURES (tricolored blackbird): Preconstruction survey per SCVHP

MITIGATION MEASURES (Swainson's hawk): Preconstruction survey per Swainson's Hawk Technical Advisory Committee 2000 guidelines

MITIGATION MEASURES (crotch bumble bee): none

MITIGATION MEASURES (western bumble bee): none

MITIGATION MEASURES (critical habitat): none

4.3.2 NESTING BIRDS

The trees and grassland/herbaceous habitats that occur within and adjacent to 18545-18565 Monterey Road provide suitable nesting habitat for many species of passerine (perching) birds and raptors (birds of prey). No nests were observed in the trees; however, due to the mobile nature of birds and the seasonality of their nesting cycle and in light of the presence of abundant suitable nesting habitat onsite, it is likely that birds will nest within the site during future nesting seasons. In the absence of preconstruction surveys for nesting birds, development-related impacts to nesting birds cannot be ruled out. If project-related activities associated with the development of the site were to commence during the bird nesting season (generally taken to mean February 1 through August 31), preconstruction nesting bird surveys would be required. These surveys are to include both tree and ground nesting species. Active nests found during surveys will either be avoided completely (to the conclusion of nesting) or will trigger appropriate avoidance strategy development with the City of Morgan Hill, CDFW, or the SCVHP managers. Strategies typically include establishment of appropriate buffer zones (vary by species) and biological monitoring by a qualified biologist. Preconstruction surveys for nesting raptors should be conducted as outlined for western burrowing owl, white-tailed kite, and Swainson's hawk (above). In addition, preconstruction survey for nesting passerines should occur within two-weeks (14 days) of initiation of project-related activities (rough grading).

MITIGATION MEASURES (Nesting Birds): Preconstruction survey 14 days prior to initiation of project activities

4.3.3 WILDLIFE CORRIDORS

The project site is located in the City of Morgan Hill to the south of the intersection of Monterey Road and Jarvis Drive (Figure 1). It is roughly triangular in shape and is bounded by elevated railroad tracks to the west, Monterey Road to the east, and commercial development to the north. The site is completely surrounded by urban development and does not provide connectivity between undeveloped areas, nor does it abut any open space or reserves. As such, the development of the site is not expected to result in any effect to existing wildlife corridors.

MITIGATION MEASURES (Wildlife Corridors): none

4.4 WATERS OF THE U.S./STATE

A total of 0.52 acre of potential waters of the U.S./State were mapped in the project area, including six separate wetlands. The project proposes to discharge dredged or fill material into these wetlands and therefore requires Clean Water Act Section 404 and Section 401 permits from USACE and the RWQCB, respectively. The applicant will be required to comply with any avoidance and minimization requirements in the Clean Water Act permits.

Additionally, Condition 3 in Chapter 6 of the SCVHP requires that projects "Maintain Hydrologic Conditions and Protect Water Quality." This condition requires projects to comply with National Pollutant Discharge Elimination System (NPDES) permit requirements, to provide stormwater quality control, and to avoid and minimize effects to local waterways. This includes measures, performance standards, and control measures to minimize increases of peak discharge of stormwater and pollutant discharge to protect water quality, including during project construction. The proposed project will comply with this condition.

Condition 12 in Chapter 6 of the SCVHP outlines wetland and pond avoidance and minimization requirements. This condition includes the requirement that projects avoid and minimize impacts to wetlands to the maximum extent practicable and measures to limit impacts to avoided or temporarily impacted wetlands. The project proponent has determined that it is impracticable to avoid permanent impacts to all the wetlands on the project site, so wetland fees will be paid to cover the costs of compensatory mitigation required by the

SCVHP.

MITIGATION MEASURES (Waters of the U.S. / State): The proposed project will comply with Clean Water Act permit requirements and Conditions 3 and 12 of the SCVHP.

4.5 OTHER CONSTRAINTS

4.5.1 LOCAL, STATE, AND FEDERAL PLANS

4.5.1.1 Santa Clara Valley Habitat Plan

In 2012 the Santa Clara Valley Habitat Plan was adopted. It was developed with the California Department of Fish and Game (CDFG) and U.S. Fish and Wildlife Service (USFWS) to guide permitting decisions in relation to the protection of natural resources. The property at 18545-18565 Monterey Road falls within the study area for the Habitat Plan and is identified as "Potential Burrowing Owl Nesting/Overwintering Habitat Depending on Site-Specific Conditions" and requires avoidance of breeding habitat as well as pre-construction surveys. Additionally, the project site is within 250 feet of potential nesting habitat for tricolored blackbird and must therefore meet the survey and avoidance requirements of the SCVHP.

Special status plant surveys are not required because habitat components, including serpentine soils, are absent for species of concern, and the site is routinely disced and mowed (there is not any suitable habitat).

Because the project is within the SCVHP permit area, it will be subject to conditions of the Plan. These conditions are outlined in Chapter 6 of the SCVHP and are included in Attachment 5 to this report.

4.5.1.3 City of Morgan Hill General Land Use Plan

The property 18545-18565 Monterey Road is currently designated for commercial use by the City's general land use plan. The project proponent is pursuing a general plan amendment to change the land use designation to mixed-use flex. This designation allows for a mix of residential, commercial, and office uses applied either vertically (i.e., one structure with multiple uses) or horizontally (i.e., structures with different land uses located adjacent to one another).

SECTION 5. CONCLUSIONS AND RECOMMENDATIONS

The majority of 18545-18565 Monterey Road is regularly disturbed, but portions of the site retain some potential to provide habitat for special-status wildlife species that require mitigation measures, as specified below. Additional site surveys for special status plants are unnecessary as presence of these species is not expected given the lack of habitat and the routine and regular discing/mowing of the site. However, the project site provides suitable nesting habitat for white-tailed kite (California fully protected species), burrowing owl, and Swainson's hawk, and is within 250 feet of potential nesting habitat for tricolored blackbird. Therefore, preconstruction surveys for these species are required. If work is scheduled to commence during the nesting season (February 1 through August 31), a preconstruction nesting bird survey should be conducted within all suitable nesting habitat prior to the commencement of vegetation removal/ground disturbance. Burrowing owls may occupy burrows outside of the nesting season, and as such, a bird survey should be conducted prior to earthwork, even if commencement is outside of the nesting season.

According to the USFWS Environmental Conservation Online System (ECOS), 18545-18565 Monterey Road is not within critical habitat for the California tiger salamander, California red-legged frog, or Bay checkerspot butterfly (the only designated critical habitat local to Morgan Hill). Therefore, the proposed project is not expected to affect designated critical habitat.

The project will implement all applicable SCVHP conditions (Attachment 5) and the following mitigation measures to protect biological resources:

- MITIGATION MEASURES (Trees): Project must comply with City Ordinance
- MITIGATION MEASURES (white-tailed kite): Preconstruction survey per Swainson's Hawk Technical Advisory Committee 2000 guidelines
- MITIGATION MEASURES (western burrowing owl): Preconstruction survey per SCVHP
- MITIGATION MEASURES (tricolored blackbird): Preconstruction survey per SCVHP
- MITIGATION MEASURES (Swainson's hawk): Preconstruction survey per Swainson's Hawk Technical Advisory Committee 2000 guidelines
- MITIGATION MEASURES (Nesting Birds): Preconstruction survey 14 days prior to initiation of project activities
- MITIGATION MEASURES (Waters of the U.S. / State): The proposed project will comply with Clean Water Act permit requirements and Conditions 3 and 12 of the SCVHP.

SECTION 6. LITERATURE CITED

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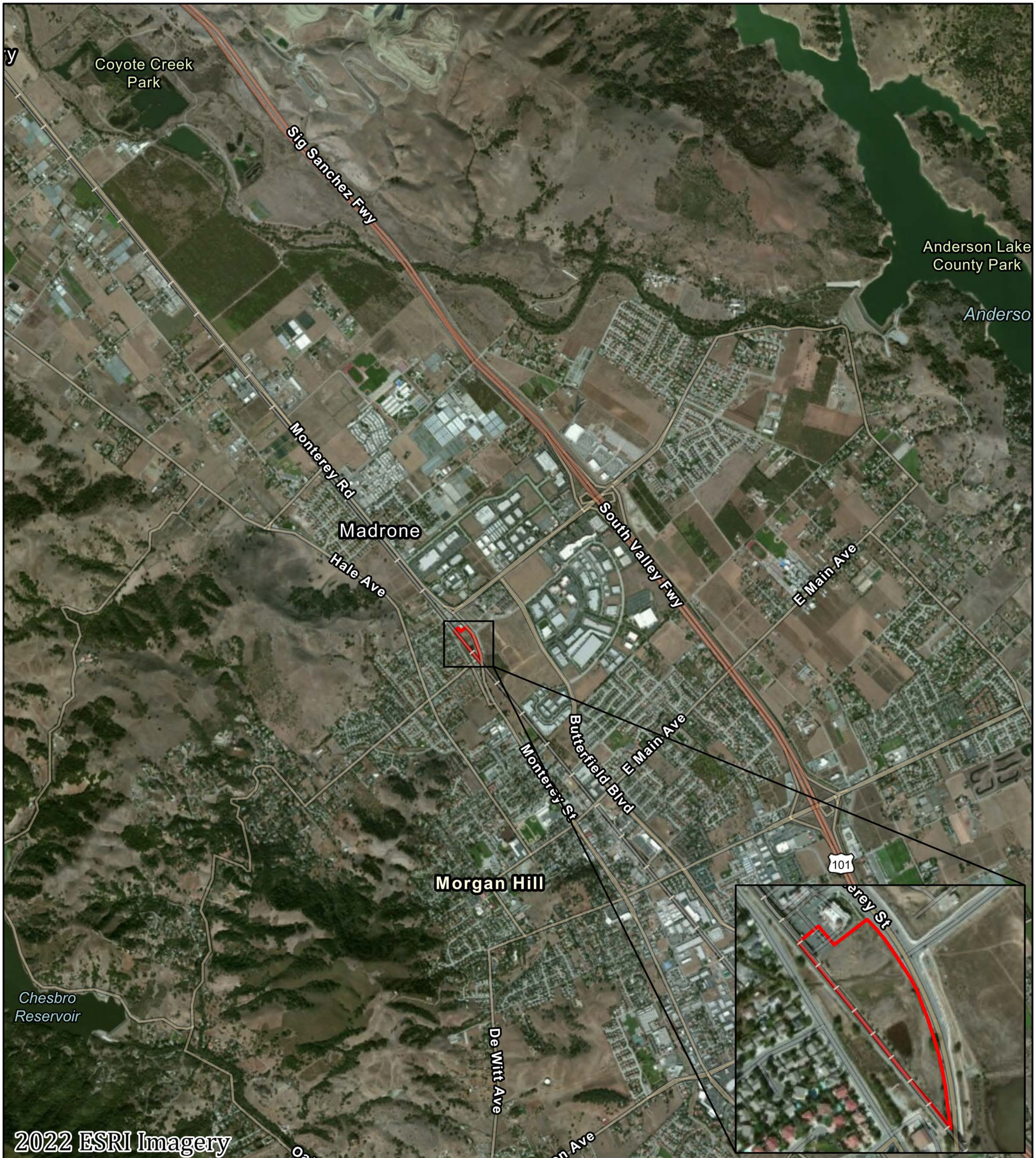
Figures



Map Created 4/21/2022
by N. Schowalter

Legend

Project Area

18545-18565 Monterey Road

Figure 1. Site and Vicinity Map

0 0.5 1
Miles

N

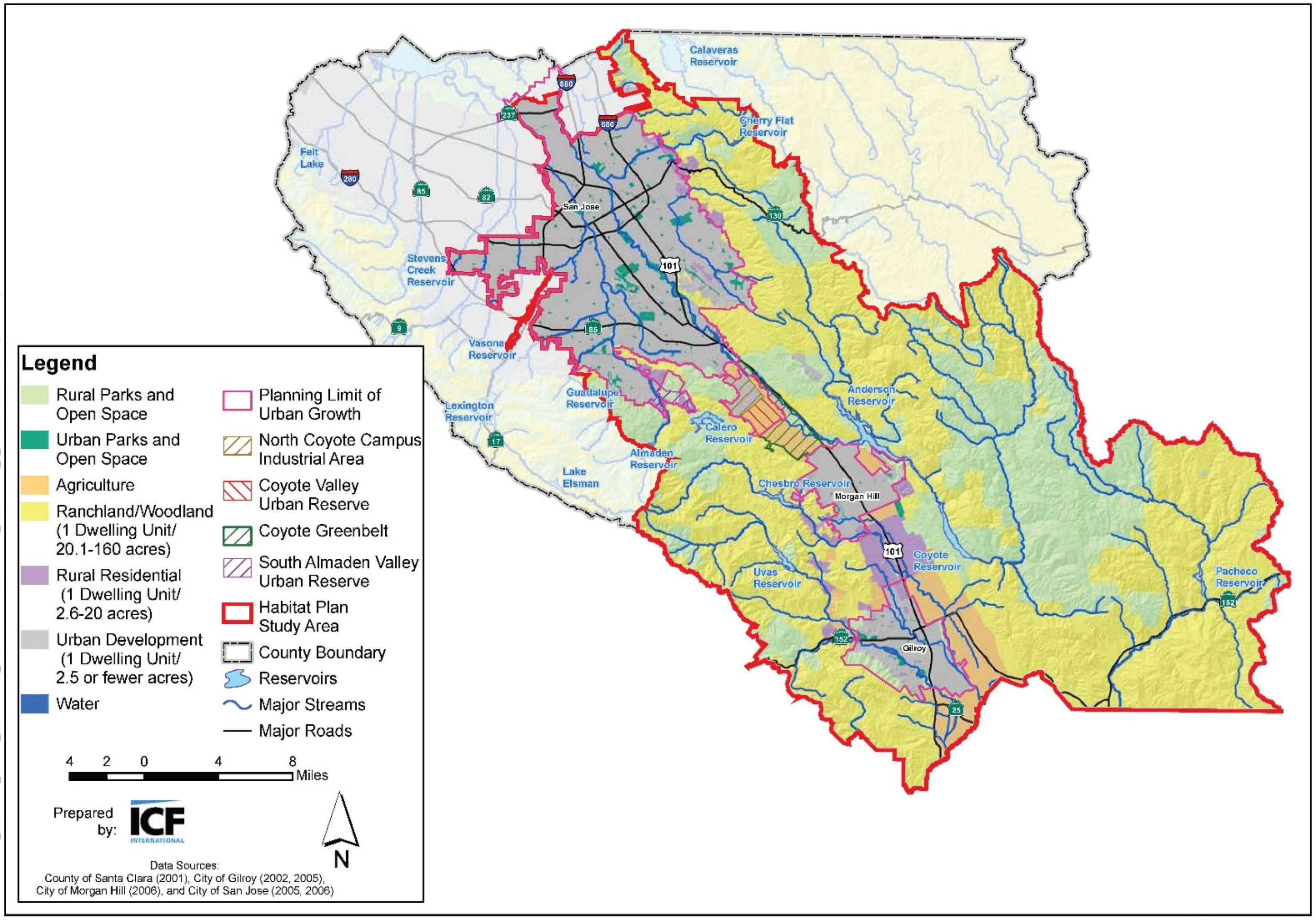


Figure 2-2
Santa Clara Valley Habitat Plan Land Use Categories

JOHNSON MARIGOT CONSULTING, LLC

Map Created 4/21/2022
by N. Schowalter

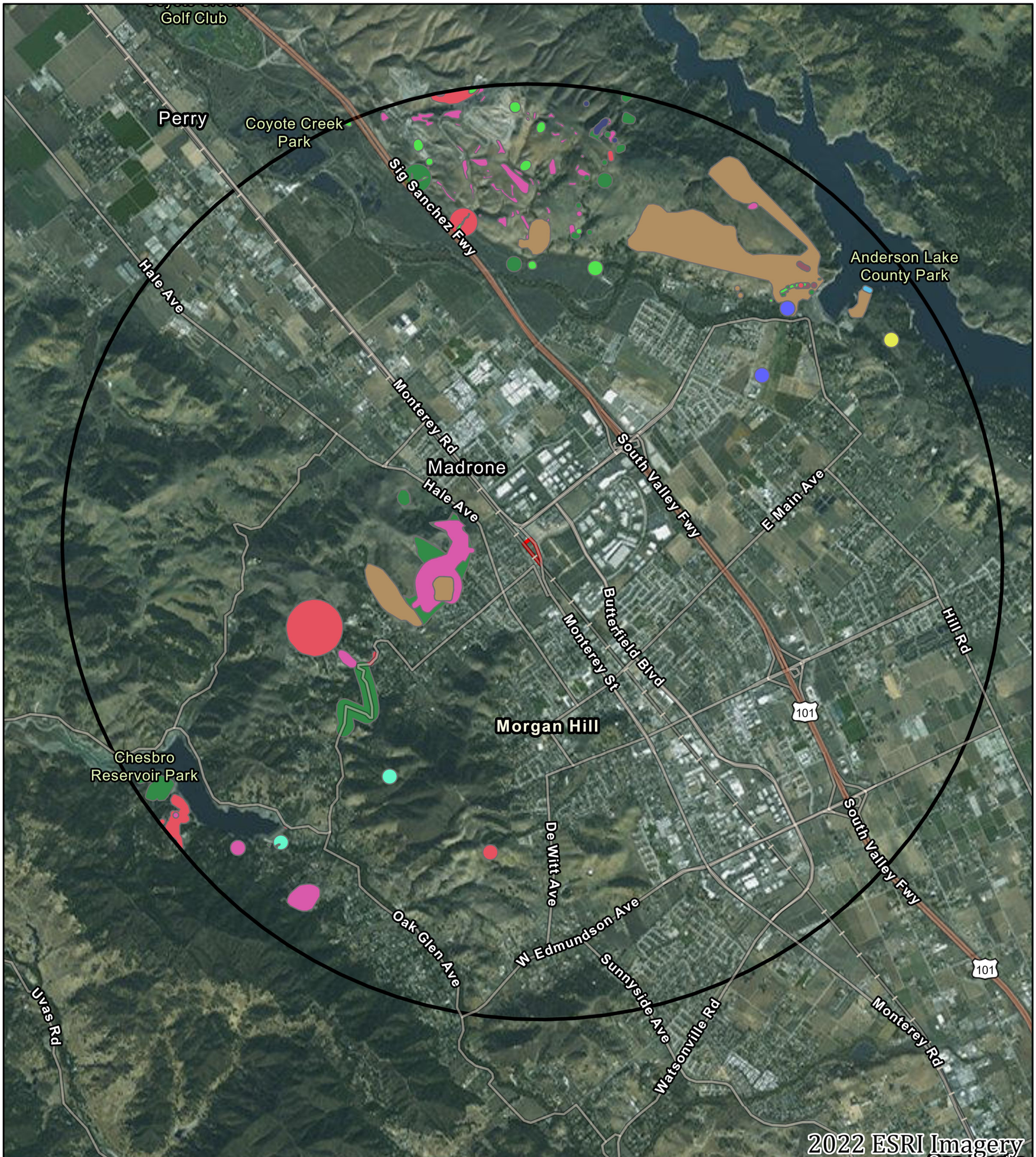
Legend

Project Area
Seasonal Wetland
Ornamental Woodland
Annual Grassland
Urban-Suburban

18545-18565 Monterey Road

Figure 3. Land Cover Types

0 100 200
Feet
N



JOHNSON MARIGOT CONSULTING, LLC

Map Created 4/11/2022
by N. Schowalter

Legend

- Project Area
- 3-Mile Buffer

CNDDB Plants

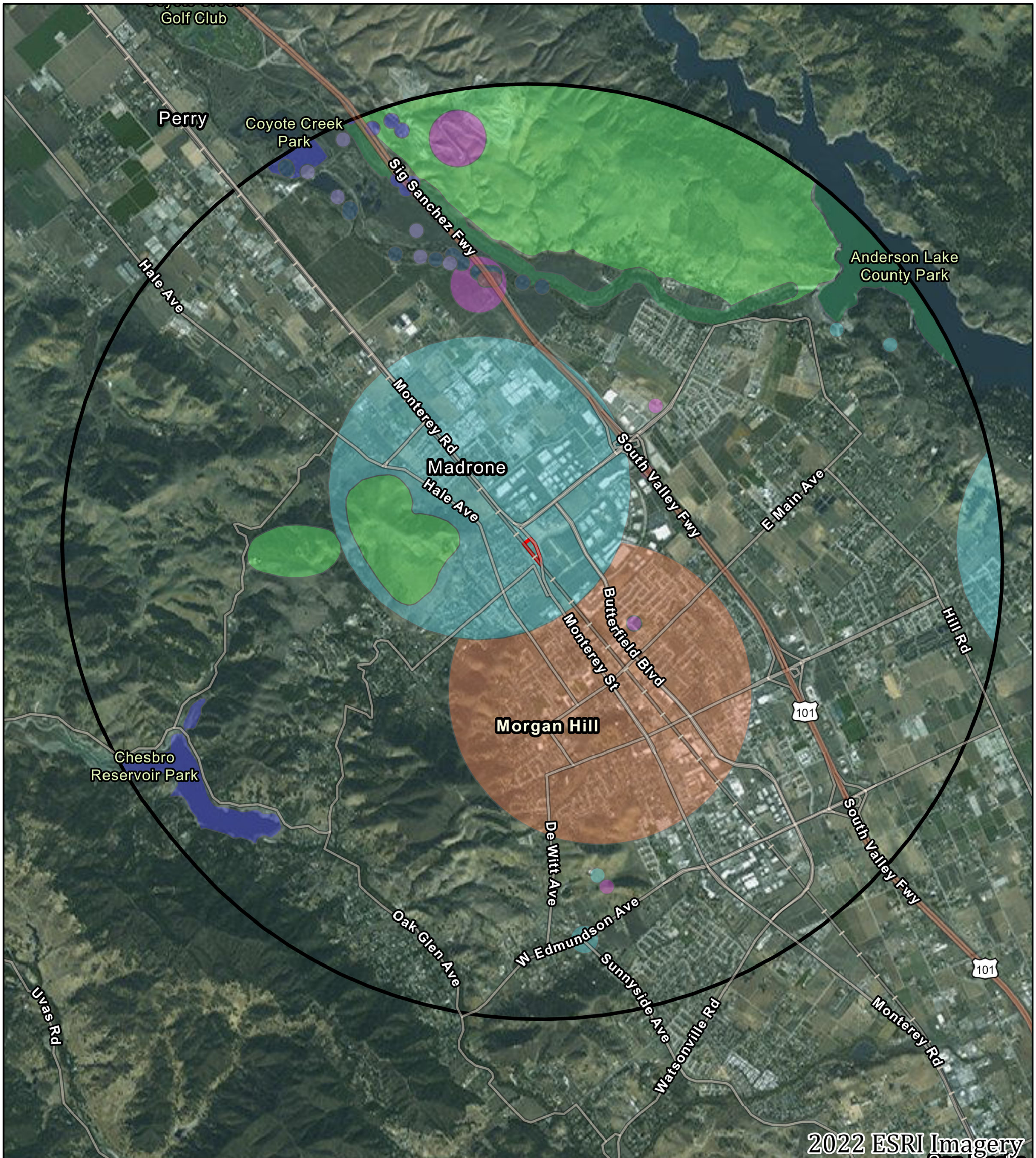
- Coyote ceanothus
- Hall's bush-mallow
- Mt. Hamilton thistle
- San Francisco collinsia
- Santa Clara Valley dudleya
- Tiburon paintbrush
- arcuate bush-mallow
- fragrant fritillary
- most beautiful jewelflower
- smooth lessingia
- woodland woollythreads

18545-18565 Monterey Road

Figure 4. Special-Status Plants

0 0.75 1.5
Miles

N



Legend

- Project Area
- 3-Mile Buffer

CNAME

- American badger
- Bay checkerspot butterfly
- California red-legged frog
- California tiger salamander - central California DPS
- Opler's longhorn moth
- San Francisco dusky-footed woodrat
- burrowing owl
- coast horned lizard
- western bumble bee
- western pond turtle
- white-tailed kite

JOHNSON MARIGOT CONSULTING, LLC

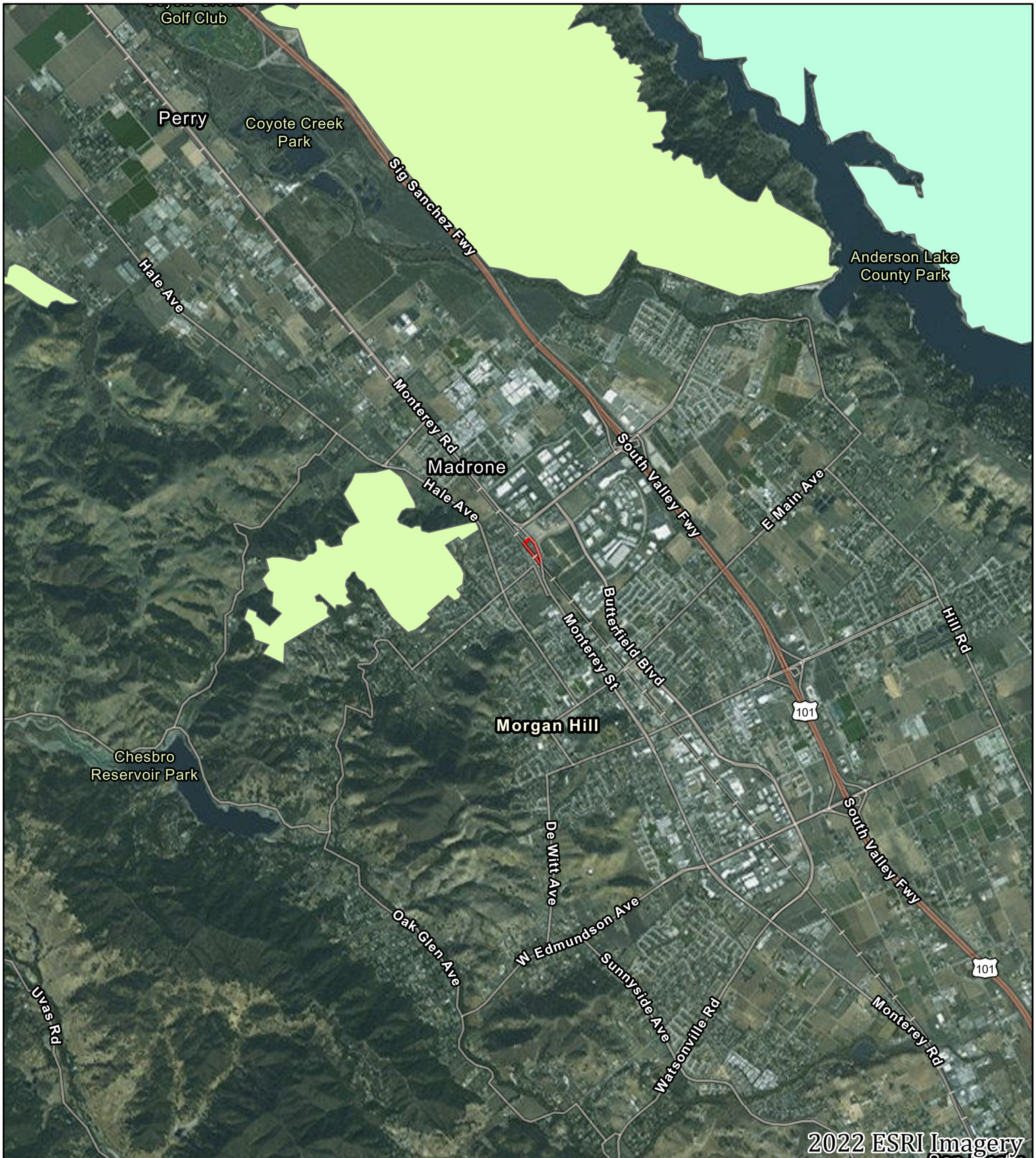
Map Created 4/11/2022 by N. Schowalter

18545-18565 Monterey Road

Figure 5. Special-Status Wildlife

0 0.75 1.5
Miles

N



Map Created 4/11/2022
by N. Schowalter

Legend

Project Area

Critical Habitat

Bay checkerspot butterfly

California red-legged frog

18545-18565 Monterey Road

Figure 6. Critical Habitat

0 0.75 1.5
Miles

N

Tables

Table 1. Plants Observed at 18545-18565 Monterey Road

Scientific Name	Common Name
Acacia dealbata	silver wattle
Avena fatua	wild oat
Baccharis pilularis	coyote brush
Bromus diandrus	ripgut brome
Bromus hordeaceus	soft brome
Cedrus deodara	deodar cedar
Cichorium intybus	chicory
Convolvulus arvensis	field bindweed
Cyperus eragrostis	tall cypress
Distichlis spicata	saltgrass
Dittrichia graveolens	stinkwort
Echinochloa crus-galli	barnyard grass
Epilobium brachycarpum	annual fireweed
Erodium botrys	broad leaf filaree
Festuca perennis	Italian rye grass
Hordeum marinum	seaside barley
Hordeum murinum	foxtail barley
Jugluns hindsii	Northern California black walnut
Medicago polymorpha	bur clover
Nerium oleander	oleader
Persicaria lapathifolia	dock-leaf smartweed
Persicaria maculosa	spotted ladysthumb
Plantago lanceolata	English plantain
Platanus racemosa	California sycamore
Polypogon monspeliensis	rabbitsfoot grass
Populus fremontii	Fremont cottonwood
Pyrus calleryana	Callery pear
Quercus agrifolia	coast live oak
Quercus kelloggii	California black oak
Quercus lobata	valley oak
Raphanus sativus	cultivated radish
Rumex crispus	curly dock
Salix exigua	narrow leaved willow
Sequoia sempervirens	coast redwood
Typha latifolia	common cattail
Xanthium stumarium	rough cocklebur

Table 2. Special-Status Plant Species Known to Occur in the Vicinity of 18545-18565 Monterey Road

Common Name	Scientific Name	Status	Habitat type	Occurence information	Probability of occuring on site
Tiburon paintbrush	*Castilleja affinis var. neglecta*	Federally Endangered, State Threatened, CNPS 1B.2	Serpentine chaparral, valley, and foothill grasslands.	Mapped within Morgan Hill Quad.	**None**. No suitable habitat occurs on or around the site.
Pink Creamsacs	*Castilleja rubicundula var. rubicundula*	State ranked - S2, CNPS 1B.2	Serpentine chaparral, cismontane woodland, meadows and seeps, and valley and foothill grasslands.	Mapped within Morgan Hill Quad.	**None**. No suitable habitat occurs on or around the site.
Coyote ceanothus	*Ceanothys ferrisiae*	Federally endangered, CNPS 1B.1	Serpentine chaparral, valley, and foothill grasslands.	Three records, the closest less than a mile away on serpentine.	**None.** No suitable habitat occurs on or around the site.
Dwarf soaproot	*Chlorogalum pomeridianum var. minus*	CNPS 1B.2	Serpentine chaparral, valley, and foothill grasslands.	Mapped within Morgan Hill Quad.	**None.** No suitable habitat occurs on or around the site.
Mt. Hamilton fountain thistle	*Cirsium fontinale var. campylon*	State ranked - S2, CNPS 1B.2	Serpentinite seeps in chaparral, cismontane woodland, and valley and foothill grassland.	Seven records, the closest approximately 2.25 miles from the site.	**None.** No suitable habitat occurs on or around the site.
San Francisco collinsia	*Collinsia multicolor*	State ranked - S2, CNPS 1B.2	Northern Coastal Scrub, Closed-cone Pine Forest	One population on the shore of Anderson Reservoir.	**None**. No suitable habitat occurs on or around the site.
Santa Clara Valley dudleya	*Dudleya abramsii ssp. setchellii*	State ranked - S2, CNPS 1B.1	Valley Grassland, Foothill Woodland	Multiple populations in the area, the closest less than a half mile from the site.	**None.** No suitable habitat occurs on or around the site. Requires serpentine soils.

Fragrant fritillary	*Fritillaria liliacea*	State ranked - S2, CNPS 1B.2	Serpentine chaparral, valley, and foothill grasslands.	One population near shore of Anderson Reservoir.	**None**. No suitable habitat occurs on or around the site.
Smooth lessingia	*Lessingia micradenia var. glabrata*	State ranked - S2, CNPS 1B.2	Serpentine, often roadsides. Chaparral, Cismontane woodland, and valley and foothill grassland.	Multiple populations in the area, the closest is less than a half mile from the site.	**None.** No suitable habitat occurs on or around the site. Requires serpentine soils.
Arcuate bush-mallow	*Malacothamnus arcuatus*	State ranked - S2, CNPS 1B.2	Coastal Sage Scrub, Foothill Woodland, Chaparral	Two occurences. the closest about two miles from the site.	**None**. No suitable habitat occurs on or around the site.
Hall's Bush Mallow	*Malacothamnus hallii*	CNPS 1B.2	Coastal Sage Scrub, Foothill Woodland, Chaparral	Two occurences near Anderson Reservoir.	**None**. No suitable habitat occurs on or around the site.
Woodland wollythreads	*Monolopia gracilens*	State ranked - S3, CNPS 1B.2	Sometimes serpentine soils in Mixed Evergreen Forest, Redwood Forest, Chaparral.	One occurrence near Anderson Reservoir	**None.** No suitable habitat occurs on or around the site.
Metcalf Canyon jewelflower	*Streptanthus albidus ssp. albidus*	State Endangered, CNPS 1B.1	Serpentine chaparral, valley, and foothill grasslands.	Mapped in Quad.	**None.** No suitable habitat occurs on or around the site.
Most beautiful jewelflower	*Streptanthus albidus ssp. peramoenus*	State ranked - S2, CNPS 1B.2	Serpentine chaparral, valley, and foothill grasslands.	Multiple occurences, closest less than half mile from site.	**None.** No suitable habitat occurs on or around the site.

Table 3. Special-Status Wildlife Species Known to Occur in the Vicinity of 18545-18565 Monterey Road

Common Name	Scientific Name	Status	Habitat type	Occurrence information	Probability of occurring on site
California tiger salamander	*Ambystoma californiense*	Federally Threatened, State Threatened	Seasonal wetlands and ponds and adjacent grasslands.	Many occurrences in the greater area. Four within the 3-mile radius presumed extant, closest about 2.5 miles away.	**None.** There is no known population with the capacity to colonize the site, and no known CTS on or adjacent to the site.
California red-legged frog	*Rana draytonii*	Federally threatened, State ranked S2S3	Wet areas. Permanent or seasonal, such as ponds, streams, and marshes.	Three occurrences near edge of 3-mile radius.	**None.** There is no known population with the capacity to colonize the site, and no known CRLF on or adjacent to the site.
Western pond turtle	*Emys marmorata*	California Species of Concern	A variety of habitats adjacent to permanent or nearly permanent water.	Three occurrences, including at Anderson Reservoir, Chesbro Reservoir, and Coyote-Evergreen Canal.	**None**. There is no known population with the capacity to colonize the site, and no known WPT on or adjacent to the site.
Coast horned lizard	*Phrynosoma blainvilli*	California Species of Concern	Grasslands, scrublands, oak woodlands. Often found in dry riverbeds	One historic occurrence in "Vicinity of Morgan Hill"	**None.** There is a single local record that dates to 1894.
White tailed kite	*Elanus leucarus*	California Protected	Open grasslands and agricultural areas throughout California	Two occurrences along Coyote Creek.	**Likely**. This species is known to occur throughout the region and onsite trees may represent nesting sites. A preconstruction bird survey should be conducted.
Burrowing owl	*Athene cunicularia*	State ranked - S3	Grasslands, rangelands and other open dry areas.	Multiple occurrences in area, but those within 1.5 mile of site are "possibly extirpated."	**Low**. A preconstruction bird survey should be conducted.

Swainson's Hawk	*Buteo swainsonii*	California Threatened	Found in open (primarily agricultural areas) with low crops, and grasslands. Nests in trees.	None recorded within 3-mile radius. Nesting pair has been reported in Coyote Valley.	**Low**. A preconstruction bird survey should be conducted.
Tricolored blackbird	*Agelaius tricolor*	California Species of Concern	Colonial nesting species associated with fresh-water emergent marsh.	None recorded within 3-mile radius	**Low**. Potential for nesting at Butterfield Retention Basin on adjacent property. A preconstruction bird survey should be conducted.
American badger	*Taxidea taxus*	State ranked - S3	Open grasslands, fields, and pastures.	Two occurrences recorded. The closest occurrence is about one mile away.	**None.** No connectivity to existing habitat. Site is not suitable for burrows.
San Francisco dusky-footed woodrat	*Neotoma fuscipes annectens*	State ranked - S2S3	Oak woodlands and chaparral.	Three occurrences at Coyote Creek, nearest about 2 miles away.	**None**. No suitable habitat occurs on or around the site.
Bay checkerspot butterfly	*Euphydryas editha bayensis*	State ranked - S1	Serpentine soils. Host plants are *Plantago erecta* and *Castilleja densiflora* or *C. exserta*	Two occurrence, including one about half mile from site.	**None**. No suitable habitat occurs on or around the site.
Opler's longhorn moth	*Adela oplerella*	State ranked – S2	Serpentine soils, grasslands.	Two occurrences, nearest about half mile away.	**None**. No suitable habitat occurs on or around the site.
Crotch bumble bee	*Bombus crotchii*	none	Inhabits open grassland and scrub habitats. This species occurs primarily in California, including the Mediterranean region, Pacific Coast, Western Desert, Great Valley, and adjacent foothills through most of southwestern California. Colonial nests in underground cavities	No known records within 3 miles	**None.** Site conditions are not suitable for nest colonies.
Western bumble bee	*Bombus occidentalis*	none	Found throughout in the eastern part of the state in the Sierra-Cascade Range from near Yosemite to Oregon and west along the	One historic occurrence in "Vicinity of Morgan Hill"	**None**. Site conditions are not suitable for nest colonies. There is a single local record that

	northern tier of counties into Humboldt County. Colonial nests in underground cavities. Colonial nests in underground cavities	dates to 1940.

Attachments

Attachment 1. Proposed Project Development

Attachment 2. Site Photos

Attachment 3. NRCS Soils Report

Attachment 4. Petition to State of California for Listing of Bumble Bees

Attachment 5. Conditions of Santa Clara Valley Habitat Plan

Attachment 1. Proposed Project Development

City Ventures

THE GATES - CONCEPTUAL ILLUSTRATIVE PLAN

Morgan Hill, CA

0 15' 30' 60'
Scale: 1" = 30'-0"

03.09.22

L-1

C2 Collaborative

Attachment 2. Site Photos

Photo 1. Seasonal wetland ditches exiting property

Photo 2. Central wetland ditch

Photo 3. Beginning of central wetland ditch

Photo 4. Beginning of northeastern wetland ditch

Photo 5. Depressional wetland in northern portion of site

Photo 6. Depressional wetland in center of site

Photo 7. Northern half of property

Photo 8. Detention basin

Photo 9. Depressional wetland at southern end of property

Photo 10. Standpipe in detention basin

Photo 11. Ornamental woodland along southern property edges and detention basin

Photo 12. Ornamental woodland along eastern edge of proptery

Photo 13. Ornamental woodland along western edge of property

Photo 14. Ornamental woodland along edge of detention basin

Attachment 3.   NRCS Soils Report

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Eastern Santa Clara Area, California

April 7, 2022

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:1,660 if printed on A portrait (8.5" x 11") sheet.

Meters: 0, 20, 40, 80, 120

Feet: 0, 50, 100, 200, 300

N

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 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
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: Eastern Santa Clara Area, California
Survey Area Data: Version 17, Sep 9, 2021

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

Date(s) aerial images were photographed: Jun 8, 2021—Jun 15, 2021

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

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
SdA	San Ysidro loam, 0 to 2 percent slopes, MLRA 14	4.5	100.0%
Totals for Area of Interest		**4.5**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Eastern Santa Clara Area, California

SdA—San Ysidro loam, 0 to 2 percent slopes, MLRA 14

Map Unit Setting

National map unit symbol: 2tyys
Elevation: 70 to 1,990 feet
Mean annual precipitation: 13 to 22 inches
Mean annual air temperature: 59 to 61 degrees F
Frost-free period: 300 to 360 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

San ysidro and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of San Ysidro

Setting

Landform: Valley floors, alluvial fans, terraces
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

A - 0 to 23 inches: loam
B1 - 23 to 38 inches: clay loam
Bt2 - 38 to 64 inches: loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 16 to 24 inches to abrupt textural change
Drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R014XE029CA - LOAMY CLAYPAN
Hydric soil rating: No

Minor Components

Arbuckle

Percent of map unit: 6 percent

Hydric soil rating: No

Solano

Percent of map unit: 2 percent
Hydric soil rating: No

Pleasanton, loam

Percent of map unit: 2 percent
Hydric soil rating: No

Rincon

Percent of map unit: 2 percent
Hydric soil rating: No

Palexeralfs

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Pescadero

Percent of map unit: 1 percent
Landform: Basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Cropley, clay

Percent of map unit: 1 percent
Hydric soil rating: No

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Attachment 4. Petition to State of California to List Bumble Bees

FGC - 670.1 (3/94)

A PETITION TO THE STATE OF CALIFORNIA
FISH AND GAME COMMISSION

For action pursuant to Section 670.1, Title 14, California Code of Regulations (CCR) and Sections 2072 and 2073 of the Fish and Game Code relating to listing and delisting endangered and threatened species of plants and animals.

I. SPECIES BEING PETITIONED:

1. Common Name: Crotch bumble bee
   Scientific Name: *Bombus crotchii*
2. Common Name: Franklin's bumble bee
   Scientific Name: *Bombus franklini*
3. Common Name: Suckley cuckoo bumble bee
   Scientific Name: *Bombus suckleyi*
4. Common Name: Western bumble bee
   Scientific Name: *Bombus occidentalis occidentalis*

II. RECOMMENDED ACTION:

1. Common Name: Crotch bumble bee As Endangered X
   Scientific Name: *Bombus crotchii*
2. Common Name: Franklin's bumble bee As Endangered X
   Scientific Name: *Bombus franklini*
3. Common Name: Suckley cuckoo bumble bee As Endangered X
   Scientific Name: *Bombus suckleyi*
4. Common Name: Western bumble bee As Endangered X
   Scientific Name: *Bombus occidentalis occidentalis*

III. AUTHOR OF PETITION:

Name: The Xerces Society, including: Rich Hatfield, Sarina Jepsen, Sarah Foltz Jordan, Michele Blackburn, Aimée Code

Address: 628 NE Broadway, Portland, OR 97232

Phone Number: 503-232-6639

I hereby certify that, to the best of my knowledge, all statements made in this petition are true and complete.

Signature: Sarina Jepsen

Sarah foltz jordan

Date: 16 October 2018

FGC - 670.1 (3/94)

A PETITION TO THE STATE OF CALIFORNIA
FISH AND GAME COMMISSION TO LIST

The Crotch bumble bee (*Bombus crotchii*), Franklin's bumble bee (*Bombus franklini*), Suckley cuckoo bumble bee (*Bombus suckleyi*), and western bumble bee (*Bombus occidentalis occidentalis*) as Endangered under the California Endangered Species Act

Bombus crotchii, by Stephanie McKnight, the Xerces Society (top left); *Bombus franklini*, by Pete Schroeder (top right); *Bombus occidentalis occidentalis*, by Rich Hatfield, the Xerces Society (bottom left); *Bombus suckleyi*, by Hadel Go/www.discoverlife.org (bottom right).

Submitted by
The Xerces Society for Invertebrate Conservation, Defenders of Wildlife, Center for Food Safety

October 2018

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I. EXECUTIVE SUMMARY

The Crotch bumble bee (*Bombus crotchii*), Franklin's bumble bee (*Bombus franklini*), Suckley cuckoo bumble bee (*Bombus suckleyi*), and western bumble bee (*Bombus occidentalis occidentalis*) are endangered with extinction throughout their ranges, including in California. Recent research has shown a significant reduction in both the range and relative abundance of these species, and where they still persist, they are far less common than they were historically. **The Crotch bumble bee (*Bombus crotchii*)** was historically common in the southern two-thirds of California, but now appears to be absent from most of it, especially in the center of its historic range (Hatfield et al. 2014; Richardson et al. 2014); analyses suggests sharp declines in both relative abundance (98% decline) and persistence (80% decline) over the last ten years. **Franklin's bumble bee (*Bombus franklini*)** is in imminent danger of extinction and notably has the most limited geographic distribution of any bumble bee in North America and possibly the world (Williams 1998). Extensive surveys since 1998 have demonstrated that there has been a precipitous decline in the number of individuals and localities in the past several decades; this species has not been seen in California since 1998, and has not been seen anywhere since 2006. The **western bumble bee (*Bombus occidentalis occidentalis*)** has recently undergone a dramatic decline in abundance and distribution, and is no longer present across much of its historic range. Declines suggest it has been lost from 53% of its historic range and has experienced an 84% decline in relative abundance (Hatfield et al., unpublished data); in

California, *B. o. occidentalis* populations are currently largely restricted to high elevation sites in the Sierra Nevada (Xerces Society 2012). The **Suckley cuckoo bumble bee (*Bombus suckleyi*),** relies upon western bumble bees to complete its life cycle, and thus is uniquely susceptible to extinction (Suhonen et al. 2015).

Bumble bees are among the most iconic and well understood group of native pollinators in North America. They are generalist pollinators that play a valuable role in the reproduction of a wide variety of plants, including California specialty crops such as tomato, squash, melon, and pepper, and numerous wildflowers. Pollinators are critical components of our environment and essential to our food security. Insects – and primarily bees – provide the indispensable service of pollination to more than 85% of flowering plants (Ollerton et al. 2011), contributing to 35% of global food production (Klein et al. 2007). Many vitamins and other nutrients essential to human nutrition are found primarily in plants that require insect pollination (Eilers et al. 2011); as such, the loss of pollinators may pose challenges to human nutrition.

Each of the following factors pose a substantial threat to the survival of the four species of bumble bees included in this petition: present or threatened modification or destruction of its habitat; overexploitation; competition; disease; and other natural events and human-related activities, including pesticide use, population dynamics and structure, global climate change, and for the Suckley cuckoo bumble bee, loss of its host species.

While each of these four bumble bee species have been placed on California Department of Fish and Wildlife's Special Animal List, and their extinction risk has been recognized by the International Union for the Conservation of Nature (IUCN) and the global network of bumble bee researchers engaged in IUCN's Bumblebee Specialist Group, these species receive no formal protection. This petition presents information that each of these four bumble bee species is experiencing dramatic declines and protections under the California Endangered Species Act are necessary to conserve their populations and protect and restore their habitat throughout their ranges in California.

II. POPULATION TRENDS, ABUNDANCE, RANGE, AND DISTRIBUTION

Current Conservation Status

The conservation status and extinction risk of the petitioned species has been evaluated by the International Union for the Conservation of Nature (IUCN) Bumblebee Specialist Group, a global network of bumble bee researchers dedicated to the conservation of bumble bees, and published on the IUCN's Red List of Threatened Species (Hatfield et al. 2015a, 2015b, 2015c; Kevan 2008).The IUCN Bumblebee Specialist Group utilized methods published in the 2001 IUCN Red List Categories and Criteria version 3.1, a standard, global method to evaluate the conservation status of plant and animal species worldwide. Each species was assessed according to the IUCN Red List criteria by multiple bumble bee experts, and the methods used in the assessments were peer-reviewed by additional bumble bee experts (see reviewers and assessors listed in Hatfield et al. 2015a, 2015b, 2015c), with the exception of the Red List profile for *B. franklini*, which was added to the Red List in 2008, before the IUCN Bumblebee Specialist Group existed.

The IUCN Bumble Bee Specialist Group (BBSG) measured changes in each species' range and relative abundance between historic (1805-2001) and recent (2002-2012) time periods for *B. crotchii*, *B. occidentalis*, and *B. suckleyi* (Hatfield et al. 2015a; 2015b; 2015c). *Bombus franklini* was listed on the IUCN Red List previously (Kevan 2008).

A database of more than 200,000 electronic specimen records of North American bumble bee species was assembled from academic, research and private collections (Richardson 2014) and analyzed to evaluate the change in each species' range between the recent and historic time periods. Once these analyses were completed, quantitative thresholds for extinction risk were used (IUCN 2012) to determine the extinction risk of each bumble bee species (IUCN Red List 2016).

The petitioned species are listed on the IUCN Red List as: Critically Endangered (*Bombus franklini* and *Bombus suckleyi*) and Endangered (*Bombus crotchii*) (Table 1) (Kevan 2008; Hatfield et al. 2015a; 2015c). An IUCN Red List category has not yet been formally assigned for the southern subspecies of the western bumble bee (*B. occidentalis occidentalis*), but the full species (*B. occidentalis*) is listed as Vulnerable to extinction on the IUCN Red List (Hatfield et al. 2015b), and a more recent analysis of changes in range and relative abundance of *B. o. occidentalis* suggests that this subspecies would meet the criteria of Endangered on the IUCN Red List (Hatfield et al. 2018a, unpublished data).

Table 1: Conservation status of each of the four petitioned bumble bee species. *The subspecies *Bombus occidentalis occidentalis* has not been evaluated by CNDDB; the S1 rank is for the entire species *Bombus occidentalis*. **The subspecies *Bombus occidentalis occidentalis* is not on the IUCN Red List (since the taxonomic change came after the assessments were done), but the IUCN's Bumblebee Specialist Group range and relative abundance decline estimates indicate that it would meet the IUCN Red List's Endangered criteria. The species *Bombus occidentalis* has been listed as Vulnerable on the IUCN Red List.

Species	CNDDB State Rank	NatureServe global (G) and national (T) ranks	ESA Status	IUCN Red List Status
Crotch bumble bee (*Bombus crotchii*)	S1S2	G3G4	None	Endangered
Franklin's bumble bee (*Bombus franklini*)	S1	G1	None (SSA phase)	Critically Endangered
Western bumble bee, southern subspecies (*Bombus occidentalis occidentalis*)	S1*	G4T1T3	None (parent species SSA phase)	Subspecies not evaluated, but meets the criteria of Endangered**
Suckley cuckoo bumble bee (*Bombus suckleyi*)	S1	G1G3	None	Critically Endangered

Changes in Range, Distribution, and Relative Abundance

In Table 2, we summarize the changes in range (extent of occurrence, or EOO, and persistence) and relative abundance for each of the petitioned species (Kevan 2008; Hatfield et al. 2015a; 2015c; IUCN Red List 2016; Hatfield 2018a and 2018b, unpublished data).

Table 2: Summary of changes in species' ranges, persistence, and relative abundance between recent (2002-2012) and historic (pre-2002) time periods.

Species	Historic Distribution	Range Decline: Extent of Occurrence	Range Decline: Persistence	Relative Abundance Decline	Average Decline	Reference
Crotch bumble bee (*Bombus crotchii*)	**United States** (CA) **Mexico** (B.C.)	25%	79%	98%	67%	Hatfield et al. 2015a
Franklin's bumble bee (*Bombus franklini*)	**United States** (CA, OR)	44%	67%	85%	65%	Hatfield 2018b, unpublished data
Western bumble bee, southern subspecies (*Bombus occidentalis occidentalis*)	**United States** (AZ, CA, CO, ID, MT, NE, NV, NM, OR, SD, UT, WA, WY) **Canada** (AB, BC, SK)	53%	33%	84%	57%	Hatfield 2018a, unpublished data
Suckley cuckoo bumble bee (*Bombus suckleyi*)	**United States** (AK, CA, CO, ID, MT, NY, ND, OR, SD, UT, WA, WY) **Canada** (AB, BC, MB, NL, NT, NS, ON, QC, SK, YT)	57%	84%	90%	77%	Hatfield et al. 2015c

Each of the species included in this petition have experienced dramatic declines in their ranges, relative abundance, and persistence, and these sharp decreases have likely been driven by population declines. The life history of *Bombus suckleyi*, a cuckoo bumble bee, makes it uniquely susceptible to extinction (Suhonen et al. 2015). Below we provide more information on the distribution and population status of each species in this petition.

The Crotch bumble bee (Bombus crotchii)

Distribution

Bombus crotchii has a limited distribution in southwestern North America. This species occurs primarily in California, including the Mediterranean region, Pacific Coast, Western Desert, Great Valley, and adjacent foothills through most of southwestern California (Williams et al. 2014). It also occurs in Mexico (Baja California and Baja California Sur) (Williams et al. 2014) and has been documented in southwest Nevada, near the California border.

Population Status

This species was historically common throughout much of the southern two-thirds of California, but now appears to be absent from most of it, especially in the center of its historic range (Hatfield et al. 2014, Richardson et al. 2014). In the Central Valley there has been extensive agricultural intensification and the southern part of its range is experiencing rapid urbanization.

Average decline for this species was calculated by averaging the changes in relative abundance and two measures of range: persistence and Extent of Occurrence (EOO) between a recent time period (2002-2012) and a historic (1805-2001) time period (for an explanation of methods, see below). This analysis yielded the following results:

- Current range size relative to historic range (EOO): 74.67% (25.33% decline)
- Persistence in current range relative to historic occupancy: 20.48% (79.52% decline)
- Current relative abundance compared to historic relative abundance: 2.32% (97.68% decline)
- **Average decline: 67.51%**

This analysis suggests sharp declines in both relative abundance and persistence over the last ten years.

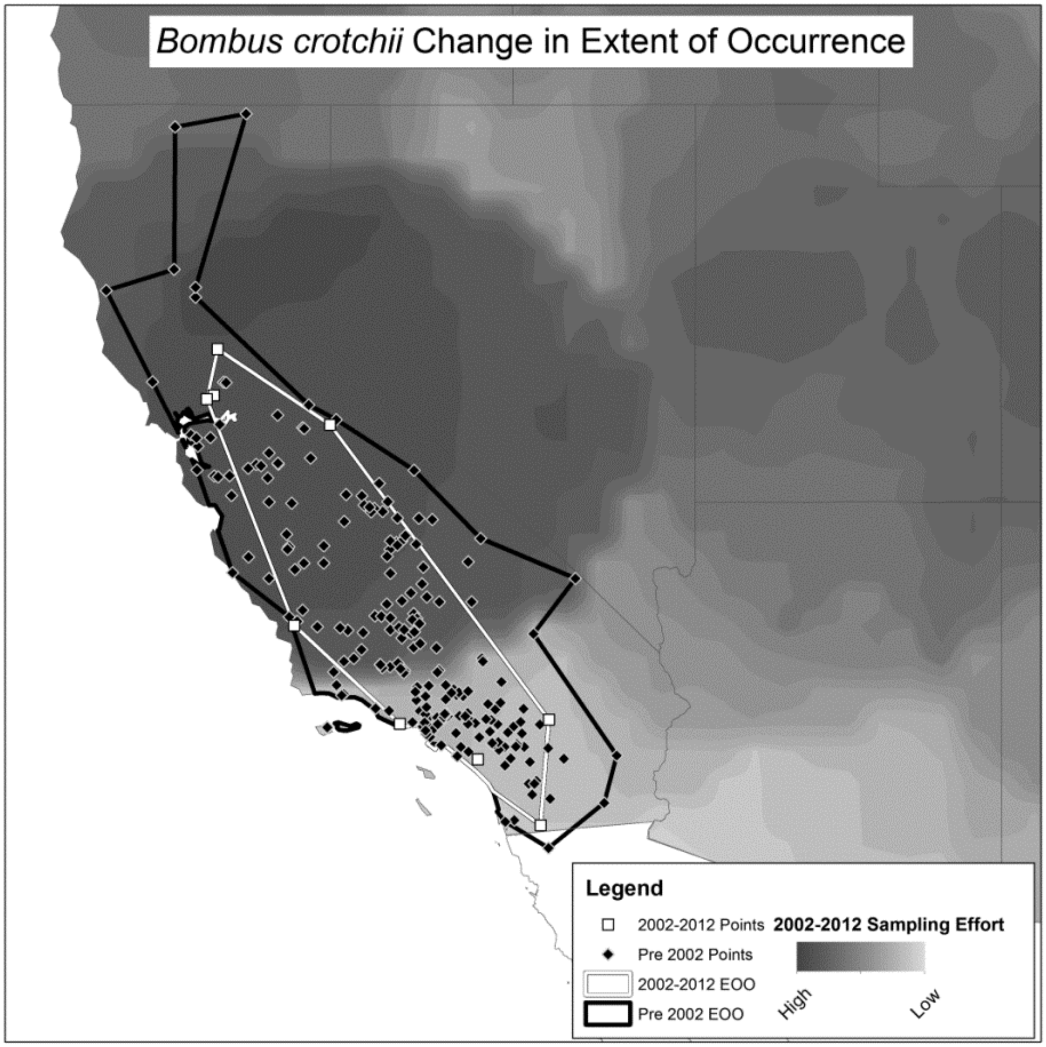

Figure 1: Recent and historical range map for *Bombus crotchii* displayed with a map of sampling effort across its range.

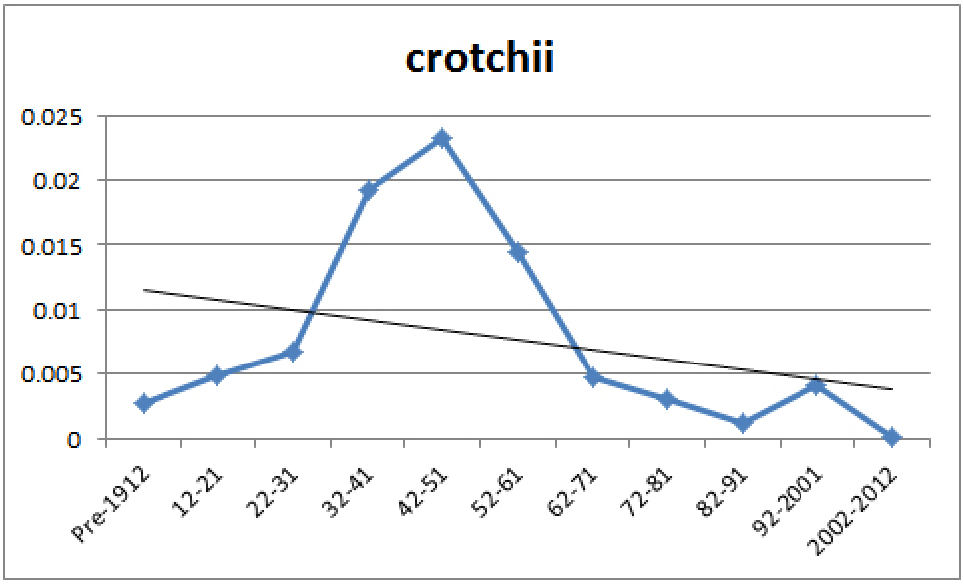

Figure 2: Relative abundance of *Bombus crotchii* by 10-year periods.

Franklin's bumble bee (Bombus franklini)

Distribution

Bombus franklini has the most limited geographic distribution of any bumble bee in North America and possibly the world (Williams 1998). *B. franklini* is known only from southern Oregon and northern California between the Coast and Sierra-Cascade Ranges. Stephen (1957) recorded it from the Umpqua and Rogue River Valleys of Oregon. Thorp et al. (1983) also recorded it from northern California and suggested its restriction to the Klamath Mountain region of southern Oregon and northern California. Its entire distribution, including recent range extensions (Thorp 1999; 2001; 2004) can be covered by an oval of about 190 miles north to south and 70 miles east to west between 122° to 124° west longitude and 40° 58' to 43° 30' north latitude. It is known from Siskiyou and Trinity counties in California. Elevations of localities where it has been found range from 540 feet (162 m) in the north to above 7,800 feet (2,340 m) in the south of its historic range. Although the number of populations that existed prior to 1998 is unknown, there are several historic records for this species, both published and in museums, including two in 1925 (Gold Hill and Roseburg, OR), one in 1930 (Roseburg, OR), two in 1950 (Gold Hill and Medford, OR), two in 1958 (Ashland, OR), two in 1968 (Mt. Ashland and near Copper, OR), one in 1980 (Ashland, OR), two in 1988 (Ashland and Merlin, OR), two in 1989 (Hilt and Yreka, CA), four in 1990 (Ashland, Ruch, Central Point, and Gold Hill, OR), one in 1992 (Ashland, OR), two in 1997 (Roxy Ann Peak near Medford and Ashland Pond in Ashland, OR), and four in 1998 (Roca Canyon in Ashland, Lost Creek Reservoir, and Grizzly Peak near Shale City, OR). Additional records with unknown dates and or localities are also available, including the 1917 type specimen whose locality (Nogales, AZ) has been determined to be erroneous.

Population Status

Evidence for the decline in this species is based on intensive and extensive surveys, primarily by R.W. Thorp (Thorp 1999, 2001, 2004, 2005a, b, 2008) from 1998 through 2017. Surveys for the Bureau of Land Management were also conducted in 2005 (Code and Haney 2006). R.W. Thorp surveyed from nine to seventeen historic sites (average 13.8 sites) per year from 1998 to 2009; reports of surveys completed since 2009 are not available, although it has been confirmed that no *B. franklini* have been found in surveys that have occurred since 2009 (Thorp 2010-2017, pers. comm. with S. Jepsen). Dr. Thorp also surveyed from six to nineteen additional sites (average 12.8 sites) each year, some of which were visited more than once per year and some of which were visited in multiple years (Table 3).

Bombus franklini has not been seen in California since surveys by R.W. Thorp for the species at Hilt in Siskiyou County in 1998 documented two individuals (Table 3). Between 1998 and 2005, the number of sightings of *B. franklini* throughout its range declined precipitously from ninety-four individuals in 1998 to twenty in 1999, nine in 2000 and one in 2001. In Oregon, twenty were found in 2002, although only three were sighted in 2003, all at a single locality at Mt. Ashland in southern Oregon. None were found in 2004 and 2005 in Oregon or California. A single worker of *B. franklini* was sighted in 2006 at Mt. Ashland in Oregon, which is the same locality where *B. franklini* were found in 2003 (Table 3). None have been found from 2007-2017. R.W. Thorp's unpublished surveys have revealed that, since 1998, the populations have decreased to the point of being not seen at all in 2004 or 2005, with only one individual found in 2006. Because extensive surveys of the area within which *B. franklini* exists have, as of 2006, uncovered only one individual, but similar surveys in the first three years (1998-2000) uncovered individuals at many historic and seven new sites, it can be concluded that the extent of population is decreasing severely. Though further investigation would be required to determine the exact number of extant *B. franklini*, based on their limited range, it can be assumed that their populations have decreased to dangerously low levels.

Table 3: Historic and new* localities surveyed for *Bombus franklini* and numbers of *B. franklini* observed from 1998 through 2007 (Thorp 2008). Bolded entries denote that *B. franklini* was observed. Surveys were conducted by Dr. Thorp during 2008 and 2009, but no *B. franklini* were encountered.

Site	ST	Year	# times visited / # *Bombus franklini* found									
			1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
		CO										
Sutherlin, W of	OR	Douglas	**1/1***	1/0	1/0	2/0	1/0		2/0	3/0		1/0
Ashland	OR	Jackson			1/0	2/0	**3/1**		4/0	7/0	5/0	2/0
Ashland, ENE (3)	OR	Jackson	1/0	1/0	1/0	2/0	5/0	1/0			1/0	1/0
Buncom, E of	OR	Jackson		**1/1***	3/0	1/0	1/0					
Gold Hill, E of	OR	Jackson	**4/44***	2/0	**7/5**	7/0	3/0	4/0	2/0	4/0	2/0	2/0
Grizzly Peak	OR	Jackson	2/0	2/0	1/0	2/0	2/0	2/0	2/0	3/0	1/0	2/0
Jackson Campground	OR	Jackson	**2/2***	2/0	1/0		1/0			1/0		
Kenney Meadows	OR	Jackson	**2/3***	2/0	2/0	2/0	1/0	1/0		1/0		
Lost Creek Reservoir	OR	Jackson		1/0		1/0			1/0	1/0		
Medford	OR	Jackson			3/0	3/0		1/0	1/0			
Mt. Ashland (2)	OR	Jackson	**3/37**	**6/19**	**7/2**	**5/1**	**10/19**	**9/3**	13/0	11/0	**8/1**	7/0
Phoenix, E of	OR	Jackson			1/0	2/0						
Ruch	OR	Jackson	**3/3**	2/0	**2/1**	1/0	2/0		2/0			
Ruch, S of (2)	OR	Jackson	1/0	2/0			1/0	2/0	2/0	1/0		
Ruch, SSE of	OR	Jackson		2/0	**3/1***	2/0	1/0	2/0		1/0		
Union Creek	OR	Jackson		1/0								
Selma, S of	OR	Josephine	**1/2***	1/0	1/0							
Wonder, W of	OR	Josephine			1/0							
Mt. Shasta	CA	Siskiyou	1/0	1/0	1/0		1/0			1/0	2/0	1/0
Hilt	CA	Siskiyou	**2/2**	3/0	3/0	1/0	2/0	1/0	1/0	2/0	2/0	1/0
Montague	CA	Siskiyou		1/0					1/0		1/0	
Total *B. franklini* seen			94	20	9	1	20	3	0	0	1	0
New sites for *franklini*			5	1	1	0	0	0	0	0	0	0
B. franklini site visits			22	32	41	33	36	20	31	36	22	17
Other sites visited			19	23	14	7	6	8	9	19	14	2

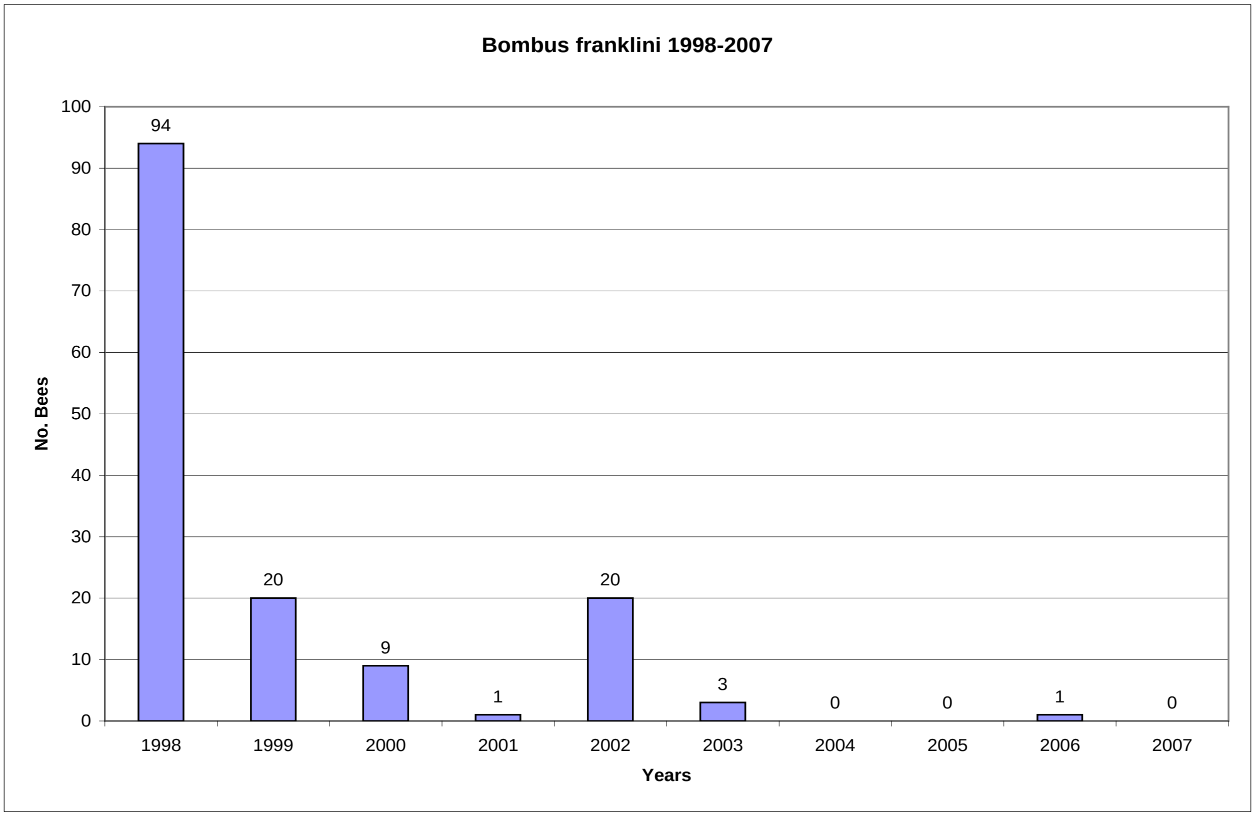

Figure 3: Number of *Bombus franklini* observed in surveys from 1998-2007 (Thorp 2008). Surveys were also conducted by Dr. Thorp from 2008-2017, but no *B. franklini* were found.

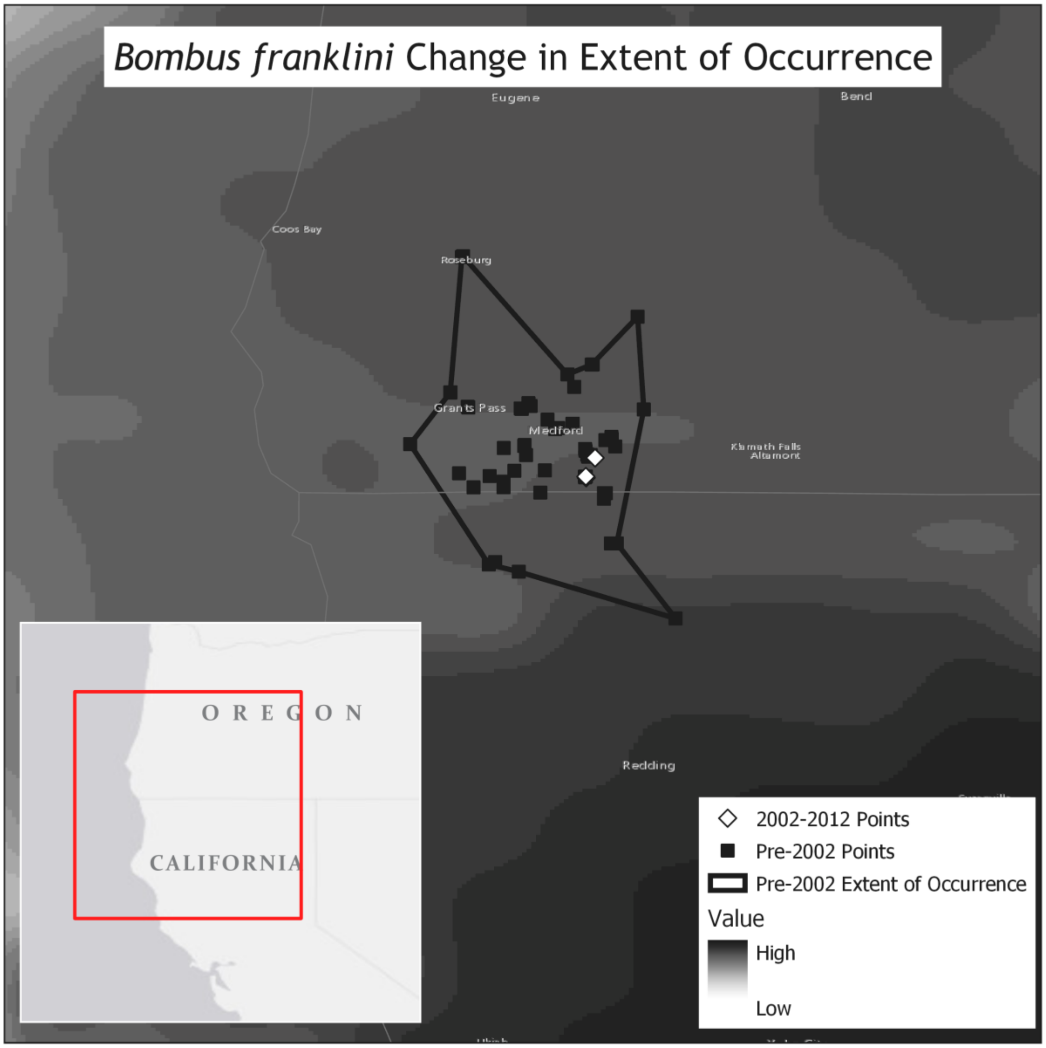

Figure 4: Current and historical range map for *Bombus franklini*.

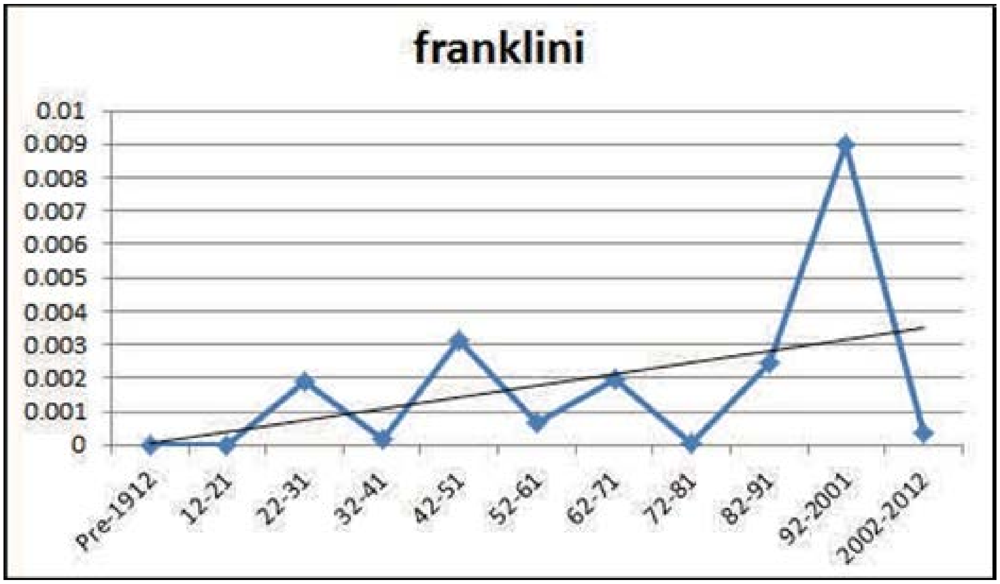

Figure 5: Relative abundance of *Bombus franklini* by 10-year periods. Note that a targeted survey effort for *B. franklini* began in 1998, probably explaining the spike in this species' relative abundance in the *Bombus* specimen database during the decade from 1992-2001.

The Western bumble bee (Bombus occidentalis occidentalis)

Bombus occidentalis consists of two subspecies: *B. occidentalis mckayi*, which occurs in Alaska, Yukon Territory, Northwest Territories, northern British Columbia, and northern Alberta, and *B. occidentalis occidentalis,* which occurs from southern British Columbia, southern Alberta, and southwestern Saskatchewan south to multiple western U.S. states (Sheffield et al. 2016). Existing evidence suggests that it is the southern subspecies, *B. occidentalis occidentalis*, which has undergone a dramatic range contraction and population decline, especially in the western part of its range. The authors of this petition are not aware of any evidence suggesting that *B. occidentalis mckayi* has undergone any range reduction or population decline. The IUCN Bumblebee Specialist Group recently completed analyses of changes in range, persistence, and relative abundance of both *B. occidentalis* (Hatfield et al. 2015b) and *B. occidentalis occidentalis* (Hatfield 2018 unpublished data) between recent and historic time periods.

Distribution

Bombus occidentalis occidentalis was historically broadly distributed across the west coast of North America from southern British Columbia to central California, east through Alberta and western South Dakota, and south to Arizona and New Mexico (Williams et al. 2014; Sheffield et al. 2016). In California, it has been documented in Alameda, Alpine, Butte, Calaveras, Contra Costa, Del Norte, El Dorado, Fresno, Humboldt, Lake, Lassen, Madera, Marin, Mariposa, Mendocino, Modoc, Monterey, Napa, Nevada, Placer, Plumas, Sen Benito, San Francisco, San Joaquin, San Luis Obispo, San Mateo, Santa Clara, Santa Cruz, Shasta, Sierra, Siskiyou, Solano, Sonoma, Tehama, Trinity, Tulare, Yolo, and Yuba counties (Bumble Bee Watch 2017; Richardson 2017; Rickman 2017).

Population Status

Bombus occidentalis occidentalis was once very common in the western United States but has recently undergone a dramatic decline in abundance and distribution, and is no longer present across much of its historic range. A rangewide analysis including more than 73,000 records of eight bumble bee species suggests that the parent species, *B. occidentalis* has undergone a 28% range decline between recent (2007-2009) and historic (1900-1999) time periods (Cameron et al. 2011a). A separate analysis comparing the current (2002-2012) and historic (1805-2001) ranges of *B. occidentalis occidentalis* (using a database of more than 200,000 records of 43 species of North American bumble bees developed by Williams et al. 2014) suggests that the southern subspecies has been lost from 53% of its historic range, or EOO (Hatfield et al., unpublished data). The relative abundance of *B. o. occidentalis* has declined by 84% (Hatfield et al., unpublished data). Declines were found to be most significant at the edges of this species' range (Hatfield et al., unpublished data). In California, *B. o. occidentalis* populations are currently largely restricted to high elevation sites in the Sierra Nevada (Xerces Society 2012), though there have been a couple of observations of this species on the northern California coast (Xerces Society et al. 2017).

Average decline for this species was calculated by averaging the change in abundance, persistence, and EOO. This analysis yielded the following results (see also the graph of relative abundance and map of change in EOO over time below):

- Current EOO (range) relative to historic EOO: 47% (53% decline)
- Persistence in current range relative to historic occupancy: 57% (33% decline)
- Current relative abundance relative to historic values: 16% (84% decline)
- Average decline: 57%

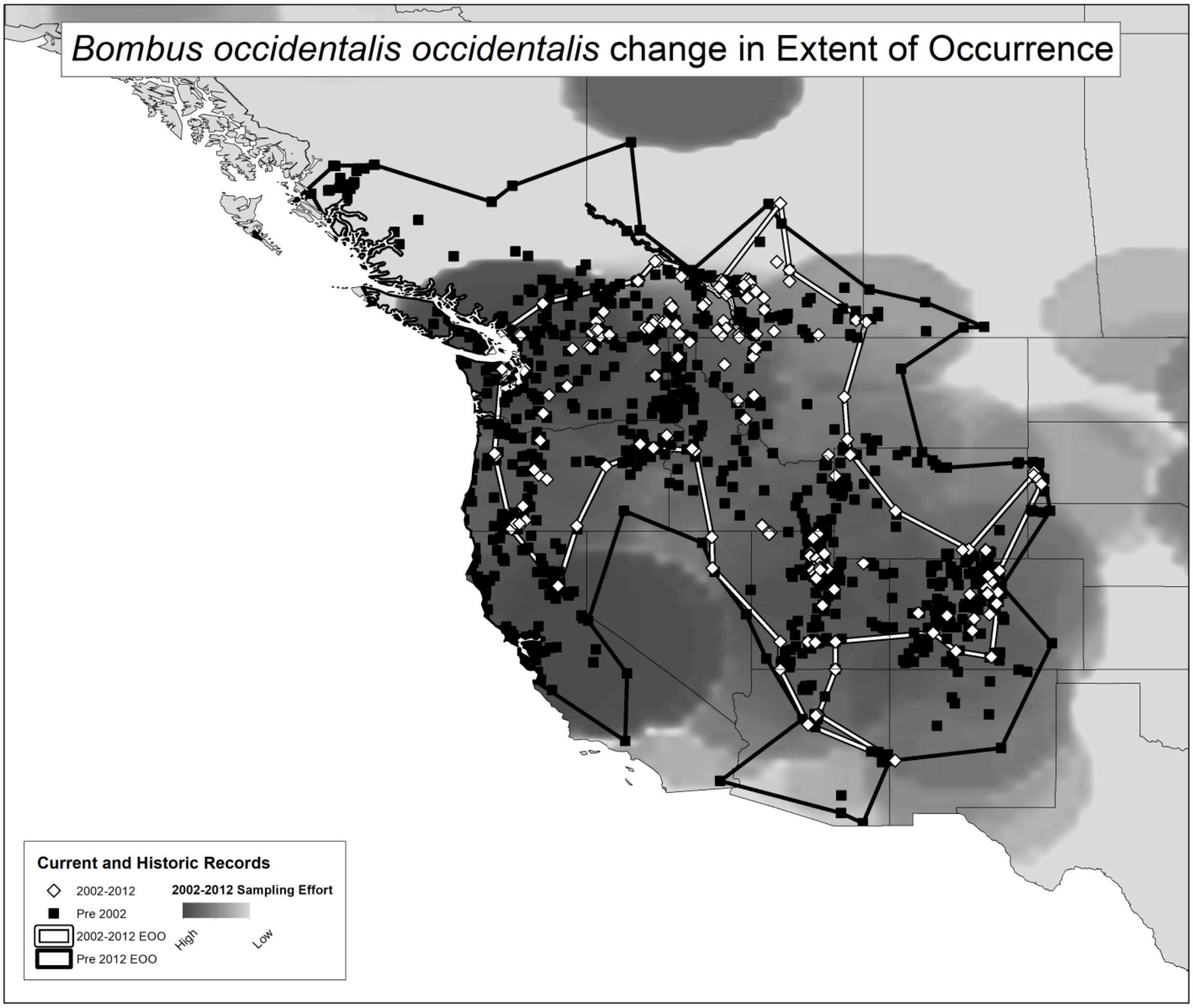

Figure 6: Current and historical range map for *Bombus occidentalis occidentalis*.

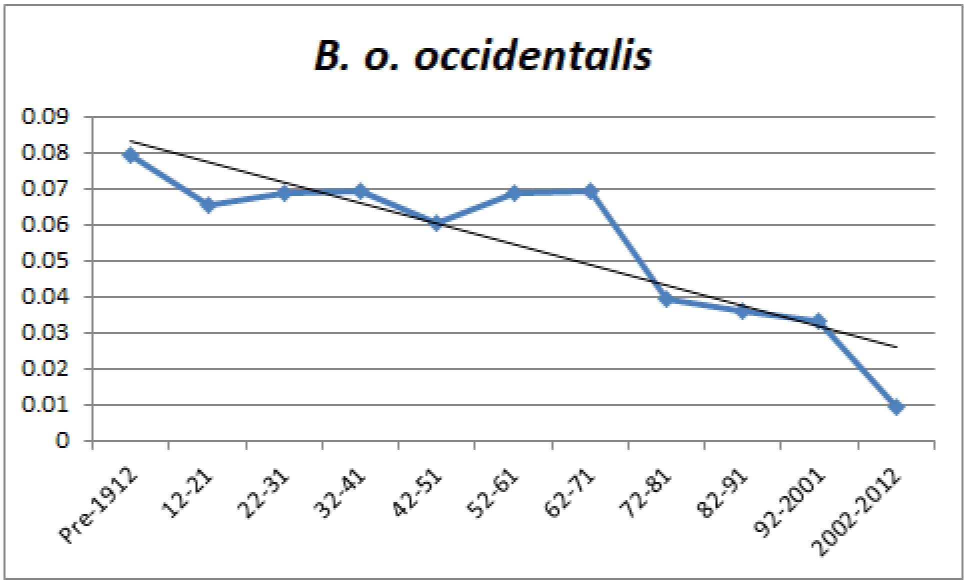

Figure 7: Relative abundance of *Bombus occidentalis occidentalis* by 10-year periods.

The Suckley cuckoo bumble bee (Bombus suckleyi)

Distribution

This species has a broad distribution centered in western North America and also including several scattered localities in the northeast. It occurs in the Mountain West from California and Colorado to Alaska, east to the Canadian Great Plains, with a disjunct subpopulation in Newfoundland (Williams et al. 2014). In California *Bombus suckleyi* has a very limited distribution, occurring only in the Klamath Mountain region in the northern part of the state.

Population Status

Bombus suckleyi has experienced dramatic population declines throughout its range and has declined by over 80%, according to criteria established by the IUCN (Hatfield et al. 2015c). The decade by decade relative abundance regression shows a gradual decline since the 1940s, and the relative abundance regression over just the past 50 years is highly significant (R-squared value of nearly 1; showing a continued steep decline). If we project the 50 year relative abundance regression into the future, it falls below the x-axis in the next 10 years. Notably, this species' declines are likely due – at least in part – to the rapid disappearance of its host, the **western bumble bee (*Bombus occidentalis occidentalis*)**, which has declined by 84% (Hatfield et al., unpublished data). Both the past decline in relative abundance (90.11% over the past 10 years) and predicted future decline in relative abundance (based on 50-year regression) indicate dramatic, rapid declines. Note that the range and persistence of this species have also declined, however, since some historic sites have not been re-sampled and since we only have records of this species in approximately six general localities for the current time period, we were not comfortable using those measures of decline.

Average decline for this species was calculated by averaging the change in abundance, persistence, and EOO. This analysis yielded the following results (see also the graph of relative abundance and map of change in EOO over time below):

- Current range size relative to historic range: 42.61% (57.39% decline)
- Persistence in current range relative to historic occupancy: 15.95% (84.05% decline)
- Current relative abundance relative to historic values: 9.89% (90.11% decline)
- Average decline: 77.18%

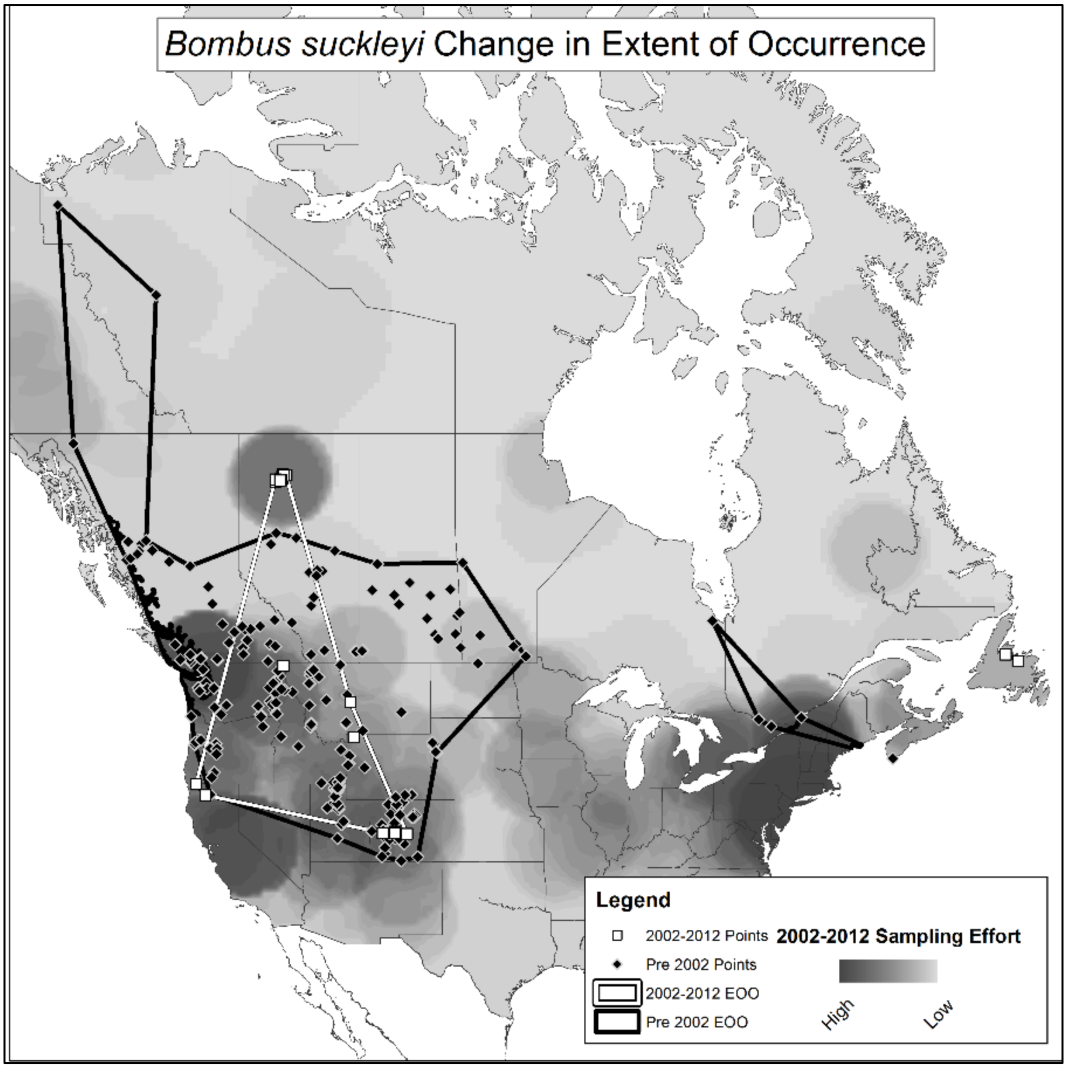

Figure 8: Current and historical range map for the Suckley cuckoo bumble bee (*Bombus suckleyi*).

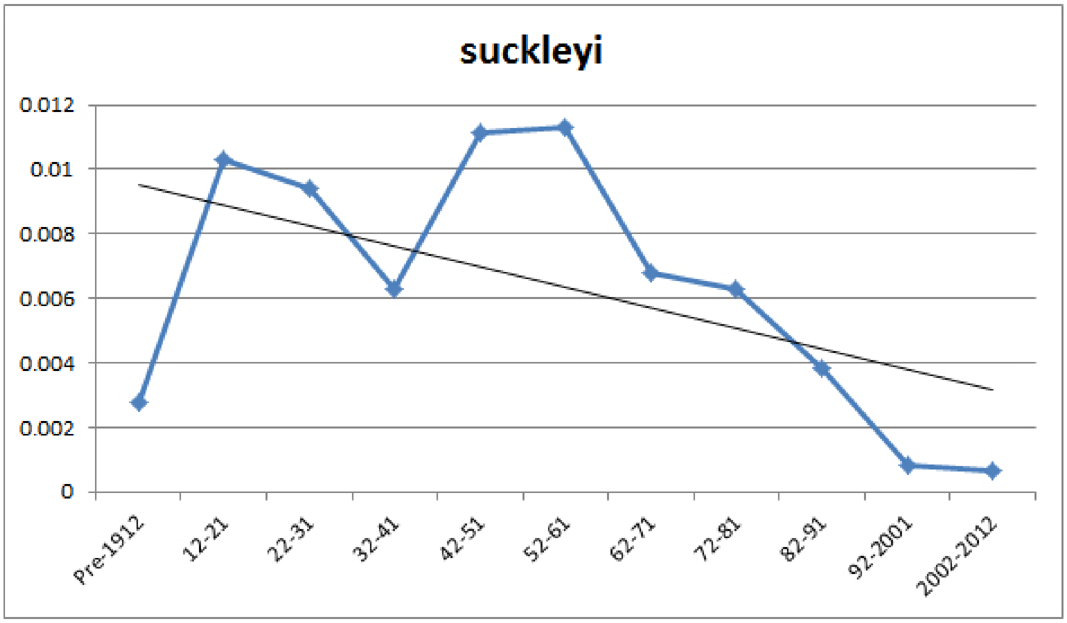

Figure 9: Relative abundance of the Suckley cuckoo bumble bee (*Bombus suckleyi*) by 10-year periods.

METHODS USED

Analyses

Hatfield et al. (2014) evaluated changes between recent and historic time periods in each species': overall Extent of Occurrence (EOO), persistence within 50km grid cells, and relative abundance. For both the EOO and persistence calculations, a database of >200,000 specimen records (Richardson et al. 2014) was divided into historical (1805 – 2001, N=128,572) and current (2002-2012, N=73,626) records (Hatfield et al. 2014, Hatfield et al 2018c).

Extent of Occurrence (EOO)

Since the historical database had significantly more records, and therefore could lead to an over estimate of range loss due to an increased chance of including more records near the edge of each species' range, Hatfield et al. (2014) rarefied the historic data set by randomly selecting 73,626 records from the historical time period to use in the EOO measurement. Using z-tests for differences in proportion, it was ensured that the relative abundance of each species in the subsampled historical data was not significantly different from the relative abundance of that species in the original database. To measure changes in each species' EOO, Hatfield et al. (2014) first used a k-nearest neighbors approach to create local convex hulls for each species in each time period (Getz et al. 2007). Generally, the "minimum spurious hole covering" rule proposed in Getz et al. (2007) was used. However, since the ranges of most North America bumble bees are large, "spurious holes" frequently included large expanses of inhospitable habitat for bumble bees (e.g., The Gulf of Alaska) (Hatfield et al. 2014). After the local convex hull polygons were created, the polygons were clipped to the North American continent to remove large patches of unoccupied habitat (e.g., Great Lakes) (Hatfield et al. 2014). Using the areas calculated from these polygons, Hatfield et al. (2014) compared the current area to the historical area to determine change in home range size (see Figures 1, 4, 6, and 8).

Persistence

To determine species' persistence within their home range, Hatfield et al. (2014) divided the continent into 50 km x 50 km grid cells. Hatfield et al. (2014) used 50 km grid cells to be consistent with previous European and North American *Bombus* spp. analyses (Williams et al. 2007; Colla et al. 2012) and because the data in the historical database were georeferenced from specimen label locality descriptions, which are sometimes inaccurate at smaller spatial scales (Wieczorek et al. 2004). For each time period the number of grid cells occupied by each species was divided by the total number of grid cells occupied by all species (Hatfield et al. 2014). Then, the value from the current time period was divided by the value from the historic time period to detect changes in persistence over time. While the metric that Hatfield et al. (2014) report is not truly a measure of range size, it does provide a measure of each species' persistence within its home range.

Relative Abundance

To evaluate changes in the relative abundance (RA) of each species, Hatfield et al. (2014) divided the full database into historical (1805-2001) and current (2002-2012) time periods and calculated the RA of each species in each time period. Then, to estimate changes in RA, they divided the current RA by the historical RA. In addition to comparing the historical time period to the most recent decade, Hatfield et al. (2014) also broke the database up into ten ten-year periods, plus one time period covering all records prior to 1913 and calculated the RA of each species in each time period (e.g., pre-1913 = period 1, 1913-1922 = period 2). Then, using time as the explanatory variable and RA as the independent variable, a linear regression was conducted to assess longer-term trends in each species' RA (see Figures 2, 5, 7, and 9) (Hatfield et al. 2014). To evaluate extinction risk for several species Hatfield et al. (2014) used a linear trendline to project future declines and used the x-intercept as the theoretical point of extinction.

Sampling Effort

Specimen records were used for the analysis of change in range size, sampling effort likely played a significant role in determining species presence or absence (Hatfield et al. 2014). To account for varying sampling effort and avoid overestimating range loss, Hatfield et al. (2014) created sampling density rasters from the presence points, in both the current time period, and the random sample of the historical time period (using ArcGIS 10.2). For each species Hatfield et al. (2014) calculated the relative difference in sampling density in areas where the historical EOO did not overlap with the current period EOO. Using the area of this non-overlapping polygon, the average sampling density for both time periods was calculated (Hatfield et al. 2014). Species that experienced range loss in the current time period that had a lower sampling density than historically had their range loss estimates adjusted by the relative difference in average sampling density to account for the change in effort. Hatfield et al. (2014) did not adjust the change in range estimates for species that had a higher sampling density in the current time period.

Since most records available for the bumble bee species included in this petition are from incidental observations or museum specimen records rather than from quantitative studies, population estimates at specific sites are unavailable. Furthermore, using field estimates of abundance to understand bumble bee population stability can be problematic because observations of multiple individuals may represent a single reproductive unit (because of the colonial life history of bumble bees).

III. LIFE HISTORY (SPECIES DESCRIPTION, BIOLOGY, AND ECOLOGY)

Bumble Bee Biology

Most bumble bees are primitively eusocial insects that live in colonies composed of a queen, workers, and, near the end of the season, reproductive members of the colony (new queens, or gynes, and males). There is a division of labor among these three types of bees. Queens are responsible for initiating colonies and laying eggs. Workers are responsible for most food collection, colony defense, and feeding of the young. Males' sole function is to mate with queens. Colonies are annual, starting from colony initiation by solitary queens in the spring, to production of workers, and finally to production of queens and males. Queens produced at the end of the colony cycle mate before entering diapause, which is a form of hibernation.

Bumble Bee Pollination Ecology

Bumble bee colonies depend on floral resources for their nutritional needs. Bumble bees collect both nectar and pollen of the plants that they pollinate. Nectar provides them with carbohydrates and pollen provides them with protein. Bumble bees are generalist foragers, meaning that they gather pollen and nectar from a wide variety of flowering plants; although individual species can vary greatly in their plant preferences, largely due to differences in tongue length.

During collection of pollen and nectar from flowers, bumble bees also transport pollen between flowers, facilitating seed and fruit production. Bumble bees have many qualities that contribute to their suitability as agricultural pollinators. They are able to fly in cooler temperatures and lower light levels than many other bees, which extends their work day and improves the pollination of crops during inclement weather (Corbet et al. 1993). Bumble bees are well-known to engage in "buzz pollination," a very effective foraging technique in which they sonicate the flowers to vibrate the pollen loose from the anthers. This activity causes the flower to vibrate, which in turn dislodges pollen that would have otherwise remained trapped in the flower's anthers (Buchmann 1983). Tomatoes (Solanaceae), blueberries (Ericaceae), and many other important food plants are pollinated by bumble bees in this way. In addition to commercially important crops, bumble bees also play a vital role as generalist pollinators of native flowering plants, and their loss may have far ranging ecological impacts. Below we provide life history accounts, species identification, taxonomy, phenology, reproductive biology, habitat relationships, and vulnerability of populations to certain natural or human-caused adverse impacts for each of the petitioned species.

Crotch bumble bee (*Bombus crotchii*) Cresson 1878

Taxonomy

This species was described by Cresson (1878) and upheld as a distinct species in the subgenus *Cullamonobombus* by more recent analyses (Cameron et al. 2007; Williams et al. 2008a).

Identification

Bombus crotchii is most easily distinguished from other *Bombus* species based on hair coloration. Technical descriptions below are adapted from Williams et al. (2014):

> Queens: The queen is 22 to 25 mm in length. Their hair of the face is black with a yellow vertex (top of the head). Their hair is yellow on the front part of the thorax (scutum), usually with black hairs between and below the wings as well as at the back of the thorax (scutellum). On the abdomen, the first tergal (T-dorsal plate) segment is black, at least medially. T2 is yellow, sometimes with black medially and anteriorly. T3 has black anteriorly, sometimes with red posteriorly. T4 and T5 are either entirely red or black.
>
> Workers: The worker is 12 to 20 mm in length. Their color patterns are identical to the queens.
>
> Males: The male is 14 to 19 mm in length. The hair of the head and face are yellow with a yellow scutum and scutellum and a black band between the wings. T1 and T2 are yellow sometimes with yellow laterally and posteriorly on T3. T4-T7 are either entirely black or entirely red. Males of this species are greatly enlarged and bulbous.

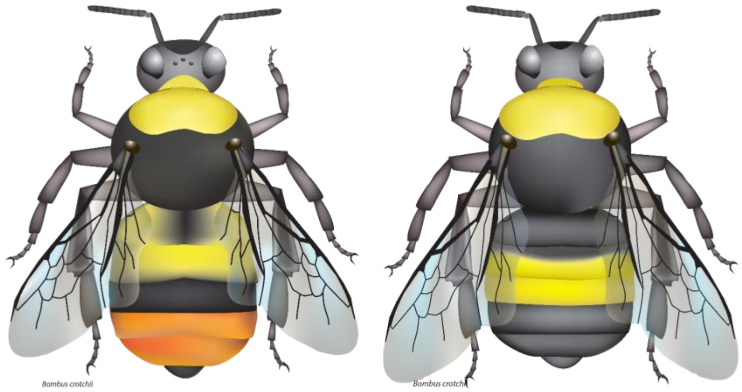

Figure 10: ***Bombus crotchii*** **(female) queen/worker color forms. Although several color forms for females of this species have been described (Williams et al. 2014), the two color forms illustrated above are representative of female** ***B. crotchii*** **that occur in California. Illustrations by Elaine Evans and Rich Hatfield, the Xerces Society.**

Franklin's bumble bee (*Bombus franklini*) (Frison, 1921)

Taxonomy

Bombus franklini is a valid species and its taxonomic status is uncontested. In 1971, Milliron questioned the taxonomic status of *Bombus franklini* as a valid species. Without presenting any evidence for his taxonomic decision, Milliron (1971) placed *B. franklini* in synonymy under *B. occidentalis* (Greene 1858) and then placed *B. occidentalis* in synonymy with *B. terricola*, which occurs in the eastern U.S. (Kirby 1837) on the basis of presumed overlapping color variation. This question has been addressed through studies of morphometrics by Plowright and Stephen (1980), the lack of intergradation (color/morphological) in areas of sympatry with *B. occidentalis* by Thorp et al. (1983), structure of the male genitalia by Williams (1991), and genetics (allozymes) by Scholl et al. (1992) and Cameron et al. (2007). All five studies between 1980 and 2007 concluded that *B. franklini* was indeed a valid species and distinct from *B. occidentalis*. *B. franklini* is currently recognized as a valid species by Williams et al (2014).

The original description by Frison (1921) was based on two queens sent to him by a commercial collector, E. J. Oslar and labeled by Oslar as having been collected at Nogales, Arizona in July 1917. Subsequently, Frison (1923) found additional specimens in the collections of the U.S. National Museum from "Oregon" (without more specific locality data) collected by C. F. Baker which he designated as a worker "Morphotype" and a male "Allotype." In 1926, Frison published additional records of one worker each from Roseburg and Gold Hill, Oregon, collected by H. A. Scullen. The same two records were published by Scullen (1927). Subsequently, evidence was marshaled by Thorp (1970) to dispute the putative Arizona records of *B. franklini* and to propose Gold Hill, Jackson County, Oregon the realistic type locality. Evidence included finding specimens of many other west coast bumble bee species labeled by Oslar as having been collected in southern Arizona about the same time, but representing a great disjunction for each of the species. Field studies by R. W. Thorp also failed to turn up *B. franklini* or any of the other dozen species of bumble bees also labeled by Oslar as having been collected in southern Arizona. This is supported by evidence presented on species of *Andrena* by LaBerge (1980; 1986) and the lack of specimens from the area in major bee collections (in Thorp et al. 2010).

Identification

Bombus franklini is readily distinguished from other bumble bees in its range by the extended yellow on the anterior thorax which extends well beyond the wing bases and forms an inverted U-shape around the central patch of black, lack of yellow on the abdomen, predominantly black face with yellow on top of the head, and white at the tip of the abdomen. Other bumble bees with similar color patterns in the range of *B. franklini* have the yellow extending back to the wing bases or only slightly beyond and usually have one or more bands of yellow on the middle or slightly behind the middle of the abdomen (most on T-4). Females of most species have yellow hair on the face, in contrast to black on *B. franklini*. Females of *B. occidentalis* and *B. fervidus* that have black hair on the face also have black hair on the vertex in contrast to the yellow hair on the vertex in *B. franklini*. Females of *B. fervidus* have a long face in contrast to the round face of *B. franklini* and *B. occidentalis*.

Queens & Workers

Face round with area between bottom of compound eye and base of mandible (= malar space) shorter than wide; hair predominantly black with some shorter light hairs intermixed above and below antennal bases. Hair on top of head (= vertex) yellow. Hair of thorax (= mesosoma) on anterior two-thirds above (= scutum) yellow extending rearward laterally inside and beyond the wing bases (= tegulae) to rear third (= scutellum), but interrupted medioposteriorly by inverted U-shaped patch of black; hair on posterior third above (= scutellum) black; hair of thorax laterally (= mesopleura) black, except for small patch of yellow in upper anterior corner in area of pronotal lobes. Hair of abdomen (= metasoma) black except for whitish or silvery hair at sides and apex of 5^{th} plate above (= tergum 5, = T-5).

Males

As for female, except malar space as long as wide, face below antennae with predominantly yellow hair, and T-6 with some pale hair laterally.

Figure 11: Female *Bombus franklini*. Illustration by Elaine Evans, The Xerces Society.

Western bumble bee (*Bombus occidentalis occidentalis*) Greene, 1858

Taxonomy
Bombus occidentalis is considered a valid species (Franklin 1913; Thorp 2005c; Cameron et al. 2007; Bertsch et al. 2010; Williams et al. 2012). *Bombus occidentalis* consists of two valid subspecies: *Bombus occidentalis occidentalis* and *Bombus occidentalis mckayi* (Williams et al. 2012; Sheffield et al. 2016).

Identification
B. occidentalis occidentalis is most easily distinguished from other *Bombus* species based on hair coloration. Note, however, that coloration in this species can be highly variable, and eight female and seven male color forms have been described (Sheffield et al. 2016). There are two prominent color forms of *B. o. occidentalis* most likely to be encountered in California. Those found in the mountains ("*occidentalis*" form) are likely to have bright white coloration on the posterior end of the abdomen (Thorp 2013, pers. comm.); this character is unusual and obvious. The "*occidentalis*" form (without any yellow on T1-4) is found throughout in the eastern part of the state in the Sierra-Cascade Range from near Yosemite to Oregon and west along the northern tier of counties into Humboldt County (Thorp 2017, pers. comm.). Specimens found closer to the coast (*"nigroscutatus"* form) replace the bright white hairs with yellowish orange hairs (Williams et al. 2014). The "*nigroscutatus"* form includes all populations on the coast and Coast Ranges from Monterey County north into Humboldt County where the yellow banding becomes narrower (Thorp 2017, pers. comm.). However, some of these yellow-banded individuals have recently been located on the Eagle Lake Ranger District of the Lassen National Forest (Rickman 2017, pers. comm.). Technical descriptions below are adapted from Williams et al. (2014):

> <u>Queens</u>: The queen is 20 to 21 mm in length. Their hair is entirely black on the head sometimes with a minority of yellow or gray hairs mixed in above the antennae. Their hair is yellow on the front part of the thorax (scutum), usually with black, or a minority of yellow hairs at the back of the thorax (scutellum). The majority of the hairs between and

below the wings are black. On the abdomen, the first two tergal (dorsal plate) segments (T1-T2) are black. If T3 is entirely yellow, then T4 is black, T5 white. If T3 is black, or with a minority of yellow, T4 and T5 are white.

<u>Workers:</u> The worker is 9 to 15 mm in length. Their hair is entirely black on the head sometimes with a minority of yellow or grayish hairs mixed in above the antennae. Their hair is yellow on the front part of the thorax (scutum), usually with black, or a minority of yellow hairs at the back of the thorax (scutellum). The majority of the hairs between and below the wings are black. On the abdomen, the first tergal (T1-dorsal plate) segment is black. T2 has at least some black on it centrally and anteriorly. If T3 is entirely yellow, the white hairs on T4 (if applicable) and T5 seen in queens will be replaced with yellowish orange hairs. If T3 with at most a minority of yellow hairs, T4 and T5 are white.

<u>Males</u>: The male is 13 to 17 mm in length. The hair on the head is pale yellowish on the front of the face. The top of the head has pale yellowish hairs medially, with some black hairs, especially laterally. The hair on the front of the thorax is pale yellowish. The hair on T1 is black with at least some black centrally and anteriorly on T2. If T3 is black the basal part of the fourth abdominal segment is black, with the remainder, as well as segments five to seven, whitish – although sometimes a yellowish orange. If T3 is entirely yellow, T5 is black basally, and the remainder, as well as T6-T7 are yellowish orange.

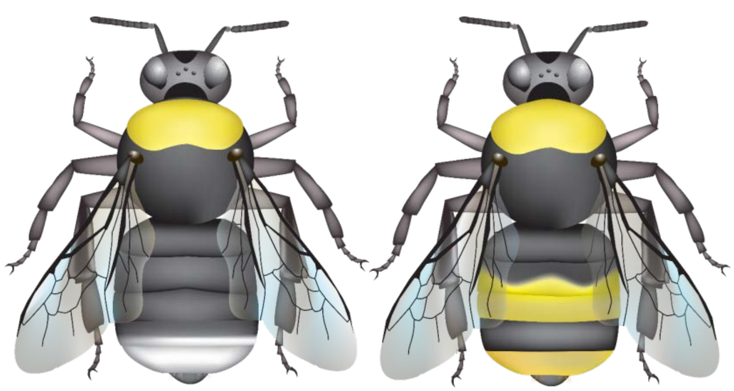

Figure 12: *Bombus. o. occidentalis* (female) worker, nominate color form ("*occidentalis*" - left), coastal color form ("*nigroscutatus*" - right). Although eight color forms for females of this species have been described (Sheffield et al. 2016), the two color forms illustrated above are representative of the two color forms of female *B. o. occidentalis* that occur in California. Illustrations by Elaine Evans and Rich Hatfield, the Xerces Society.

Suckley Cuckoo Bumble Bee (*Bombus suckleyi*) Greene, 1860

Taxonomy

This species was described by Greene (1860) and recent analyses have confirmed that it is a valid species in the subgenus *Psithyrus* (Cameron et al. 2007; Williams et al. 2008a).

Identification

As a social parasite of other *Bombus* species, the females of this species do not collect pollen and do not have a corbicula (pollen carrying basket) on their hind leg tibia. There is also no worker caste in this species; all individuals are either male or reproductive females. *Bombus suckleyi* is most easily distinguished in the field from other *Bombus* species based on hair coloration and physical characteristics. The species that look similar to *B. suckleyi* with overlapping ranges in California are *B. insularis* and *B. flavidus*. The differences between these species and *B. suckleyi* are noted in the detailed description below (descriptions compiled in part from Williams *et al.* 2014).

> Females: *Bombus suckleyi* females are 18 to 23 mm in length. Cuckoo bumble bees, members of the subgenus *Psithyrus* (including *B. suckleyi*), do not have a corbicula (pollen carrying basket on their hind leg), unlike the true bumble bees (pollen collecting, social species). Instead, their hind leg tibia is convex and densely covered in hairs. *B. suckleyi*'s hair is short and even. The hair of the head (including the vertex – top of the head) is black (contrast *B. insularis* – yellow face and vertex, and *B. flavidus* – yellow vertex). The hair of the thorax (including below the wings) is mostly yellow, with a black spot or band between the wings, sometimes with a black triangular notch behind, and between the wings. The first two tergal (T-dorsal plate) segments on the abdomen are black (contrast most *B. flavidus*), usually with at least some yellow (laterally and posteriorly) on T3 – no yellow centrally. T4 has predominantly yellow hairs, with a patch of black centrally and anteriorly (contrast *B. flavidus*). T5 is usually black, but can have yellow laterally; T6 is black.
>
> Males: The male is 13 to 16 mm in length. The color patterns for males of this species are extremely variable. The only consistent features are yellow on all of T1 and T4 (contrast *B. insularis*), with some (or all) yellow on T2, T3, T5 and T6. T7 is black (contrast *B. flavidus*).
>
> The illustration below represents the color patterns exhibited by females. Males tend to have more yellow on the abdomen, especially on the first (anterioral) abdominal segment. The hair of the face on both males and females of this species is black (contrasted with *B. insularis* – a sympatric and common member of the *Psithyrus* subgenus and look-alike species).

Figure 13: Female *Bombus suckleyi*. Illustration © Paul Williams (identification and color patterns), Elaine Evans (bee body design), and Rich Hatfield.

IV. KIND OF HABITAT NECESSARY FOR SURVIVAL

Habitat Requirements

All bumble bees have three basic habitat requirements: suitable nesting sites for the colonies, availability of nectar and pollen from floral resources throughout the duration of the colony period (spring, summer, and fall), and suitable overwintering sites for the queens. In addition, their populations can be negatively affected by both pathogens and pesticides; thus, they may require habitat that is free from exposure to high levels of both native and exotic pathogens, and pesticides that cause harm to colonies. Bumble bees are found in a wide variety of natural, agricultural, urban, and rural habitats, although species richness tends to peak in flower-rich meadows of forests and subalpine zones (Goulson 2010).

Nest and Overwintering Sites

Bumble bee colony success is often limited by the availability of suitable nesting and overwintering sites. Diverse habitat features will increase the likelihood of nesting and overwintering success. Bumble bee queens emerge from hibernation in the early spring and immediately start foraging for pollen and nectar and begin to search for a nest site. Nesting preferences vary by species and local habitat conditions. Nests are often located underground in abandoned holes made by ground squirrels, mice, and rats, or occasionally abandoned bird nests (Osborne et al. 2008). Some species nest on the surface of the ground (in tufts of grass) or in empty cavities. Bumble bees that nest aboveground may require undisturbed areas with nesting resources such as grass and hay to protect nests (Williams et al. 2014). Furthermore, areas with woody cover, or other sheltered areas provide bumble bees sites to build their nest (e.g., downed wood, rock walls, brush piles, etc.).

Although little is known about the overwintering habits of most bumble bee species, some species are known to dig a few centimeters into soft, disturbed soil and form an oval shaped chamber in which the queen will spend the duration of the winter. Other species may overwinter in small cavities just below or on the ground surface. Compost in gardens, leaf litter, or mole hills may provide suitable protection for queens to overwinter (Goulson 2010) before they emerge to begin a new colony (Williams et al. 2014). While there is still much to be learned about the nesting and overwintering biology of bumble bees, any near-surface or subsurface disturbance of the ground can be disastrous for bumble bee colonies or overwintering queens. This includes mowing, fire, tilling, grazing, and planting. Having large areas of land free from such practices is essential for sustaining bumble bee populations. Since bumble bees usually nest in abandoned rodent nests, nesting sites may be limited by the abundance of rodents; thus it is also important to retain landscape features that will support rodent populations. Furthermore, reducing ground disturbance can promote overwintering habitat for bumble bees (McFrederick and LeBuhn 2006).

Floral Resources

Bumble bees depend on the availability of habitats with a rich supply of floral resources that bloom continuously during the entirety of the colony's life. The queen collects nectar and pollen from flowers to support the production of her eggs, which are fertilized by sperm she has stored since mating the previous fall. In the early stages of colony development, the queen is responsible for all food collection and care of the young. As the colony grows, workers take over the duties of food collection, colony defense, and care of the young. The queen then remains within the nest and spends most of her time laying eggs. Colonies typically consist of between 50 and 500 workers at their peak (Plath 1927; Thorp et al. 1983; Macfarlane et al. 1994) along with the queen. Queen production is dependent on access to sufficient quantities of pollen. Thus, the amount of pollen available to bumble bee colonies directly affects the number of queens that can be produced (Burns 2004). Furthermore, since queens are the only bumble bees capable of forming new colonies, pollen availability directly impacts future bumble bee population levels. In fact, landscape level habitat quality has been shown to influence bumble bee species richness and abundance, indicating that isolated patches of habitat are not sufficient to fully support bumble bee populations (Hatfield and LeBuhn 2007; Öckinger and Smith 2007).

Bumble bees play the vital role of pollinators as they transfer pollen between native flowering plants when they are foraging. As generalist foragers, bumble bees do not depend on any one flower type. However, some plants do rely on bumble bees to achieve pollination. The loss of bumble bees can have far ranging ecological impacts due to their role as pollinators. An examination of the theoretical effect of removal of specialist and generalist pollinators on the extinction of plant species concluded that the loss of generalist pollinators poses the greatest threat to pollinator networks (Memmott et al. 2004). In Britain and the Netherlands, where multiple bumble bee species, as well as other bees, have gone extinct, there is evidence of decline in the abundance of insect pollinated plants (Biesmeijer et al. 2006).

Since bumble bee colonies obtain all of their nutrition from pollen and nectar, they need a constant supply of flowers in bloom. Not all flowers are of equal value to bumble bees. Many varietal hybrids do not produce as much pollen and/or nectar as their wild counterparts (Frankie et al. 2005). Bumble bees do have preferences for certain species of plants. Generally, they prefer flowers that are purple, blue, or yellow; they are essentially blind to the color red and will not forage on red flowers (unless there are UV cues on the petals). Having plants with a diversity of corolla tube lengths will support bumble bees with varying tongue lengths. Bumble bees also show a strong preference to perennial plants as opposed to annuals; perennials tend to have higher quantities of nectar (Fussel and Corbet 1992). In addition to flowers, many bumble bee species may benefit from the presence of native bunch grasses. Bunch grasses will add multiple textures and heights to a garden or landscape and provide places for bumble bees to nest and overwinter.

Crotch Bumble Bee (*Bombus crotchii*) Habitat Requirements

In California, *B. crotchii* inhabits open grassland and scrub habitats. This species occurs primarily in California, including the Mediterranean region, Pacific Coast, Western Desert, Great Valley, and adjacent foothills through most of southwestern California (Williams et al. 2014). This species was historically common in the Central Valley of California, but now appears to be absent from most of it, especially in the center of its historic range (Hatfield et al. 2014; Richardson et al. 2014).

Nest Sites

The size of *Bombus crotchii* colonies has not been well documented. *B. crotchii*, like most other species of bumble bees, primarily nests underground (Williams et al. 2014).

Floral Resources

Bumble bees, including *Bombus crotchii*, are generalist foragers and have been reported visiting a wide variety of flowering plants. *B. crotchii* has a very short tongue, and thus is best suited to forage at open flowers with short corollas. The plant families most commonly associated with *B. crotchii* observations or collections from California include Fabaceae (66 observations), Apocynaceae (47), Asteraceae (28), Lamiaceae (27), Boraginaceae (12) (Richardson 2017). Similarly, in an analysis largely based on records from California, Thorp et al. (1983) reports that *B. crotchii* records are primarily associated with plants in the Leguminosae (=Fabaceae), Labiatae (=Lamiaceae), Hydrophyllaceae (=Hydrophylloideae), Asclepiadaceae (=Asclepiadoideae), and Compositae (=Asteraceae). Williams et al. (2014) report plants in the genera *Asclepias, Chaenactis, Lupinus, Medicago, Phacelia,* and *Salvia* as example food plants. Note that these floral associations do not necessarily represent *B. crotchii's* preference for these plants over other flowering plants, but rather may represent the prevalence of these flowers in the landscape where this species occurs.

Overwintering Sites
Very little is known about the hibernacula, or overwintering sites utilized by *Bombus crotchii*. Generally, bumble bees overwinter in soft, disturbed soil (Goulson 2010), or under leaf litter or other debris (Williams et al. 2014).

Phenology
According to Thorp et al. (1983), the flight period for *Bombus crotchii* queens in California is from late February to late October, peaking in early April, with a second pulse in July. The flight period for workers and males in California is from late March through September; worker and male abundance peak in early July (Thorp et al. 1983).

Franklin's Bumble Bee (*Bombus franklini*) Habitat Requirements
Bombus franklini has the most limited geographic distribution of any bumble bee in North America and possibly the world (Williams 1998). It is known from Siskiyou and Trinity counties in California. *Bombus franklini* inhabits open grassy coastal prairies and Coast Range meadows from southern Oregon to northern California. Elevations of localities where it has been found range from 540 feet (162 m) in the north to above 7800 feet (2340 m) in the south of its historic range.

Nest Sites
The nesting biology of *B. franklini* is unknown, but it probably nests in abandoned rodent burrows as is typical for other members of the subgenus *Bombus sensu stricto* (Hobbs 1968).

Floral Resources
Like other bumble bees, *Bombus franklini* is a generalist forager and has been reported visiting a wide variety of flowering plants. *B. franklini* has been observed collecting pollen from lupine (*Lupinus* spp.) and California poppy (*Eschscholzia californica*), and collecting nectar from horsemint or nettle-leaf giant hyssop (*Agastache urticifolia*) and mountain monardella (*Monardella odoratissima*) (Thorp et al. 2010). This species may collect both pollen and nectar from vetch (*Vicia* spp.) as well as rob nectar from it (Thorp et al. 2010).

Overwintering Sites
Very little is known about the hibernacula, or overwintering sites, utilized by *B. franklini*, although generally bumble bee females are known to overwinter in soft, disturbed soil (Goulson 2010), or under leaf litter or other debris (Williams et al. 2014).

Phenology
The flight season of *B. franklini* is from mid-May to the end of September (Thorp et al. 1983).

Western Bumble Bee (*Bombus occidentalis occidentalis*) Habitat Requirements
Meadows and grasslands with abundant floral resources are the appropriate habitat for this

subspecies. While *Bombus occidentalis occidentalis* was historically known throughout the mountains and northern coast of California, it is now largely confined to high elevation sites and a small handful of records on the northern California coast (Cameron et al. 2011a; Xerces Society 2012; Williams et al. 2014; Xerces Society et al. 2017).

Nest Sites

Reports of *Bombus occidentalis occidentalis* nests are primarily in underground cavities such as old squirrel or other animal nests and in open west-southwest slopes bordered by trees, although a few nests have been reported from above-ground locations such as in logs among railroad ties (Plath 1922; Hobbs 1968; Thorp et al. 1983; Macfarlane et al. 1994). Thus, *B. o. occidentalis* nesting sites may be limited by rodent abundance (Evans et al. 2008). Nest tunnels have been reported to be up to 2.1 m long for this species and the nests may be lined with grass or bird feathers (MacFarlane et al. 1994). *Bombus o. occidentalis* colonies can contain as many as 1,685 workers and produce up to 360 new queens; this colony size is considered large relative to many other species of bumble bees (MacFarlane et al. 1994).

Floral Resources

Bumble bees, including *Bombus occidentalis occidentalis*, are generalist foragers and have been reported visiting a wide variety of flowering plants. *B. o. occidentalis* has a very short tongue, and thus is best suited to forage at open flowers with short corollas and has also been documented 'nectar robbing' – biting through the corolla tube and drinking nectar through the hole without contacting the anthers, or stigma of the plant – several species of flowers with longer corolla tubes. Bumble bees require plants that bloom and provide adequate nectar and pollen throughout the colony's life cycle, which is from early February to late November for *B. o. occidentalis* (although the actual dates likely vary by elevation and local climatic conditions, including interannual variation). The plant genera most commonly associated with *B. o. occidentalis* observations or collections from California include *Cirsium* (36 observations), *Erigonum* (18), *Solidago* (16), "Aster" (14), *Ceanothus* (13), *Centaurea* (13), and *Penstemon* (13) (Richardson 2017). Similarly, in an analysis largely based on records from California, Thorp et al. (1983) reports that *B. o. occidentalis* records are primarily associated with plants in the Leguminosae (=Fabaceae), Compositae (=Asteraceae), Rhamnaceae, and Rosaceae families. Note that these floral associations do not necessarily represent *B. o. occidentalis*' preference for these plants over other flowering plants, but rather may represent the abundance of these flowers in the landscape.

Overwintering Sites

Very little is known about the hibernacula, or overwintering sites utilized by most bumble bees, although Hobbs (1968) reported *B. occidentalis* hibernacula that were two inches deep in a "steep west slope of the mound of earth." The closely related *B. terrestris* reportedly hibernates beneath trees (Sladen 1912; *In* Hobbs 1968).

Phenology
According to Thorp et al. (1983), the flight period for *Bombus occidentalis occidentalis* queens in California is from early February to late November, peaking in late June and late September. The flight period for workers and males in California is from early April to early November; worker abundance peaks in early August, and male abundance peaks in early September (Thorp et al. 1983). Rangewide, including the entire species complex (including *B. o. mckayi*), queens peak in late June, workers peak in early August, and males peak in late August (Williams et al. 2014).

Suckley Cuckoo Bumble Bee (*Bombus suckleyi*) Habitat Requirements
Bombus suckleyi habitat includes western meadows largely confined to mountainous regions. *B. suckleyi*, and other species of bumble bee in the subgenus *Psithyrus,* are unique in that they have an obligate dependency on social bumble bees (Goulson 2010) to collect pollen on which to rear their young. As such, *B. suckleyi* are a cuckoo species that are nest parasites of other species of bumble bees and are not primitively eusocial themselves – there is no division of labor within the species; all members of the species have equal status, and are reproductive. Cuckoo bumble bees typically emerge from their hibernacula later in the spring than other bumble bee species. Once the female cuckoo bumble bee does emerge, she forages for herself and begins searching for occupied nests. When she finds a suitable host (*B. suckleyi* utilizes *B. occidentalis* hosts [Thorp et al. 1983]) she enters the nest, kills or subdues the queen of that colony, and forcibly (using pheromones and/or physical attacks) "enslaves" the workers of that colony. Then she lays her own eggs and forces the workers of the native colony to feed her and her developing young. Since all of the resulting cuckoo bee offspring are reproductive (not workers), they leave the colony to mate, and the mated females seek out a place to overwinter, then repeat the cycle the following spring/early summer (Goulson 2010).

Cuckoo bumble bees often attack a broad range of host species, but some species specialize in attacking the members of just one species or subgenus. *B. suckleyi* has been recorded in nests of bumble bees in six different subgenera, but the most common association is with the subgenera *Pyrobombus* and *Bombus,* and the only nests in which *B. suckleyi* adults have been produced are those of *B. occidentalis* (reviewed in Thorp et al. 1983). As such, *B. suckleyi* has been documented breeding as a parasite of colonies of *Bombus occidentalis,* and has been recorded as present in the colonies of *B. terricola, B. rufocinctus, B. fervidus, B. nevadensis,* and *B. appositus* (Williams et al. 2014). Males of this species patrol circuits in search of mates (Thorp et al. 1983).

Nest Sites
Bombus suckleyi has been detected in the nests of several species of bumble bees, but it has only ever been observed reproducing in nests of *B. occidentalis* (Thorp et al. 1983). *B. occidentalis* nests are primarily in underground cavities such as old squirrel or other animal nests and in open

west-southwest slopes bordered by trees, although a few nests have been reported from above-ground locations such as in logs among railroad ties (Plath 1922; Hobbs 1968; Macfarlane et al. 1994; Thorp et al. 1983). Availability of nest sites for *B. occidentalis* may depend on rodent abundance (Evans et al. 2008). *B. occidentalis* nest tunnels have been reported to be up to 2.1 m long and the nests may be lined with grass or bird feathers (Macfarlane et al. 1994). *Bombus suckleyi* depends upon not only the presence of suitable nesting sites for *B. occidentalis*, but also upon extant populations of that species.

Floral Resources

Bumble bees require plants that bloom and provide adequate nectar and pollen throughout the colony's life cycle. In order for *B. suckleyi* to survive, there must also be early season resources for its host, *B. occidentalis*. There are records of *B. occidentalis* from early February to late November. The amount of pollen available in the landscape directly affects the number of new queens that a bumble bee colony can produce, and since queens are the reproductive members of the colony, pollen availability is directly related to future bumble bee population size (Burns 2004). Early spring and late fall are often periods with lower floral resources; the presence of flowering plants at these critical times is essential.

Bombus suckleyi is a generalist forager and has been reported to visit a wide variety of flowering plants. The known plant associations for this species in California are scarce, but generally this species is associated with plants in the following genera: "Aster", *Chrysothamnus*, *Cirsium*, *Solidago,* and *Centaurea* (Williams et al. 2014; Richardson 2017). Plant genera that are associated with *B. occidentalis occidentalis* – its known host, and a prerequisite for the survival of *B. suckleyi* include: *Cirsium* (36 observations), *Erigonum* (18), *Solidago* (16), "Aster" (14), *Ceanothus* (13), *Centaurea* (13), and *Penstemon* (13) (Richardson 2017). Note that these floral associations do not necessarily represent *B. occidentalis'* or *B. suckleyi*'s preference for these plants over other flowering plants, but rather may represent the abundance of these flowers in the landscape.

Overwintering Sites

Very little is known about the hibernacula, or overwintering sites, utilized by *Bombus suckleyi*, although generally bumble bee females are known to overwinter in soft, disturbed soil (Goulson 2010), or under leaf litter or other debris (Williams et al. 2014).

Phenology

According to Thorp et al. (1983), the flight period for *B. suckleyi* females in California is from late May to late October, peaking in June. The flight period for males in California is from early July to late September; peaking late July, with a second pulse late August and early September (Thorp et al. 1983).

V. FACTORS AFFECTING ABILITY TO SURVIVE AND REPRODUCE

Each of the following factors pose a substantial threat to the survival of the four species of bumble bees included in this petition: present or threatened modification or destruction of its habitat; overexploitation; competition; disease; and other natural events and human-related activities, including pesticide use, genetic factors, and climate change (reviewed *in* Williams and Osborne 2009; Williams et al. 2009; Goulson 2010; Cameron et al. 2011b; Hatfield et al. 2012; Fürst et al. 2014). In addition, the cuckoo bumble bee species (*Bombus suckleyi*) is threatened by loss of its primary host species, *B. occidentalis occidentalis*. Below we summarize the rationale and available evidence that each factor poses a threat to these four bumble bee species.

A. Present or Threatened Modification or Destruction of Habitat

1. The Loss of Habitat Due to Human Induced Landscape Scale Modifications

Many North American bumble bees face threats from habitat alterations that can interfere with primary habitat requirements, including access to: sufficient food (nectar and pollen from flowers), nesting sites (such as underground abandoned rodent cavities or above ground in clumps of grasses), and overwintering sites for hibernating queens (undisturbed soil and leaf litter).

Many bumble bees historically occupied the grasslands and prairies of the continent, including California, which have largely been lost or fragmented by agricultural conversion and urban development or transformed by fire suppression, invasive species, and livestock grazing. Noss et al. (1995) considers all native grasslands in California to be a critically endangered ecosystem, having declined by more than 98%. *Bombus crotchii* was historically known from throughout California's Central Valley, which once contained vast prairies rich with wildflowers. Indeed, historic accounts of the San Joaquin Valley describe abundant and widespread wildflowers; in 1868 John Muir wrote: "the valley of the San Joaquin is the floweriest piece of world I ever walked, one vast level, even flower-bed, a sheet of flowers…". The U.S. Geological Survey reports that more than 260,000 acres of grassland and shrubland habitat within California's Central Valley ecoregion were either developed for housing or converted to agriculture between 1980 and 2000 (Sleeter 2016) – accounting for nearly 4% of the 7 million acres that make up the Central Valley. A more recent study (Lark et al. 2015) highlights the rate of grassland conversion to agriculture across the U.S. from 2008-2012, and the rate of loss is more severe in California's Central Valley than any other ecoregion in the western US.

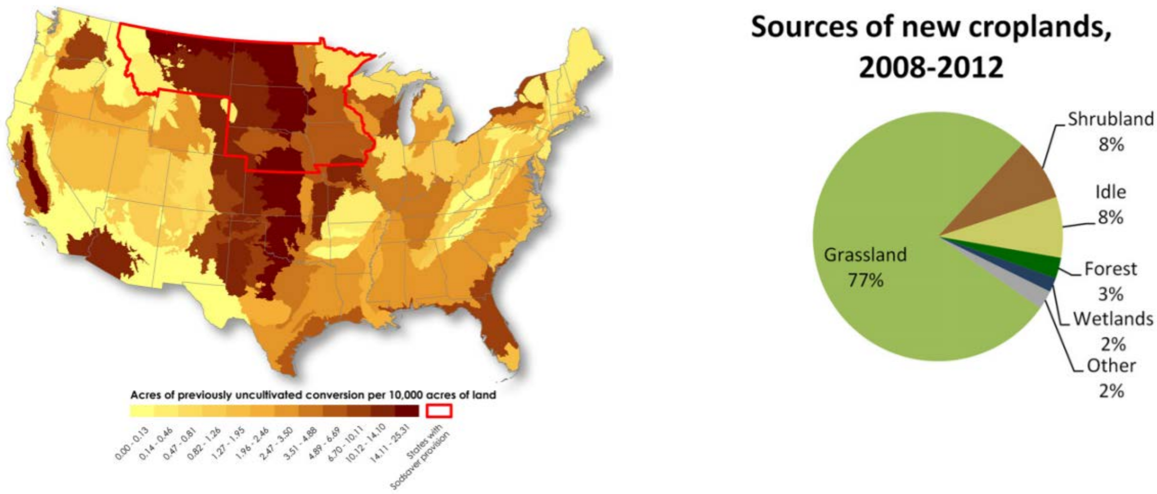

Figure 14: Left: 2008–2012 conversion of previously uncultivated land. The map identifies the amount of conversion to cropland from land that had not previously been used for agriculture (cropland or pasture), confirmed back to the early 1970s. Display units represent average number of previously uncultivated acres converted per 10 000 acres of total land within each EPA Level III Ecoregion. Red outline is of the six states covered under the 2014 US Farm Bill 'Sodsaver' provision, which aims to reduce conversion of previously uncultivated land. The observed patterns of elevated nationwide conversion suggest that the new policy's limited geographic coverage will likely be insufficient to prevent the majority of new breakings. Right: Types of land converted to crop production. Grasslands were the most common land cover to be converted to cropland, followed by shrubland and long term (10+ year) idle land. Figures from Lark et al. (2015).

In addition to the endangerment of critical prairie ecosystems, mountain meadows throughout the western United States are also a highly imperiled ecosystem, and are experiencing continued threats from climate change (Field et al. 2007; Parry et al. 2007; Saunders et al. 2008), livestock grazing (Belsky et al. 1999; Hayes & Holl 2003; Stoner & Joern 2004; Hatfield & LeBuhn 2007), and forest encroachment (Skinner 1995; Coop & Givnish 2007; Zald et al. 2012; Highland & Jones 2014). Recent analyses of western meadows in Oregon and Washington, which provide important habitat for bumble bees (Goulson 2010; Williams et al. 2014), indicate that they have lost between 18% and 40% of their area due to encroaching conifers (Skinner 1995; Coop & Givnish 2007). Several of the bees in this petition are known from montane meadows (including: *Bombus occidentalis occidentalis*, *B. franklini*, and *B. suckleyi*). Montane meadows may become particularly important habitats for declining bumble bee species as the climate warms and habitat loss in valleys and low elevation prairies increases.

Bumble bee species richness, abundance, and genetic diversity are influenced by the quality of habitat on a landscape level. While bumble bees can forage and disperse over relatively long distances, isolated patches of habitat may not be sufficient to support bumble bee populations (Hatfield & LeBuhn 2007; Öckinger & Smith 2007). Because of their unique method of sex determination and their colonial life cycle, bumble bees are particularly sensitive to habitat fragmentation and populations of bumble bees existing in fragmented habitats can also face problems with inbreeding depression (Darvill et al. 2006; 2012; Ellis et al. 2006). Specifically, Darvill et al. (2012) found that bumble bee populations limited to less than 15 km^2 of habitat were more likely to show signs of inbreeding. Goulson (2010) suggests that a viable population of bumble bees probably requires approximately 3.3-10 km^2 of suitable habitat. Habitat fragmentation has been shown to reduce bumble bee foraging rates and alter their foraging patterns (Rusterholz and Baur 2010). Fragmented habitats may not support healthy metapopulation structures and may eliminate or decrease source populations of bumble bees for recolonization (National Research Council 2007). A study in California found that inbreeding in one common species of bumble bee (*B. vosnesenskii*) was lower in landscapes with increasing natural woodland cover relative to other landscape types (Jha 2015). Thus, agricultural intensification, livestock grazing, urban development, as well as other habitat modifications, can jeopardize the habitat needs of bumble bees and lead to the fragmentation of habitat into pieces that are too small or too distant to support diverse bumble bee communities (Goulson et al. 2008). The major landscape-scale modifications and their threats to bumble bees are outlined below.

i. Agricultural Intensification

The biggest changes within the range of the species in this petition have come from modern farming techniques that have enabled more intensive use of agricultural lands, widespread grazing of grasslands and meadows, and increased use of insecticides (reviewed in Hatfield et al. 2012). Agricultural intensification has been shown to have a negative impact on species richness, abundance and diversity of wild bees (Le Féon et al. 2010). Agricultural intensification is primarily blamed for the decline of bumble bees in Europe (Williams 1986; Carvell et al. 2006; Diekötter et al. 2006; Fitzpatrick et al. 2007; Kosior et al. 2007; Goulson et al. 2008), and may also pose a significant threat to bumble bees in the US (Hines & Hendrix 2005; Grixti et al. 2009). In fact, agricultural intensification and rapid urbanization in California's Central Valley may have reduced populations of *B. crotchii*, since this species was historically common in the Central Valley but now appears to be absent from much of its historic range, especially in the central part (Thorp 2014, pers. comm.; Hatfield et al. 2015a). Furthermore, increases in farm size and changes in technology and operating efficiency have led to many practices that can be detrimental to bumble bees. This has led to the loss of pollinator friendly hedgerows, weed cover, and legume pastures through more modern practices including more effective land leveling, irrigation, tilling, and pesticide and fertilizer usage. Tilling may directly destroy bumble bee overwintering sites and bumble bee nests may be at risk of being destroyed by farm machinery (Goulson 2003). One site within *Bombus franklini*'s historic range near Gold Hill in Jackson County, OR had significant excavation and deposited soil that altered approximately 50% of the bumble bee foraging habitat. The widespread application of the herbicide glyphosate in conjunction with increased planting of genetically modified crops that are tolerant to glyphosate has reduced the availability of milkweeds in agricultural field margins (Pleasants & Oberhauser 2013), and has probably had a similar effect on other wildflower species, which would have also provided important nectar resources for bumble bees. In northern Alberta, one study found that genetically modified herbicide tolerant canola fields had a lower abundance of wild bees than conventional or organic canola fields (Morandin and Winston 2005). The broad scale use of pesticides, including a novel class of systemic insecticides (neonicotinoids), poses a unique threat to bumble bees; this topic is discussed in detail below under Factor E *Other Natural Events or Human-related Activities*.

Both floral abundance and grasslands are frequently reduced in agriculturally intensive landscapes. Hines and Hendrix (2005) found that bumble bee diversity in Iowa prairies was linked to floral abundance and the presence of grasslands in the surrounding landscape, both of which have been reduced in modern agricultural landscapes. Although some flowering crops provide nectar and pollen resources for bumble bees, which can lead to increased densities of bumble bees and colony growth (Westphal et al. 2003; 2009), large monocultures do not necessarily improve the reproductive success of bumble bees (Westphal et al. 2009); likely because the resources they provide are typically only available for a short period of time. Monocultures may in fact serve as population sinks since bumble bee colonies need floral resources throughout their colony cycle from early spring to fall (Goulson et al. 2008).

ii. Livestock Grazing

Ungulate grazing can significantly alter the landscape. Studies have shown that grazing can have both indirect and direct effects on bumble bee populations. Indirect effects include removing floral resources (Morris 1967; Sugden 1985; Kruess and Tscharntke 2002a; 2002b; Vazquez and Simberloff 2003; Hatfield and LeBuhn 2007; Xie et al. 2008; Kimoto 2010; Scohier et al. 2012) and potentially reducing populations of nesting rodents (e.g., Bueno et al. 2011), which in turn may reduce the number of nest sites available to bumble bees (Johnson & Horn 2008; Schmidt et al. 2009). Ungulates can directly affect above ground bumble bee nests by trampling (Sugden 1985). The habitat, type of grazer, as well as the timing, intensity, and length of livestock grazing are all factors that can influence how the practice affects flora and fauna (Gibson et al. 1992; Carvell 2002; Sjodin 2007). Numerous studies have found intensive sheep grazing to be particularly detrimental to bumble bee populations (Carvell 2002; Hatfield and LeBuhn 2007; Scohier et al. 2012), an effect that is likely due to the selective removal of flowers by sheep. In California, BLM and Forest Service lands historically occupied by *Bombus franklini* are periodically subject to substantial livestock impact. Although livestock grazing has differing impacts on flora and fauna based on the type, habitat, intensity, timing and length of livestock grazing (Gibson et al. 1992), several studies of livestock grazing on bees suggest increased intensity of livestock grazing negatively affects the species richness of bees (Morris 1967; Sugden 1985; Carvell 2002; Vazquez & Simberloff 2003; Hatfield & LeBuhn 2007).

iii. Urban Development

The conversion of the landscape to urban and suburban uses continues to transform and fragment habitat, which has likely had a negative effect on populations of many bumble bee species, including the species listed in this petition. Roads and railroads fragment plant populations and thus restrict the movement of bumble bees (Bhattacharya et al. 2003). Recent research in northern California found that the overall area of the landscape covered by pavement had a negative effect on the density of bumble bee nests. In addition, bumble bee colony density was greater in natural oak chaparral than other landscape types, including urban areas (Jha & Kremen 2012). The western bumble bee has been found in some natural areas within urban environments, such as parks, restored prairies, and other natural areas near urban centers (Williams et al. 2014). Some residential gardens and urban parks can provide valuable floral, and in some cases, nesting and overwintering resources, and may serve as important habitat refuges for bumble bees (Frankie et al. 2005; McFrederick & LeBuhn 2006; Goulson 2010), even though they may not support the species richness that was found historically (McFrederick & LeBuhn 2006).

iv. Fire and Fire Suppression

Fire is an important natural and managed disturbance throughout natural areas in the United States. Historically, fires maintained forbs and grasses within meadows and prairies, and prevented shrubs and trees from encroaching. Due to decades of fire suppression and the growing proximity of housing developments to wildlands, suppression of wildfire is seen as necessary to protect natural resources, homes, and businesses (Radeloff et al. 2018). Fire suppression can lead to extensive changes in vegetation structure, including degradation and loss of grasslands and herbaceous species as the shrub community matures (Schultz & Crone 1998; Panzer 2002). The practice of fire suppression has compromised grassland habitats that formerly supported diverse communities of bumble bees. In forests, these changes include an increase in combustible fuel loads, increase in tree density, increase in fire intolerant species, and loss of the herbaceous layer as the shrub community matures (Huntzinger 2003). In forested meadows fire suppression can lead to invasion and maturation of shrubs and trees and an increase in invasive plants species. Eventually continued succession results in the degradation and loss of the grasslands (Schultz & Crone 1998; Panzer 2002). Forest encroachment not only reduces available bumble bee habitat, but also closes off corridors between meadows, which reduces dispersal and foraging opportunities (Roland & Matter 2007). Continued fire suppression not only results in habitat alteration, but also renders the habitat susceptible to catastrophic, large scale, and high temperature fires due to increases in combustible fuel loads, tree density, and fire intolerant species (Huntzinger 2003). Catastrophic, large scale, and high intensity fires may be particularly harmful to already vulnerable populations of bumble bees listed in this petition. The threat is particularly acute for *B. franklini*, as a single fire event in an area where *B. franklini* are concentrated could extirpate an entire population. Prescribed fire can be a valuable tool in restoring native prairie and meadow plant fauna, which in turn has the potential to benefit bumble bees. However, natural or introduced fire can be detrimental to bumble bee populations if not planned and executed carefully with the life history needs of bumble bees considered.

2. The Loss of Habitat Due to Increased Use of Herbicides

Herbicides are often used within invasive weed management, and can be more cost effective than other management methods. However, the use of herbicides to control weeds can indirectly harm pollinators through removal of flowers that once provided them with pollen and nectar resources (Williams 1986; Shepherd et al. 2003, Pleasants & Oberhauser 2013). In addition to indirect effects, some herbicides can directly harm pollinators.

Just as pollinators can influence the plant community, changes in vegetation can have an impact on pollinators (Kearns & Inouye 1997). The broadcast application of a non-selective herbicide can indiscriminately reduce floral resources for all bumble bees and nesting habitat for species that nest above ground, such as the American bumble bee (Smallidge & Leopold 1997). Bumble bees require consistent sources of nectar, pollen, and nesting material during times adults are active, typically from mid-February to late September in temperate areas. The reduction in resources caused by non-selective herbicide use could cause a decline in bumble bee reproductive success and/or survival rates. Kevan (1999) found that herbicides reduced Asteraceae and Lamiaceae flowers in France, contributing to a decline in bumble bee populations. Kevan (1999) also found that herbicide applications have reduced the reproductive success of blueberry pollinators by limiting alternative food sources that can sustain the insects when the blueberries are not in bloom. Kearns et al. (1998) state "herbicide use affects pollinators by reducing the availability of nectar plants. In some circumstances, herbicides appear to have a greater effect than insecticides on wild bee populations… Some of these bee populations show massive declines due to the lack of suitable nesting sites and alternative food plants."

The use of the herbicide glyphosate has dramatically increased with the widespread planting of genetically modified glyphosate-tolerant corn, soybean, and cotton, which were introduced in the late 1990s (Pleasants & Oberhauser 2013). With the introduction of genetically modified glyphosate tolerant (Roundup Ready^{TM}) soybeans in 1996 and corn in 1998, a 20-fold increase in the use of the herbicide glyphosate has occurred on these two crops from 1995-2013 (Center for Biological Diversity et al. 2014). Increased use of glyphosate in agricultural areas has likely led to the reduced availability of wildflowers in field margins – which otherwise would have been an important resource for bumble bees. Moreover, recent research showed that genetically modified glyphosate-tolerant soybean fields with standard and recommended application rates of glyphosate had lower diversity of flowering weeds than control fields (Scursoni et al. 2006). The loss of flowering weeds from agricultural areas that have become genetically modified during the period from 1996-present has likely deprived many of these species of bumble bees of significant amounts of nectar and pollen, and the continued loss of these critical resources presents a threat to the future survival of these species. Moreover, recent research within the Midwest has shown that simplification of landscapes through intensive agriculture leads to more pest pressure, and thus increased application of insecticides (Meehan et al. 2011). Thus, the conversion of habitat to intensive agriculture throughout much of the United States, the increased use of glyphosate resistant crops, and the subsequent increase in insecticide use has likely had a compounding negative effect on bumble bees. Research has shown that genetically modified glyphosate-tolerant soybean fields with standard and recommended application rates of glyphosate had lower diversity of flowering weeds than control fields (Scursoni et al. 2006). Other studies have shown that agricultural lands without native habitat host a less diverse pollinator community (Kremen et al. 2002; Winfree et al. 2008; Morandin & Kremen 2013).

Recent studies (Dai et al. 2018; Motta et al. 2018) also raise the novel concern that glyphosate can negatively affect the beneficial bacterial colonies found in the honey bee gut thus indirectly affecting the health of bees. Motta et al. 2018 found that young worker bees exposed to field realistic levels of glyphosate experienced increase mortality with subsequent exposure to pathogens. The researchers' results indicate that the increased mortality was due to glyphosate reducing the protective effect of the gut microbiota.

Bumble bees could also be further threatened by the introduction of new herbicide-resistant crops that are genetically engineered to be resistant to multiple herbicides including 2,4-D and dicamba; many growers are switching to dicamba as weeds develop resistance to the herbicide glyphosate. The U.S. Department of Agriculture has recently approved a suite of 'next generation' genetically engineered (GE) herbicide resistant corn and soybeans developed by Dow Agrosciences and soy and cotton developed by Monsanto, which will be sold in conjunction with new combinations of herbicides. These GE crops are resistant to the herbicides 2,4-D, dicamba, and glyphosate (Roundup Ready Xtend™ by Monsanto). The use of herbicides is expected to increase with the adoption of these 'next generation' GE crops (Mortensen et al. 2012). Dicamba and 2,4-D are already among the leading herbicides that cause drift-related crop injury because of their volatility (Freese and Crouch 2015 and references therein). Because of the increased volatility of dicamba and 2,4-D over glyphosate (which is currently the most widely used herbicide in the U.S.), the loss of flowering weeds and wildflowers growing within and adjacent to agricultural land within the range of imperiled bumble bees is expected to be more significant than at present.

As recently as 2015, 2,4-D and dicamba were already used widely within California's Central Valley on multiple crops (USGS 2017a; 2017b), and expanded use of these herbicides is expected to have a major negative impact on populations of already vulnerable bumble bees collecting nectar and pollen from weeds and wildflowers growing near crops. It is likely that the non-target effects of the new uses of these weed control technologies may have a dramatic impact on populations of imperiled bumble bees, given the portion of their selected ranges that overlap with modified corn, soybean, and cotton production.

Beyond impacts to forage, paraquat, 2,4-D, and dicamba may also be directly toxic to bumble bees. Paraquat was found to negatively affect honey bee larvae (Cousin et al. 2013). While 2,4-D has been designated by the U.S. EPA as practically non-toxic to bees it is on the cusp of being ranked as moderately toxic. Dicamba's toxicity ranges from moderately toxic to practically non-toxic depending on the route of exposure (U.S. EPA 2000). The toxicity classification that U.S. EPA uses is driven by a pesticide's LD50 (the lethal dose that kills 50% of the test population). If the pesticide's LD50 is 2 µg/bee or less it is considered highly toxic to bees. If the LD50 is greater than 2 µg/bee but less than 11 µg/bee it is moderately toxic. It is considered practically non-toxic if the LD50 is 11 µg/bee or more. 2,4_D has a reported LD50 of 11.5 µg/bee. Dicamba has an oral LD50 of 3.6 µg/bee, but a contact LD50 of >100 µg/bee. This very blunt measure of risk may underestimate the direct impacts that 2,4-D and dicamba could have on bumble bees, especially since the test subject for these chemicals was the European honey bee, which has been shown to be a poor surrogate for non-*Apis* bees (Wisk et al. 2014). The increasing use of these herbicides should be considered a threat to the continued survival of these imperiled bumble bees due to both the anticipated indirect effects (through destruction of floral resources) and direct effects (through direct toxicity).

The range of two of the species listed in this petition (*Bombus crotchii* and *B. occidentalis occidentalis*) overlaps, at least in part, with the Central Valley of California, which has been subjected to high uses of glyphosate; which is the most commonly used pesticide within the state of California (CA DPR 2014). *B. crotchii* has experienced more significant declines in the Central Valley than it has at the edges of its range (Hatfield et al. 2015a; see Figure 1in Section II); intensive agriculture and associated herbicide use may be responsible for this pattern. Moreover, glyphosate was used for agricultural purposes in 98% of counties in the lower 48 states. The widespread use of glyphosate is a threat to the continued existence of all four petitioned bumble bee species.

In summary, the evidence presented above shows clearly that 1) the use of herbicides has both direct (2,4-D, paraquat dichloride and dicamba are toxic to bees) and indirect (removal of floral resources) effects on bumble bee populations; and 2) the use of herbicides is widespread and pervasive throughout the range of all the bumble bees listed in this petition. As such, herbicides pose a direct threat to the continued existence of each species included in this petition.

B. Overexploitation

While specimens of female workers or males are occasionally collected for research purposes, scientific and/or recreational collection probably does not pose a threat to the overall survival of the species in this petition. In fact, collection of female workers of each of these species since the late 1800s has contributed essential information to understanding species' historic ranges and conservation statuses. However, if bumble bee queens are collected, the entire colony will be effectively eliminated. Collection of queens or large numbers of workers or males from populations that are already small and isolated could threaten these species with extinction, although there is no evidence that this practice is occurring with these species.

To the best of the petitioners' knowledge, none of the petitioned species are currently being produced or sold commercially. However, in the early 1990s, *B. occidentalis* was produced commercially (Flanders et al. 2003) by both of the two primary commercial bumble bee producers operating in North America (Koppert Biological Systems and Biobest) and distributed for pollination use in the western U.S. In 1995, one company reported a mass outbreak of the fungal pathogen *Nosema bombi* in commercial colonies of *B. occidentalis* (Flanders et al. 2003). By 1997, commercial production of the western bumble bee stopped, as producers were no longer able to contend with the pathogen outbreaks (Velthius & Van Doorn 2006). Currently in North America, the common eastern bumble bee (*Bombus impatiens*) is produced on a large scale; over a million commercially produced bumble bee colonies are imported annually across the globe to pollinate greenhouse crops (Velthius and Van Doorn 2006). Commercial bumble bees are used in both greenhouse and open field pollination throughout the U.S. (except in Oregon, where use is prohibited, and California, where only greenhouse use is allowed), and two western species – Hunt's bumble bee (*Bombus huntii*) (APHIS 2014; Biobest Group 2018a [advertises *B. huntii* for use in indoor crops; though at the time of submission of this petition it is not currently available in the western U.S.]; 2018b) and the yellow faced bumble bee (*Bombus vosnesenskii*) (I. Noell, USFS, pers. comm. with R. Hatfield 2016) are being developed for larger scale commercial production. The commercial production and release into the wild of these three species of bumble bees poses a threat to the petitioned species because pathogens may be amplified in commercial rearing facilities and then spill over into wild populations, or novel pathogens may be introduced, since commercial bumble bees are currently reared in facilities outside of their native ranges or moved to areas beyond their native ranges (Meeus et al. 2011). The risk of disease transfer via commercial bumble bees is further discussed in Factor D: *Disease.*

Though overexploitation does not currently pose a substantial threat to the species included in this petition, there is strong evidence to suggest that historically the commercial production of one subspecies petitioned here – *Bombus occidentalis occidentalis* – and the associated amplification of fungal pathogens in commercial colonies led to the dramatic decline of populations of this subspecies from the wild (Cameron et al. 2016). Furthermore, the commercial propagation and release of other species of bumble bees (*Bombus impatiens*, *Bombus vosnesenskii*, and *Bombus huntii* in the U.S.) poses a significant threat to all of the species in this petition via amplification and spread of disease and competition, and thus this factor is considered in this petition.

C. Competition with Managed Honey Bees

A single honey bee colony requires substantial resources to survive. Estimates of single hive consumption vary from 20-130 lbs/year for pollen and 45-330 lbs/year of honey – representing 120-900 lbs/year of nectar (Goulson 2003, and references therein). Cane and Tepedino (2016) estimate that in three months a 40 hive apiary would remove enough pollen resources from the surrounding area that would have supported the development of 4,000,000 native bees. Depending on the environment and the density of honey bee hives in an area and the time of year, this could represent a substantial percentage of the resources available and has the potential to affect native bee populations. Recent research has also documented that under controlled conditions honey bees displaced native bees from flowers, altered the suite of flowers that native bees were visiting, and had a negative impact on native bee reproduction (Hudewenz and Klein 2015). The proportion of resources used by honey bees, as well as the effects of this resource depletion on the native bee community are likely to vary by location, the time of year, the species involved, floral abundance and diversity, and climatic and other environmental conditions.

A recent comprehensive review of the effects of managed bees (including honey bees) on native bee populations found that the majority of studies conclude that managed bees have a negative effect on native bees via competition, change in plant community, and disease transmission (Mallinger et al. 2017). Mallinger et al. (2017) also acknowledge the need for additional research investigating the effects of managed bees on bee fitness, as well as population and community level effects. While there remains a need for additional research, there is evidence that honey bees can potentially impact the native bee community by removing the available supplies of pollen and nectar (Anderson & Anderson 1989; Paton 1990, 1996; Wills et al. 1990; Dafni & Shmida 1996; Horskins & Turner 1999; Cane & Tepedino 2016), or by competitively excluding native bees, thus forcing them to switch to other, less abundant, and less rewarding plant species (Wratt 1968; Eickwort & Ginsberg 1980; Pleasants 1981; Ginsberg 1983; Paton 1993; 1996; Buchmann 1996; Horskins & Turner 1999; Dupont et al. 2004; Thomson 2004; Walther-Hellwig et al. 2006; Tepedino et al. 2007; Roubik 2009; Shavit et al. 2009; Hudewenz & Klein 2013; Rogers et al. 2013; but see Butz-Huryn 1997; Steffan-Dewenter & Tscharntke 2000; Minckley et al. 2003) – but none of these studies have addressed population level effects on native bees.

Additional research demonstrates that honey bees are regularly using, and depleting, the most abundant resources in the surrounding environment (Paton 1996; Mallick & Driessen 2009; Shavit et al. 2009), and that upon removal of honey bees, native bees exhibit signs of competitive release by returning to plants that were formerly used by honey bees (Pleasants 1981; Wenner & Thorp 1994; Thorp 1996; Thorp et al. 2000). The long-term implications of this shift in resource use are not entirely clear, although there is a growing body of research on bumble bees that demonstrates negative competitive effects of honey bees on bumble bees, including lower reproductive success, smaller body size, and changes in bumble bee foraging behavior – notably a reduction in pollen gathering (Evans 2001; Goulson et al. 2002; Thomson 2004; 2006; Paini & Roberts 2005; Walther-Hellwig et al. 2006; Goulson & Sparrow 2009; Elbgami et al. 2014).

Because of the threats mentioned above, one recent review paper concludes that honey bees are inappropriate in protected areas where they pose the biggest threat to wild bee populations (Geldmann and González-Varo 2018); the same could be said for the placement of honey bees near species of conservation concern. In summary, competition with honey bees, along with the threat of disease transmission pose a significant threat to the four petitioned bumble bee species.

D. Disease

1. Pathogens and Parasites of Bumble Bees

The spillover, spillback, and facilitation of infectious diseases from domesticated livestock to wildlife populations is one of the main sources of emerging infectious disease, which pose a major threat to a wide variety of wildlife species (Daszak et al. 2000; Fürst et al. 2014; Graystock et al. 2015a; McMahon et al. 2015), including high profile declines of many bat and amphibian species caused by emerging infectious diseases. While this phenomenon has not been well studied in invertebrates, there is recent evidence of the transmission of pathogens from commercial bumble bees to wild bumble bees and pathogens have been implicated in the decline of both *B. franklini* and *B. occidentalis occidentalis* (Colla et al. 2006; Otterstatter & Thomson 2008; Murray et al. 2013; Graystock et al. 2015a; Cameron et al. 2016). Worldwide, reported pathogens and parasites of bumble bees include: viruses, bacteria, fungi, protozoa, nematodes, hymenopteran and dipteran parasitoids, one lepidopteran parasite, and mites (Acari) (Schmid-Hempel 2001). Pathogen prevalence and fitness effects in wild North American bumble bees are generally not well understood. However, the microparasites and macroparasites that have been identified as pathogens of concern to wild North American bumble bees (Cameron et al. 2011b) are discussed below. Pathogens and parasites pose a substantial threat to the continued survival of all of the species included in this petition.

i. Microparasites

<u>*Nosema bombi*</u>

Nosema bombi is a microsporidian parasite that infects bumble bees primarily in the malpighian tubules, but also in fat bodies, nerve cells, and sometimes the tracheae (Macfarlane et al. 1995). Colonies can appear to be healthy but still carry *N. bombi* (Larsson 2007) and transmit it to other colonies. *N. bombi* can reduce colony fitness, as well as reduce individual reproduction rate and life span in bumble bees (Schmid-Hempel & Loosli 1998; Schmid-Hempel 2001; Colla et al. 2006; Otti & Schmid-Hempel 2007; 2008; van der Steen 2008; Rutrecht & Brown 2009). This parasite has been observed recently in wild bumble bees throughout North America (Colla et al. 2006; Gillespie 2010; Cameron et al. 2011a; Kissinger et al. 2011; Cordes et al. 2012).

Cameron et al. (2011a) found a significantly higher prevalence of *N. bombi* in declining North American bumble bee species (*Bombus occidentalis* and *B. pensylvanicus* [American bumble bee]). In the same study, *N. bombi* infection was significantly lower in species that have not exhibited recent declines in range and relative abundance (Cameron et al. 2011a). Blaker et al. (2014) also found an increased prevalence of *N. bombi* in *B. occidentalis* than sympatric species that have not exhibited population declines. These studies indicate that *N. bombi* is a threat to the continued existence of *B. occidentalis*. Since the western bumble bee is host to the Suckley cuckoo bumble bee (Williams et al. 2014) – *N. bombi* is a threat to the continued existence of this species as well.

Nosema ceranae

While the primary disease implicated in recent bumble bee declines is the microsporidian *Nosema bombi*, bumble bees have recently been seen to harbor *Nosema ceranae*, a common disease of honey bees that can be particularly virulent to honey bee colonies, and has been implicated as a factor in Colony Collapse Disorder (Paxton 2010; Fürst et al. 2014). *N. ceranae* has recently been detected in honey bees in Canada, and the United States (Williams et al. 2008b), and more recently been detected in bumble bees in South America (Plischuk et al. 2009) and Europe (Graystock et al. 2013a; Fürst et al. 2014). It is likely only a matter of time until this pathogen is detected in wild bumble bees in North America. Recent studies have shown that *N. ceranae* is easily transferred to bumble bees, and was found in all species of bumble bees tested in Europe (Graystock et al. 2013a). In laboratory experiments, virulence of *N. ceranae* in infected bumble bees was very high, reducing survival by 48% (Graystock et al. 2013a). Graystock et al. (2013a) conclude that *N. ceranae* represents a real and emerging threat to bumblebees, with the potential to have devastating consequences for their already vulnerable populations.

While to our knowledge *N. ceranae* has not been detected in any of the species in this petition, this microsporidian represents a current and potential threat to their populations. Recent studies have shown that pathogen transmission (including *N. ceranae*) between honey bees and bumble bees is readily occurring at flowers (Graystock et al. 2015b) and the range of all bumble bees in this petition overlaps with the range of both feral and managed honey bees. Furthermore, honey bees are both resident and regular migrants throughout the range of all of these bumble bees, thus, there is a clear vector for transmission of *N. ceranae* to all of the bumble bees in this petition. The uncertainty around the effects that this pathogen may have on wild bumble bees deserve further scrutiny and cautionary action; they should not be dismissed as a threat to the continued survival of the species in this petition.

Crithidia species

Crithidia bombi is a trypanosome protozoan that can dramatically reduce bumble bee longevity and colony fitness (Brown et al. 2003; Otterstatter & Whidden 2004), interfere with learning among bumble bee foragers (Otterstatter et al. 2005), increase ovary development in workers (Shykoff & Schmid-Hempel 1991), and decrease pollen loads carried by workers (Shykoff and Schmid-Hempel 1991). In the UK, researchers found a higher prevalence of the pathogen *C. bombi* in bumble bee populations with reduced genetic diversity, suggesting that as populations become smaller and lose heterozygosity, the impact of this parasite will increase (Whitehorn et al. 2011), pushing already at-risk populations closer to extinction. Moreover, there may be a synergistic effect between the effects of pesticides and disease. A recent laboratory study demonstrated that chronic exposure to low, realistic doses of two neonicotinoid insecticides, when combined with a sublethal infection of *C. bombi*, significantly reduced bumble bee queen survival (Fauser-Misslin et al. 2014).

Crithidia expoeki is a recently identified protozoan characterized from bumble bees collected in North America (Alaska) and Switzerland (Schmid-Hempel & Tognazzo 2010) that may also present a serious threat to wild populations of bumble bees. The increasing prevalence of these two species of *Crithidia* is an emerging and increasing threat to the bumble bees included in this petition.

B. occidentalis, the parent species to *B.occidentalis occidentalis* in this petition has been shown to be infected with *Crithidia bombi* (or *C. expoeki*) (Gillespie 2010; Cordes et al. 2012). One additional species in this petition was tested for infection by Cordes et al. (2012), however, because of their extreme rarity in the landscape, collection rates were very low for this species (*B. suckleyi*, N=4) and *C. bombi* was not detected (Cordes et al. 2012). Cordes et al. (2012) found *Crithidia sp.* in all regions of the United States in 15 different bumble bee host species.

Apicystis bombi

Apicystis bombi is a neogregarine protozoa that has been shown to infect 7.4% of American bumble bee queens in Ontario, Canada (Macfarlane et al. 1995). This parasite is associated with rapid death of infected bumble bee queens early in the season (Macfarlane et al. 1995; Rutrecht & Brown 2008). It has also been shown to inhibit ovary development and reduce queen longevity (Rutrecht & Brown 2008). More research is needed to understand causal effects that this parasite has on bumble bees and how this parasite is transmitted. This parasite has been found in commercial bumble bee colonies (Meeus et al. 2011), and researchers suggest that this pathogen may have been introduced from Europe to NW Patagonia, Argentina on commercial bumble bees, potentially causing an observed population collapse in a native bumble bee species (Arbetman et al. 2013; Maharramov et al. 2013). In a study in Mexico, *A. bombi* was the most frequently encountered pathogen in commercial bumble bee colonies (of *Bombus impatiens* - the species of bumble bee most commercially available in the United States) that were tested for emerging infectious diseases (Sachman-Ruiz et al. 2015). As shown above, because of its virulence, its apparent widespread infection of wild bumble bees throughout North America, and its high prevalence in commercial bumble bees, *A. bombi* poses a serious potential threat to the continued survival of the bumble bees named in this petition.

Apicystis bombi has recently been detected in northern California and Oregon (Kissinger et al. 2011), which is within the current range of all of the species included in this petition, except *Bombus crotchii*. It is notable that in 2006-2007 all species included in this petition and within the range of the study were so rare (or absent) that they were not detected in the surveys by Kissinger et al. (2011). Since this pathogen has a detrimental effect on queens it can directly impact entire colonies of bumble bees. As such, it is a threat to the continued existence of all of the species in this petition.

<u>RNA viruses</u>

RNA viruses that have historically been considered to be specific to honey bees (*Apis mellifera*), including Israeli acute paralysis virus, black queen cell virus, sacbrood virus, Deformed Wing Virus (DWV), and Kashmir bee virus, have been recently detected in wild North American bumble bees foraging near apiaries (Singh et al. 2010). Recent research has emerged that documents the transmission of diseases from managed bees (both European honey bees and commercial bumble bees) to wild pollinators. These studies have demonstrated the threat that RNA viruses pose (Fürst et al. 2014; Manley et al. 2015; McMahon et al. 2015). DWV, which is associated with severe winter losses in honey bees (Highfield et al. 2009), was also detected in bumble bees in Germany, and the infected bumble bees displayed the same deformities that are typical of infected honey bees (Genersch et al. 2006). To understand the extent of the threat to wild bumble bees, the prevalence of these viruses in wild populations of bumble bees, as well as their effects on bumble bee fitness, are in urgent need of further study. While further study is needed, RNA viruses such as DWV have been shown to be virulent to bumble bees, resulting in malformed wings, non-viable offspring, and reduced longevity (Fürst et al. 2014). And, there is a growing body of evidence that RNA viruses can be transmitted between managed bees and wild bees on flowers (Manley et al. 2015).

While most of the recent research has been conducted in Europe, these same pathogens exist within the historic and current range of the bumble bees in this petition, and the pathogen spillover from honey bees and commercial bumble bees poses a significant threat to them. Since honey bees and commercial bumble bees (documented vectors for RNA viruses) are used throughout the United States, and within the range of all four species in this petition, RNA viruses are a clear threat to the continued existence of all of these animals.

ii. Macroparasites

<u>*Locustacarus buchneri*</u>

Bumble bees are often infected by mites. While many external mites can be relatively benign, many internal mites can be particularly virulent (Plischuk et al. 2013). This includes *Locustacarus buchneri*, a species that parasitizes the trachea of bumble bees (Husband & Shina 1970). *L. buchneri* is associated with reduced foraging and lethargic behavior (Husband & Shina 1970) and a significantly reduced lifespan in male bumble bees (Otterstatter & Whidden 2004). Otterstatter and Whidden (2004) reported that this mite was most prevalent in bumble bees of the subgenus *Bombus sensu stricto* (*B. occidentalis, B. moderatus, B. terricola*) in a study in southwestern Alberta. The internal mite was also reported in *B. bellicosus* and one of *B. atratus* (both in the subgenus *Thoracobombus*) from Argentina (Plischuk et al. 2013) and from the majority of populations of *B. jonellus* (subgenus *Pyrobombus*) and *B. muscorum* (subgenus *Thoracobombus*) in the United Kingdom (Whitehorn et al. 2014). Significantly, populations in this study that had high infection rates of *L. Buchneri* also had lower genetic diversity than populations that were not infected (Whitehorn et al. 2014). This suggests that small populations that may already be suffering from reduced genetic diversity may be particularly susceptible to this tracheal mite. Importantly *L. buchneri* was also detected in commercial *Bombus impatiens* colonies found in greenhouses in Mexico (Sachman-Ruiz et al. 2015) suggesting that commercial bumble bees may be a source of this tracheal mite for wild bumble bees. The presence of this mite in commercial bumble bee colonies in North America (Mexico), and the apparent susceptibility of populations with reduced genetic diversity to infection, suggest that this macroparasite is a threat to the continued existence of the four petitioned bumble bee species.

<u>*Sphaerularia bombi*</u>

Sphaerularia bombi is an entomopathogenic nematode that infects hibernating bumble bee queens and sterilizes them (Schmid-Hempel 2001). In a literature review, Macfarlane et al. (1995) notes that bumble bee queens infected with this parasite in New Zealand colonized new areas at a rate of less than 1% of that of healthy queens. Infected queens do not initiate a nest, but do continue to visit flowers (Kadoya & Ishii 2015). Because queens are foraging later in the summer there is evidence that through manipulation of behavior infected queens can negatively affect uninfected workers of conspecific and sympatric *Bombus* species through competition (Kadoya & Ishii 2015). This parasite has been detected in 16 species in North America (Macfarlane et al. 1995; Maxfield-Taylor et al. 2011), and may pose a threat to the long-term survival of the species in this petition.

2. Pathogen Spillover

The spread of pathogens to bumble bees from the domesticated common eastern bumble bee (*Bombus impatiens*) and other species of bumble bees that are currently being developed for commercial use threatens the species included in this petition with extinction. In addition, RNA viruses from the domesticated honey bee (*Apis mellifera*) can be transmitted to bumble bees at shared flowers (Singh et al. 2010; Graystock et al. 2015a, 2015b; Manley et al. 2015; McMahon et al. 2015), and pose a novel threat to bumble bees.

i. Commercial Bumble Bees

The dramatic decline in numerous species of North American bumble bees, including *B. franklini* and *B. occidentalis occidentalis* has been attributed to pathogen infection from managed bumble bees (Evans et al. 2008; Thorp 2005c). Robbin Thorp first developed the hypothesis that an exotic strain of the fungal pathogen *Nosema bombi* escaped from commercial bumble bee rearing operations in the late 1990s and subsequently spread to wild populations of bumble bees in the subgenus *Bombus* (including *B. occidentalis*, *B. franklini*, *B. affinis*, and *B. terricola*) (Thorp 2005c). This hypothesis was supported by the timing, speed and severity of declines observed in wild populations of *B. occidentalis* and *B. franklini*, coincident with reports by commercial producers of *N. bombi* outbreaks in their facilities (Flanders et al. 2003). Cameron et al. (2016) tested Thorp's hypothesis and found that although the prevalence of *Nosema bombi* increased in bumble bees during the 1990s - the same time period that researchers reported that *B. occidentalis* and *B. franklini* were disappearing in the wild – they did not find evidence that an exotic strain of this pathogen was introduced to the U.S.

Commercial bumble bees are used primarily to pollinate greenhouse tomatoes, and increasingly to pollinate a wide variety of other greenhouse and open field vegetable and fruit crops in the US and worldwide (Velthius & Van Doorn 2006; Koppert Biological Systems 2018), though California only permits commercial bumble bees to be imported into the state for greenhouse use. The commercial bumble bee industry has grown dramatically in the past two decades (Velthius & Van Doorn 2006), coincident with the growth of the greenhouse tomato industry. In 2004 55,000 colonies of the common eastern bumble bee (*Bombus impatiens*) were commercially reared in the United States, and nearly 1,000,000 colonies were produced world-wide (Velthius & Van Doorn 2006) and demand is ever increasing (Sachman-Ruiz et al. 2015). Commercial bumble bees often escape greenhouses to forage on nearby plants (Whittington et al. 2004; Morandin et al. 2001), where they interact with wild bumble bees and have the opportunity to transmit pathogens at shared flowers. Commercially raised bumble bees frequently harbor high pathogen loads (Goka et al. 2000; Whittington & Winston 2003; Niwa et al. 2004; Colla et al. 2006; Graystock et al. 2013b) and the spillover of pathogens from commercial bumble bees in greenhouses to wild, native bumble bees foraging near greenhouses has been documented (Colla et al. 2006; Goka et al. 2006; Otterstatter & Thomson 2008; Graystock et al. 2014). Moreover, recent analysis has shown that many of the pathogens transmitted from commercial colonies are virulent to bumble bees (Graystock et al. 2013b).

Commercially reared bumble bees frequently harbor significantly more pathogens than their wild counterparts and their escape from greenhouses leads to infections in nearby wild native species

(Colla et al. 2006). In fact, Colla et al. (2006) found that bumble bees far away from greenhouses had zero *Crithidia bombi* infections, while their counterparts found close to greenhouses had infection rates of 5.3% – 75%. An additional study demonstrated that commercial bumble bees in greenhouses regularly escape greenhouses; 73% of the pollen found on bumble bees within a greenhouse originated from plants outside of the greenhouse (Whittington et al. 2004). A more recent study in the UK found that three bumble bee pathogens (*Nosema ceranae*, *Apicystis bombi*, and *Crithidia bombi*) were more prevalent around greenhouses using commercially produced bumble bees (Graystock et al. 2014). Notably this study also found that the species of bumble bee did not affect infection rates, indicating that these two pathogens infect all species equally, and that the presence of commercial bumble bees was the best measured predictor of infection rates (Graystock et al. 2014). Bumble bee diseases can be spread from bee to bee at shared flowers (Gorbunov 1987; Lipa & Triggiani 1988; Graystock et al. 2015a; 2015b).

Meeus et al. (2011) reviewed the effects of invasive parasites on bumble bee declines. They report that the commercial production of bumble bees has the potential to lead to bumble bee declines in three ways: commercial colonies may have high parasite loads, which could then infect wild bumble bee populations; commercial production may allow higher parasite virulence to evolve, leading to the introduction of parasites that are potentially more harmful to wild bumble bees than naturally occurring parasites; and the global transport of commercial bumble bees can introduce novel parasites to which resident, native bumble bees have not adapted. Pathogens reported from commercial bumble bee colonies worldwide include: *Apicystis bombi*, *Crithidia bombi*, *Locustacarus buchneri*, *Nosema bombi*, Black Queen Cell Virus (BQCV), Deformed Wing Virus (DWV), Israeli Acute Paralysis Virus (IAPV), and Kashmir Bee Virus (KBV) (Meeus et al. 2011). Commercial bumble bee colonies in North America have tested positive for *Crithidia bombi*, *Nosema bombi*, *Locustacarus buchneri*, DWV, BQCV, Sacbrood Virus (SBV) (Morkeski & Averill 2012; Averill unpublished data), and IAPV (Singh et al. 2010).

When tested, commercial bumble bee colonies in the U.S. have repeatedly been found to harbor parasites and pathogens harmful to wild bees (reviewed in Graystock et al. 2015a). In 2010, Morkeski and Averill reported results from testing bumble bees from the commercial vendors Koppert Biological Systems and BioBest. They found the commercially reared bumble bees were infected with *N. bombi*, *C. bombi*, *L. buchneri*, and viruses that also affect honey bees, including DWV and BQCV. Averill (unpublished data) also reported that commercial bumble bee colonies have tested positive for SBV. Singh et al. (2010) reported that commercial bumble bee colonies tested positive for IAPV. Furthermore, a recent study of commercially produced bumble bees (*Bombus impatiens*) in Mexico found that the colonies were infected with *L. buchneri*, *N. bombi*, Acute Bee Paralysis Virus (ABPV), Chronic Bee Paralysis Virus (CBPV), DWV, IAPV and KBV (Sachman-Ruiz et al. 2015). Since *B. impatiens* is native to the eastern

U.S. and Canada but not native to Mexico, and used in commercial bumble bee rearing facilities in both the U.S. and Canada, it is likely that these pathogens originated in rearing facilities in either the U.S. or Canada, and may also occur in managed bumble bee colonies in these two countries.

Examples from multiple continents exist demonstrating that pathogens from managed bumble bees can spread to wild bumble bees with catastrophic results (Graystock et al. 2015a). In South America, the commercial buff-tailed bumble bee (*Bombus terrestris*) was first introduced into Chile from Europe in 2006 and has since spread to Argentina (Morales et al. 2013; Schmid-Hempel et al. 2014). Researchers suggest that the highly pathogenic *Apicystis bombi* hitchhiked on the commercial bumble bees and spread to wild bumble bees, potentially causing the observed population collapse in the world's largest native bumble bee – *Bombus dahlbomii* (Arbetman et al. 2013; Schmid-Hempel et al. 2014). Indeed, scientists have found that wherever *B. terrestris* invades, the native bumble bee species disappears (Morales et al. 2013; Schmid-Hempel et al. 2014). In Japan, researchers found that commercially raised bumble bees had a higher infestation rate of the tracheal mite *L. buchneri* than wild bumble bees. Their findings also suggested that a European strain of this mite has likely invaded native Japanese bumble bee populations and may help explain its decline (Yoneda et al. 2008; Goka 2010; Graystock et al. 2015a). In Canada, higher levels of the protozoan parasite *Crithidia bombi* were detected in wild bumble bees foraging near greenhouses that used commercial bumble bees (Colla et al. 2006; Otterstatter & Thomson 2008), and it was suggested that this pathogen may be implicated in the sudden, widespread decline observed in North American bumble bees in the subgenus *Bombus sensu stricto* (Otterstatter & Thomson 2008). However, a more recent analysis of pathogen prevalence in wild bumble bees did not find evidence that *Crithidia* infections are involved in the decline of U.S. bumble bee species (Cordes et al. 2012).

In other regions of the world—where the two major North American bumble bee producers also operate—commercial bumble bee colonies have been more widely tested and have routinely been found to be infected with numerous parasites and pathogens, including: *Apicystis bombi, Crithidia bombi, Nosema bombi, N. ceranae*, DWV, and three honey bee specific parasites (Graystock et al. 2013b; Meeus et al. 2011; Murray et al. 2013; Sachman-Ruiz et al. 2015). In a 2013 European study, scientists tested commercially produced bees imported into the UK. Although the bees were sold as "disease-free," the scientists found that 77 percent of the colonies tested were infected with at least five parasites and an additional three parasites were present in pollen that was supplied as food for the bumble bee colonies (Graystock et al. 2013b).

Should non-native *Bombus impatiens*, which California currently allows to be imported for greenhouse use only, escape greenhouses, the pathogens they harbor may pose a risk to wild bumble bees, including the four species included in this petition.

ii. Honey Bees

In addition to competitive effects listed above, honey bees may pose a risk to the four bumble bees listed in this petition by transmitting pathogens to them. Recent evidence has emerged demonstrating that honey bees can transmit diseases to many different species of native bees, including bumble bees, when they interact at shared flowers (Singh et al. 2010; Fürst et al. 2014). Bumble bees placed close to honey bee hives were found to have an 18% higher prevalence of *Crithidia bombi*, than bumble bees placed away from honey bees (Graystock et al. 2014). A number of RNA viruses that were formerly thought to be specific to honey bees have now been reported to infect bumble bees (Genersch et al. 2006; Morkeski & Averill 2010; Singh et al. 2010; Meeus et al. 2011; Evison et al. 2012; and see RNA Viruses in section D: Diseases above). In addition, while the primary disease implicated in recent bumble bee declines is the microsporidian *Nosema bombi*, bumble bees have recently been seen to harbor *Nosema ceranae*, a common disease of honey bees that can be particularly virulent to honey bee colonies, and has been implicated as a factor in Colony Collapse Disorder (Paxton 2010; Fürst et al. 2014; and see *Nosema ceranae* in section D: Diseases above.).

Two recent review papers that investigated disease transmission between managed (including honey bees and commercial bumble bees) and wild bees concluded that the commercial use of pollinators is a key driver of emerging disease in wild pollinators, and that avoiding anthropogenic induced pathogen spillover is crucial to preventing disease emergence in native pollinators (Graystock et al. 2015a; Manley et al. 2015). To help mediate this potential, the authors suggest that it is crucial to prevent wild bees from interacting with managed bees (Graystock et al. 2015a; Manley et al. 2015). Graystock et al. (2015b) also documented that pathogen transmission occurs between bumble bees and honey bees at shared flowers, showing a clear mechanism and vector for infection. Since small, fragmented, and declining populations are especially susceptible to infectious disease (Fürst et al. 2014), and disease is already implicated as a likely causal factor of some native bee declines in North America (Cameron et al. 2011b), this emerging body of research suggests that caution should be exercised when considering the placement of managed bees of any species in habitat that supports vulnerable or declining native bee populations or that strict regulations should be implemented that include regular screening and clear actions for diseased managed bees to prevent further infection (Graystock et al. 2015a).

The continental distribution, transport, and use of commercially reared honey bees throughout the United States presents a clear vector for disease transmission to the four species of bumble bees included in this petition. Several of the diseases harbored by honey bees have been shown to be pathogenic and virulent to bumble bees, posing a significant risk. Since the populations of the bumble bee species included in this petition are already small and fragmented, any further stressor threatens each species with local extirpation, and perhaps extinction. As such, continued unrestricted use of commercial honey bees poses a threat to the continued existence of each species included in this petition.

E. Other Natural Events or Human-related Activities

1. Pesticides

Pesticides are used widely in agricultural, urban, and even natural areas and can exert both direct effects (lethal and sublethal) and indirect effects (harm via the effect on another species) on bumble bees. Foraging bumble bees can be poisoned by pesticides when they absorb toxic substances directly through their exoskeleton, drink contaminated nectar, gather contaminated pollen, or when larvae consume contaminated pollen. Because bumble bees nest in the ground, they may be uniquely susceptible to pesticides used on lawns or turf (National Research Council 2007). Pesticides applied in the spring, when bumble bee queens are foraging and colonies are small, are likely to be most detrimental to bumble bee populations (Goulson et al. 2008; Stoner 2016). Since males and queens are produced at the end of the colony cycle, sublethal doses of pesticides applied at any time during the bumble bee lifecycle can have substantial adverse effects on subsequent generations. Any application of pesticides can threaten bumble bees, but pesticide drift from aerial spraying can be particularly harmful. One study demonstrated that 80% of foraging bees close to the source of an insecticide application were killed, and drift can continue to be dangerous for well over a mile from the spray site (Johansen and Mayer 1990). In Europe, the recent declines in bumble bees have been partially attributed to the use of pesticides (Williams 1986; Thompson and Hunt 1999; Rasmont et al. 2006).

Bumble bees are threatened by the widespread use of pesticides across their range. Insecticides are designed to kill insects directly and herbicides can indirectly affect bumble bees by removing floral resources (see Section A.2: The Loss of Habitat Due to Increased Use of Herbicides). There is very little data available on the effect of fungicides on bumble bees, although a growing body of evidence suggests fungicides may be linked with sublethal concerns including weakening the immune system of bumble bees. Below, we outline the threats posed to bumble bee populations by insecticides and fungicides.

i. Insecticides

Of the various pesticide groups, insecticides are most likely to directly harm bees. Many commonly used insecticides are broad spectrum and thus could kill or otherwise harm exposed bumble bees. Systemic insecticides, such as neonicotinoids, have the added concern of causing exposure months to years after a treatment as they are taken up by the plant and expressed in the pollen, nectar and leaves. Extensive research into the effects of neonicotinoids has been performed. Below is a brief summary of a subset of this body of research.

<u>Neonicotinoids</u>

Neonicotinoids are a relatively new class of systemic insecticides that are used widely to combat insect pests of agricultural crops, turfgrass, gardens, and pets (Cox 2001). Colla & Packer (2008) suggested that neonicotinoids may be one of the factors responsible for the decline of the rusty patched bumble bee (*Bombus affinis*; recently listed as an Endangered species under the U.S. Endangered Species Act), noting the use of this class of insecticides began in the U.S. in the early 1990s, shortly before the decline of the rusty patched bumble bee was first observed.

A recent study exposing bumble bees to field-realistic levels of the neonicotinoid imidacloprid found an 85% reduction in the production of new queens and significantly reduced colony growth rates compared to control colonies (Whitehorn et al. 2011). The authors suggest that neonicotinoids “may be having a considerable negative impact on wild bumble bee populations across the developed world” (Whitehorn et al. 2011). Another study of bumble bees exposed to varying levels of imidacloprid found a dose-dependent decline in fecundity and documented that field realistic levels of this pesticide were capable of reducing brood production by one-third (Laycock et al. 2012). The authors speculate that this decline in fecundity is a result of individual bumble bees failing to feed, which raises concerns about the impact of this pesticide on wild bumble bees (Laycock et al. 2012). In another study (Fauser et al. 2017) the researchers found that early lifestage exposure to low dose, field realistic levels of thiamethoxam and its metabolite clothianidin significantly reduced the survival of hibernating queens. Other toxicity studies have demonstrated that contact exposure of imidacloprid and clothianidin to bumble bees can be very harmful (Marletto et al. 2003; Gradish et al. 2009; Scott-Dupree et al. 2009), and an acute oral dose of imidacloprid is highly toxic to bumble bees (Marletto et al. 2003, *In* Hopwood et al. 2016). Mommaerts et al. (2010) found that chronic exposure of three neonicotinoids to bumble bees was dose dependent, and another study by Incerti et al. (2003) found that one third of bumble bees in a flight cage exposed to blooming cucumbers treated with a “field dose” of imidacloprid died within 48 hours (*In* Hopwood et al. 2016). A study by Gill et al. (2012) examining the effects of the combined exposure of bumble bees to field realistic levels of two pesticides – an imidacloprid and a pyrethroid – found that foraging behavior was impaired, worker mortality increased, and both brood development and colony success were significantly reduced.

Other studies have also documented sublethal effects of neonicotinoids on bumble bees, including: reduced foraging ability (Morandin & Winston 2003; Stanley et al. 2016); reduced drone production and longer foraging times (Mommaerts et al. 2010; Arce et al. 2016; Stanley et al. 2016); reduced foraging activity, reduced food storage and reduced adult survival (Al-Jabr 1999); and lower worker survival and reduced brood production (Tasei et al. 2000; Fauser-Misslin et al. 2014; *In* Hopwood et al. 2016). Studies have also shown that neonicotinoid exposures can lead to impaired learning and memory (Stanley et al 2015a) as well as impaired crop pollination services (Stanley et al. 2015b). Bumble bees appear to be affected by dietary concentrations of the systemic insecticide imidacloprid at levels lower than honey bees, perhaps because, unlike honey bees, bumble bees do not metabolically degrade imidacloprid effectively while continuing to ingest it (Cresswell et al. 2014; *In* Hopwood et al. 2016).

Neonicotinoids are widely used on agricultural crops that are attractive to pollinators, as well as on horticultural plants and lawns in urban and suburban areas. Thus, this class of insecticide is likely to affect all bumble bees, which were historically found in all of these landscapes. Of particular concern is a finding in a recent review of the impact of neonicotinoid pesticides on pollinating insects which found that some products approved for home and garden use may be applied to ornamental and landscape plants at significantly higher concentrations (as much as 120 times higher) than the allowable concentration of the similar products applied on agricultural crops (Hopwood et al. 2016).

Nitroguanidine neonicotinoids (clothianidin, dinotefuran, imidacloprid and thiamethoxam) are highly toxic to bumble bees and their use has dramatically increased over the last 20 years (USGS 2017c), especially in California's Central Valley, where *B. crotchii* and *B. o. occidentalis* occur. In fact, imidacloprid is the fourth most commonly used insecticide in California, with reported uses on more than 140 crops and other non-crop locations. Its use has increased from 5,179 pounds (658 applications) in 1994 to 441,304 pounds (70,054 applications) in 2015. While not as commonly used as imidacloprid, the other neonicotinoids are also becoming more widely used. For example, thiamethoxam use has increased from 11,090 pounds (2,826 applications) in 2002 when it was first used in California, to 41,908 pounds (26,932 applications) of reported use in 2015 (CA DPR 2014). Throughout the U.S., nitroguanidine neonicotinoids were used to some degree for agricultural purposes in 94% (2,930 out of 3,109) of counties in the lower 48 states (the states for which this study collected data) in 2012 (Baker & Stone 2015). This level of use suggests that there are very few large refuges left in the country for bumble bees to access insecticide free forage – which is necessary to avoid the lethal, and sub-lethal effects of these toxic substances. As such neonicotinoid insecticides pose a direct threat to the continued existence of the bumble bee species included in this petition. Other insecticides, including new systemic insecticides, may also jeopardize these species. Standardized testing completed for registration demonstrates moderate to high toxicity for most insecticides to terrestrial insects. Still, significantly less data is available on sub-lethal effects and field realistic impacts.

ii. Fungicides

A growing body of research demonstrates how some fungicides, especially the multi-site contact activity fungicides like chlorothalonil and the ergosterol inhibiting fungicides (like tebuconazole) can harm bees, including bumble bees. McArt et al. (2017) found that fungicide usage was the strongest predictor of range contractions for four declining bumble bees and that one particular fungicide, chlorothalonil was more closely associated with prevalence of the pathogen *Nosema bombi*--an infection that was about twenty times higher in declining versus stable bumble bee species. Bernauer et al. (2015) found that bumble bees exposed to chlorothalonil produced fewer workers, lower total bee biomass, and had lighter mother queens than control colonies. Sprayberry et al. (2013) determined that the presence of the fungicide product Manzate (active ingredient mancozeb) decreased bumble bees' ability to locate food within a maze. Bartlewicz et al. (2016) document negative impacts of fungicides on microflora, particularly yeasts, in nectar, that could affect pollinator gut microbiota. As in humans, gut microbial communities affect nutritional health, development, detoxification abilities, and parasite susceptibility (Kwong and Moran 2016; Schwarz et al. 2016). A review of research into the combined effects of pesticides on honey bees found ergosterol inhibiting fungicides significantly contribute to the spread and abundance of honey bee pathogens and parasites (Sánchez -Bayo et al. 2016). The authors also stated that these same concerns are likely to exist for bumble bees and many other wild insects. Contrary to the above mentioned studies, one literature review suggests that most active ingredients in fungicides are compatible with commercial bumble bees (Mommaerts & Smagghe 2011).

In summary, the evidence presented above shows clearly that 1) pesticides, particularly nitroguanidine neonicotinoid insecticides, are highly toxic to bumble bees and exhibit both lethal and sub-lethal effects on bumble bee populations; and 2) the use of pesticides is widespread and pervasive throughout the range of all of the species listed in this petition; As such, pesticides pose a direct threat to the continued existence of each species included in this petition.

2. Population Dynamics and Structure

Bumble bees may be more vulnerable to extinction than other species due to their unique system of reproduction (haplodiploidy with single locus complementary sex determination) (Zayed and Packer 2005; reviewed in Zayed 2009). Therefore, reduced genetic diversity resulting from any of the threats summarized in this petition can be particularly concerning for bumble bees since genetic diversity already tends to be low in this group due to the colonial life cycle (i.e., even large numbers of bumble bees may represent only one or a few queens) (Goulson 2010; Hatfield et al. 2012; but see Cameron et al. 2011a and Lozier et al. 2011). Since the bumble bees listed in this petition have undergone dramatic declines in range and relative abundance (Kevan 2008; Hatfield et al. 2015a; 2015c; unpublished data).), genetic factors (including reduced genetic diversity, inbreeding depression, and the method of sex determination utilized by bumble bees) are likely among the most significant threats to the long-term survival of these species (reviewed in Zayed 2009).

i. Impacts of Genetic Factors on Bumble Bees

Recent research indicates that populations of the declining western bumble bee (*Bombus occidentalis*) have lower genetic diversity compared to populations of co-occurring stable species (Cameron et al. 2011a; Lozier et al. 2011). It is reasonable to expect that the other three species of bumble bees in this petition may have suffered a similar loss of genetic diversity and increase in population structure, although this has not been examined directly.

Loss of genetic diversity, which is frequently the result of inbreeding or random drift, can pose significant threats to small, isolated populations of bumble bees (Whitehorn et al. 2009). A loss of genetic diversity limits the ability of a population to adapt and reproduce when the environment changes and can lead to an increased susceptibility to pathogens (Altizer et al. 2003).

Bumble bees have a single locus complementary sex determination system, meaning that the gender of an individual bee is determined by the number of unique alleles at the sex-determining locus (van Wilgenburg et al. 2006). Normally this gender determination comes through a haplodiploid genetic structure in which female bees are diploids and are produced from fertilized eggs with two different copies of an allele at the sex-determining locus. Most male bees are haploid, and they are produced from unfertilized eggs (with only a single copy of an allele at the sex-determining locus). However, when closely related bumble bees mate, the offspring can have two copies of the exact same allele (or be homozygous) at the sex-determining locus, which causes a diploid male to be produced instead of a diploid female. These diploid males may have reduced viability or may be sterile (van Wilgenburg et al. 2006). When diploid males are able to mate, they produce sterile triploid offspring, which has been found to be negatively correlated with surrogates of bumble bee population size (Darvill et al. 2012). Diploid males are produced at the expense of female workers and new queens, and the production of diploid males can reduce colony fitness (including slower growth rates, lower survival, and colonies that produce fewer offspring) in bumble bees (Whitehorn et al. 2009). Diploid male production in inbred populations can substantially increase the risk of extinction in bumble bee populations compared to other animal taxa (Zayed & Packer 2005).

Inbreeding and loss of genetic diversity can also increase parasite prevalence in populations and parasite susceptibility in individuals (Frankham et al. 2010 *in* Whitehorn et al. 2011). Populations of bumble bees with low genetic diversity have been found to have a higher prevalence of pathogens (Cameron et al. 2011a; Whitehorn et al. 2011; 2014), suggesting that as populations lose genetic diversity, the impact of parasitism will increase and threatened populations will become more prone to extinction.

In summary, the unique method of sex determination, along with the fact that small populations have lower genetic diversity make bumble bees highly susceptible to extinction and thus a rapid extinction vortex that is not experienced in other animals (Zayed & Packer 2005). As such, bumble bees are perhaps more at-risk of extinction than non-haplodiploid animals of similar population size and the threshold for action should necessarily be more conservative.

3. Global Climate Change

Climate change may pose a significant threat to the continued survival of the bumble bees listed in this petition. Changes to the climate that are expected to have the most significant effects on bumble bee populations include: increased temperature and precipitation, increased drought, increased variability in temperature and precipitation extremes, early snow melt, and late frost events. These changes may lead to increased pathogen pressure, decreased resource availability (both floral resources and hibernacula), and a decrease in nesting habitat availability due to changes in rodent abundance or distribution (Cameron et al. 2011b).

Variability in climate can lead to phenological asynchrony between bumble bees and the plants they use (Memmott et al. 2007; Thomson 2010). There is evidence of mismatch between early blooming plants and their bumble bee pollinators (Kudo et al. 2004). Early spring is a critical time for bumble bees since that is the time when the foundresses emerge from hibernation and initiate nests. Since bumble bees are generalist foragers, they do not require synchrony with a specific plant, but asynchrony could lead to diminished resource availability at times that are critical to bumble bee colony success. For example, as the climate in the Rocky Mountains has become warmer and drier in the past 30 years, researchers have observed a mid-season period of low floral resources, a change which can negatively impact pollinators (Aldridge et al. 2011). Furthermore, changes in the distributions of plants visited by bumble bees have been correlated with a changing climate (Inouye 2008; Forrest et al. 2010). There is further evidence that this shift in climate has led to altered bumble bee morphology by reducing the tongue length of bumble bees in response to the changed availability of food plants (Miller-Struttmann et al. 2015). The effects of this shift on bumble bee populations, or native plant populations – which have not experienced a concordant shift in morphology (Miller-Struttmann et al. 2015) – needs further investigation. However, if long-tongued bumble bees like the American bumble bee (*Bombus pensylvanicus*, which occurs in California) are getting shorter tongues, this will lead to increased competition with shorter tongued bees (like *B. occidentalis occidentalis* and *B. crotchii*—included in this petition) for food plants as there will be greater niche overlap.

In modeling studies, Kirilenko and Hanley (2007a; 2007b) predict that the ranges of three bumble bee species will change in size and shift in response to predicted changes in the North American climate. In a more recent study Kerr et al. (2015) found that as the climate warms in North America that the southern range of bumble bees is contracting, while at the same time there is no evidence that populations are moving northward. The reason that bumble bees are not responding to this climactic cue by moving northward is unknown, but has dramatic implications for bumble bees; it suggests that range contraction from the south is a severe threat to the continued existence of North America's bumble bees. Other research in Europe has suggested that bumble bees are particularly susceptible to heat waves, and other effects of a changing climate (Rasmont & Iserbyt 2012). In California, increasing aridity may be particularly detrimental for *B. franklini* since this species has a very narrow climatic specialization compared to most bumble bees (NatureServe 2017a).

Climate change can also affect the quality of nectar produced by flowers. Pumpkin flowers grown under experimental conditions mimicking predicted climate futures were altered in attractiveness and nutritional quality (Hoover et al. 2012). Bumble bees foraging on these plants suffered a 22% reduction in survival. Although this study was based on predicted future conditions, similar effects may be occurring presently at levels that are undetected but may still affect bumble bee populations.

In summary, there is evidence that a shifting climate is 1) altering the timing of food plant availability for bumble bees; 2) changing the morphology of bumble bee mouth parts in response to food-plant availability; 3) reducing the habitable area of bumble bees in the southern portion of their ranges without a concordant range expansion to the north; and 4) altering the quality of food plants. Each of these landscape scale factors threaten the four bumble bee species included in this petition.

4. Loss of Host Species - Co-Extinction

One species included in this petition is in the subgenus *Psithyrus* (cuckoo bumble bees - Suckley cuckoo bumble bee [*Bombus suckleyi*]), which means that it is dependent on a bumble bee host species for its life-cycle; thus the disappearance, or increasing rarity of that host would represent a threat to species existence. This relationship was recently examined by Suhonen et al. (2015), who found that cuckoo bumble bees were more vulnerable to extinction than their host species. Unsurprisingly, the conclusions of this research were that the conservation of the host species for these animals was essential to the short and long-term persistence of cuckoo bumble bees (Suhonen et al. 2015).

The cuckoo bumble bee included in this petition is dependent on bumble bees that have recently documented range declines. *B. suckleyi* uses *B. occidentalis occidentalis* and the yellow banded bumble bee (*B. terricola*) as hosts (Williams et al. 2014) - both of which have been identified as in decline by recent research (Evans et al. 2008; Cameron et al. 2011b; Hatfield et al. unpublished data). The continued decline of the host species is a severe and permanent threat to the continued existence of this cuckoo bumble bee. The host species (*B. o. occidentalis*) mentioned above is included in this petition to be listed as an endangered species.

VI. DEGREE AND IMMEDIACY OF THREAT

Bumble bees, as a whole, are threatened by a number of factors discussed above in section V, including agricultural intensification, habitat loss and degradation, pesticide use, pathogens from managed pollinators, competition with non-native bees, climate change, genetic factors, and loss of host species (reviewed *in* Goulson 2010; Williams et al. 2009; Williams and Osborne 2009; Cameron et al. 2011b; Hatfield et al. 2012; Fürst et al. 2014). The magnitude of loss and rate of decline that each of these species have experienced is outlined above in section II. Current regulations and regulatory mechanisms are inadequate to protect these species of bumble bees against the threats they face within California. Without protective measures, *Bombus crotchii*, *B. franklini*, *B. suckleyi*, and *B. occidentalis occidentalis* are likely to go extinct in California.

VII. IMPACT OF EXISTING MANAGEMENT EFFORTS

Currently none of the four species included in this petition receive substantive protection under federal law or California state law. None have legal protection under the U.S. Endangered Species Act. No known specific management actions, recovery plans, or research in the state of California have been implemented for any of these species. California Department of Fish and Wildlife lists all four bumble bees included in this petition on their "Special Animals List". In addition, *Bombus occidentalis* is listed as a "Sensitive Species" by the US Forest Service in California (USFS 2013); thus the Forest Service will consider this species when implementing any management actions proposed in the forests where this species occurs.

Below, we list the known candidate status or special status, if any, for each species.

Crotch Bumble Bee (*Bombus crotchii*)
Bombus crotchii is on the "Special Animals List" of the California Department of Fish and Wildlife (CDFW 2017) and is listed as Endangered by the IUCN Red List of endangered species (Hatfield et al. 2015a). The species has a NatureServe Global Status rank of G3G4 (Vulnerable/Apparently Secure) and a state rank of S1S2 in California (NatureServe 2017a). Although *B. crotchii* is widely recognized as a vulnerable species, it receives no formal or informal protection.

Franklin's bumble bee (*Bombus franklini*)
Until 1996, the U.S. Fish and Wildlife Service classed *Bombus franklini* as a "Category 2" Candidate Species which indicates that listing may be warranted, but not enough information was known to federally list the species. This status was based on the recognition of the narrow endemism of the species and the lack of knowledge on the specific biological characteristics, habitat requirements, potential threats to its existence, and other critical parameters that affect the persistence and viability of its populations. In 2010, this species was petitioned for endangered species status, has received a positive 90-day finding, and is currently the focus of a Species Status Assessment by USFWS to determine if the species warrants ESA listing (USFWS 2011).

B. franklini is included on the California Department of Fish and Wildlife "Special Animals List" (CDFW 2017). The species has a NatureServe Global Status rank of G1 (Critically Imperiled), and has a state rank of S1 (Critically Imperiled) in both Oregon and California (NatureServe 2017b). It is listed as Critically Endangered on the IUCN Red List (Kevan 2008) and critically imperiled on the *Red List of Pollinator Insects of North America*, produced by the Xerces Society for Invertebrate Conservation (Thorp 2005c). Although *B. franklini* is widely recognized as a vulnerable species, it receives no formal or informal protection.

Western bumble bee (*Bombus occidentalis occidentalis*)

Bombus occidentalis occidentalis is on the "Special Animal List" of the California Department of Fish and Wildlife (CDFW 2017) and is listed as a "Sensitive Species" by the US Forest Service in California, where it has been documented on the following National Forests: Eldorado, Klamath, Lassen, Modoc, Plumas, Shasta-Trinity, Six Rivers, Tahoe, and Lake Tahoe (USFS 2013). The subspecies has a NatureServe Global Status rank of G4T1T3 (Apparently Secure/"T1T3 is assigned because the subspecies has almost certainly declined by more than 95% since 1998 and is not secure") and SNR (Unranked) in California (NatureServe 2017c); the parent species *B. occidentalis* is ranked S1 (Critically Imperiled) in California (NatureServe 2017d). An IUCN Red List category has not yet been formally assigned for the southern subspecies of the western bumble bee (*B. occidentalis occidentalis*), but the full species (*B. occidentalis*) is listed as Vulnerable to extinction on the IUCN Red List (Hatfield et al. 2015b), and an analysis of changes in range and relative abundance of *B. o. occidentalis* suggest that the species would meet the criteria of Endangered on the IUCN Red List (Hatfield et al., unpublished data). The parent species *B. occidentalis* has been petitioned for endangered species status, has received a positive 90-day finding, and is currently the focus of a Species Status Assessment by the USFWS to determine if the species warrants ESA listing (USFWS 2016). Though this species receives no formal protection, any conservation or management actions implemented due to its "Sensitive Species" status on National Forests in California may provide some benefit to this species.

Suckley bumble bee (*Bombus suckleyi*)

Bombus suckleyi is on the "Special Animal List" of the California Department of Fish and Wildlife (CDFW 2017) and was listed as Critically Endangered by the IUCN Red List of endangered species (Hatfield et al. 2015c). The species has a NatureServe Global Status rank of G1G3 (Critically Imperiled/Vulnerable; the rank changed from GU to "G1G3?" to highlight the recognized major decline but uncertainty about its status in the most northern section of its range) and a state rank of S1 (Critically Imperiled) in California (NatureServe 2017e).

Restoration of Bee Habitat in California

Currently, extensive efforts exist to restore habitat for pollinators near insect-pollinated crops in California, especially in the agriculturally intensive Central Valley. These efforts have the potential to provide resources that will benefit the petitioned bumble bee species – especially *B. crotchii* and *B. occidentalis occidentalis,* which occur or historically occurred in parts of the Central Valley. The petitioners recommend that, should these bumble bees be protected under

California's Endangered Species Act, this listing should not hinder efforts to restore bee habitat. As such, a programmatic Safe Harbor agreement should be developed between CDFW and the NRCS, so that private landowners enrolled in Farm Bill incentive programs will not be discouraged from restoring pollinator habitat by fears that they may attract an endangered species to their property.

VIII. SUGGESTIONS FOR FUTURE MANAGEMENT

To prevent extinction in California of each of the four species of bumble bees listed in this petition, all extant populations of each species need to be identified and their habitat should be protected and managed to benefit the species. Surveys throughout the historic ranges of each species are recommended in order to accomplish this. To rebuild populations of *Bombus crotchii*, *B. franklini*, *B. suckleyi*, and *B. occidentalis occidentalis*, habitat should be restored within their historic ranges, prioritizing habitat closest to extant populations of each species. These efforts will be most effective if both public land managers and private landowners engage in habitat restoration and species recovery efforts.

The following general guidelines include management practices that will maintain and restore habitat for *B. crotchii*, *B. franklini*, *B. suckleyi*, and *B. o. occidentalis*:

General Guidelines for Bumble Bees

Due to the inherent vulnerability of many bumble bee species and importance of supporting wild bee populations for pollination services, the following general conservation practices are recommended:

1. Identify, protect, enhance, and restore natural high-quality habitats to include suitable forage, nesting and overwintering sites.
2. Promote farming practices that increase of nitrogen-fixing fallow (legumes) and other pollinator-friendly plants along field margins.
3. Restrict pesticide use on or near each species' habitat, particularly while treated plants are in flower.
4. Minimize exposure of wild bees to diseases transferred from managed bees.
5. Avoid honey bee introduction to high-quality native bee habitat.

Creating High-Quality Habitat

There are three things that bumble bees need in the landscape to thrive: flowers on which to forage, somewhere to nest, and a place to overwinter. Each of these habitat requirements is vital for different phases of the bees' annual life cycle.

Pollen and Nectar Sources

Bumble bees need a rich supply of flowers during the entirety of the colony's life. Bumble bees are generalist foragers and will gather pollen and nectar from a variety of flowering plants. However, individual bumble bees do show high fidelity to particular flowers within a bloom period. The flight season of different species varies, but generally queens emerge in the late winter or early spring and the colony continues through to late summer or early fall. This requirement makes bumble bees sensitive to differing management practices throughout the course of the year. Monoculture crops, grazing, mowing, and weed control can interfere with the long-term health of bumble bee populations.

Careful selection of plants that are beneficial to bumble bees is essential to creating valuable habitat. Native plants are an excellent choice to provide nectar and pollen sources. They provide several benefits:

- Bumble bees coevolved with native plants and therefore know how to use them as a resource.
- Once established, native plants typically need less maintenance (less water, reduced use of fertilizers and pesticides).
- Native plants usually do not spread to become weedy species in natural areas.

Nesting and Overwintering Habitat

Most bumble bees nest underground, often in abandoned holes made by rodents, or occasionally abandoned bird nests (Osborne et al. 2008). Some species do nest on the surface of the ground (in grass tussocks) or in empty cavities (hollow logs, dead trees, under rocks, etc.). Queens most likely overwinter in small cavities just below or on the ground surface. While there is still much to be learned about the nesting and overwintering biology of bumble bees, it is clear that any near-surface or subsurface disturbance of the ground is likely disastrous for bumble bee colonies or overwintering queens. This includes mowing, fire, tilling, grazing, and planting. Protecting areas of land from such practices is essential for sustaining bumble bee populations. Since bumble bees usually nest in abandoned rodent nests, it is also important to retain landscape features that will support rodent populations (McFrederick and LeBuhn 2006).

Restoring and Managing Habitat

The following management recommendations are designed to be synchronous with the bumble bee life cycle and minimize risks to colonies, while maintaining flower-rich foraging areas and secure nest sites. Mowing, fire, and grazing are all widely used and valuable tools for maintaining the open, meadow-like conditions that bumble bees prefer. However, if done inappropriately (such as too frequently, or over too wide of an area), these activities can also remove too many floral resources and destroy nesting habitat for bumble bees, as well as harm butterflies, moths, and other invertebrates whose life cycles depend on the plants being disturbed (Mäder et al. 2011). Two key principals that apply irrespective of which management action is being employed include: do not treat the entire site at one time and when a treatment is being applied, do not treat more than one third of the site per year.

Mowing

Grassy areas such as meadows, forest edges, hedgerows, and lawns may all be subject to mowing. Research in Britain has shown that unmanaged meadows and garden areas with a high proportion of grass and different layers of habitat have the highest diversity of bumble bees (*in* Mäder et al. 2011), and that mowed sites have significantly fewer bumble bee nests (Potts et al. 2009). When mowing is a necessary management action, the following guidelines may be adopted:

- Leave one or more patches—as large as possible—of meadow, lawn, or edge habitat unmowed for the entire year.
- If you need to mow during the flight season (March-September), try to create a mosaic of patches with structurally different vegetation.
- Mow at the highest cutting height possible to prevent disturbance of established nests or overwintering queens. A minimum of 12-16 inches is ideal.

Fire is an important management tool for many meadows or open habitats, but requires care to avoid disturbance to plant and animal populations. The following recommendations will maximize the benefit to bumble bees.

- Only burn a specific area once every 3-6 years.
- Burn from October through February.
- Burn small sections at a time.
- No more than one third of the land area should be burned each year.
- If possible mow fire breaks that will result in patches of unburned or lightly burned areas to serve as refuge for animals within the burn area.
- Avoid high intensity fires.

Grazing

A common practice in natural areas and agricultural landscapes, grazing has been shown to have dramatic effects on the structure, diversity, and growth habits of plants. When carefully applied, grazing can be beneficial for limiting shrub and tree succession, encouraging the growth of nectar rich plants, and providing the structural diversity that creates nesting habitat. However, grazing animals have the potential to remove flowering resources, as well as trample nesting and overwintering sites—and in turn harm the animal communities that depend on them (Black et al. 2011).

Grazing is usually only beneficial to bumble bees at low to moderate levels and when the site is grazed for a short period followed by ample recovery time. We make the following general recommendations, but stress the importance of assessing local and historical conditions before implementing a plan.

- Grazing management strategies should be completed according to the characteristics of the site and the animals being used.

- Grazing on a site should occur for a short period of time, giving an extended period for recovery.
- Grazing should only occur on approximately one third of the property each year.
- Establish exclosures and rotate grazing to allow recovery of the vegetation community.

Tillage

Any surface or subsurface disturbance can be harmful to bumble bee colonies. In order to ensure the long-term health of bumble bee populations at least some areas under management must remain permanently free of tillage. These areas could be fence margins, hedgerows, debris piles, ditches, compost heaps, etc. Nesting surveys in Britain showed that gardens and linear features like hedgerows (i.e., places free from tillage) provided important bumble bee nesting habitat (Osborne et al. 2008).

Using Pesticides

Decision-making systems such as Integrated Pest Management can be important for developing less toxic responses to pests, and ensure that actual pest damage is taking place before chemicals are used. It is important to note that it is not just cropland and rangeland that experience high use and concentrations of pesticides. Surveys of urban streams suggest heavy use of pesticides in urban and suburban areas (USGS 2014). Also, for some pesticides allowable application rates are higher for home use relative to their agricultural counterparts (Hopwood et al. 2016).

For situations when pesticides must be used (e.g. an economic or public health pest having reached an established threshold), the following recommendations will reduce harm to these bumble bee species:

- Follow the manufacturer's directions.
- Choose the least toxic option:
    - ➢ Avoid dusts and microencapsulated products
- Use the lowest effective application rate.
- Apply the pesticide as directly and locally as possible.
- Apply when bumble bees are not active (keeping in mind that bumble bees can fly at cold temperatures, and are often active in the early morning and early spring):
    - ➢ Late fall or winter.
    - ➢ At dusk or at night (if the pesticide is short lived).
- Do not spray or allow drift to move onto field margins or boundaries.
- Do not apply pesticides when plants are in bloom.
- Reduce spray drift:
    - ➢ Avoid aerial spraying and mist blowers.
    - ➢ Spray on calm days (winds between 2 and 9 mph) to minimize spray drift from

targeted applications.
- Avoid the use of systemic insecticides, such as neonicotinoids.

Commercial Use of Bumble Bees

Increasingly, as the cost of honey bee rental increases and the benefits of bumble bees as pollinators are realized, bumble bees are being shipped throughout the world for pollination of greenhouse and field crops. Pathogens harbored by commercially reared bumble bees have been implicated in the decline of multiple species of North American bumble bees, including two species included in this petition (*Bombus occidentalis occidentalis* and *B. franklini*). Currently, there is only one species of bumble bee being used for managed pollination, the common eastern bumble bee, which is native to the eastern U.S., but used in California for pollination of greenhouse crops. Should the common eastern bumble bee escape greenhouses and establish in the wild, as it has in southern B.C., it may spread pathogens to wild bumble bees, or outcompete native species for nest sites or floral resources (Whittington et al. 2004; Colla et al. 2006). In addition, commercial bumble bee producers are actively developing species that could be used for open-field pollination in California (Biobest 2018a; 2018b; APHIS 2014), and should that occur, these commercial bumble bees may pose a considerable risk to the four species of bumble bees listed in this petition.

Any use of commercially reared bumble bees for crop pollination should focus on minimizing the exposure of wild native species to managed species.
- Do not allow commercial bumble bees to be used outside of the native range of the species; if native bumble bees are allowed, ensure that they are produced within their native ranges.
- Only use commercial bumble bees in greenhouses; do not use them for open-field crops.
- Screens should be placed over window, vents, and other openings in greenhouses to prevent commercial bumble bees from escaping and interacting with wild bumble bees.
- Commercially acquired colonies should be killed (for example, by being placed in a freezer overnight) after their period of use and NOT released into the wild.

Honey Bees

Honey bees may pose a significant threat to at-risk bumble bees in this petition through competition for floral resources and spread of pathogens (Mallinger et al. 2017). Significantly, honey bees have been shown to extract vast quantities of pollen from the environment; an averaged sized apiary (40 hives) effectively removes nutritional resources that could have produced 4,000,000 wild bees over the course of three months (Cane & Tepedino 2016).

Recommendations for Land Managers

Where local and federal laws permit the placement of honey bees, and managers are deciding whether to include hives on their land, we suggest that managers consider the following potential impacts of honey bees.

Are populations of endangered or threatened pollinators present on the land?

- If rare species of bees and butterflies, including threatened or endangered species, are known to exist within the flight area where the hives are to be placed, assessment of potential risks to these populations should be undertaken.
- If it is possible that rare or declining pollinator species can be found in the area, efforts should be made to determine if they are present. Consulting scientists with expertise in pollinator surveys and species identification is recommended. In cases where a particular pollinator species is critically imperiled, every remaining population and individual may be essential to the species' immediate and long-term survival. There is potential that honey bees may transmit diseases to native bees (e.g., spread of deformed wing virus from honey bees to bumble bees causing wing damage) and may compete for floral resources (e.g. decreased fecundity in bumble bees).
- We recommend that land managers discourage the placement of honey bee hives in natural areas, especially if populations of imperiled pollinators are present. Areas with diverse wildflowers are likely to also be hosts to diverse populations of native pollinators including imperiled bumble bees, and as such are not appropriate for honey bee apiaries; this is particularly true in protected areas (Geldmann & González-Varo 2018).
- If this recommendation cannot be followed, we recommend that honey bee hives be placed as far as practicable from areas receiving specialized management treatment for bumble bees.
    - Especially important will be to distance honey bee apiaries from potential bumble bee nesting sites, such as unmowed and untilled areas, old rock walls, fencerows or hedgerows, treed field margins, and hollow trees.
    - Where possible, distances greater than 2.4 miles (4 kilometers) will substantially reduce the competitive effects of managed hives on bumble bees (Cane & Tepedino 2016).

Are there invasive plant populations, or ongoing efforts to eradicate invasive plant species, that would be affected by the inclusion of honey bees?

- Honey bees may not be compatible with invasive plant species management. If honey bees pollinate and increase seed production of the invasive species in question (e.g., yellow star thistle), land managers may want to exclude honey bees during periods of bloom.

What are the potential impacts to other wildlife?

- Are there bears in the area that will be attracted to the apiary as a food source? Land managers need to work with beekeepers to determine if placement of an apiary will increase the potential for human–bear conflicts. If this is a risk, then electric fencing and maintenance of that fencing to prevent intrusion from bear should be mandated on public lands to avoid bear damage to apiaries and to prevent habituation of bears to hives.

Is there sufficient infrastructure to support the drop-off and storing of the proposed operation?

- Commercial beekeepers may bring anywhere between 4 and 400 hives, depending upon the size of the operation. Hives are delivered using a range of vehicles from flatbed trucks to semi-tractor trailers. Access roads must be appropriate for the required transport, and should not result in excess erosion, road damage, or other infrastructure challenges.
- Apiary sites also must be of sufficient size, with level and firm ground to accommodate small forklifts or bobcats used to move pallets of bees. An apiary location will also need sufficient space for trucks to turn around.

Inventory, Research & Management Needs

Inventory, research, and management needs for each species listed in this petition are outlined below:

Crotch Bumble Bee (Bombus crotchii)

Inventory needs: Once very common in central and southern California, *B. crotchii* has recently undergone a dramatic decline, and is no longer present across much of its historic range. In order to better understand this species' distribution, in order to conserve existing populations, comprehensive surveys of this species at historic sites and other locations within its historic range are needed.

Research needs: Research needs for North American bumble bees (as a whole) are summarized in Cameron et al. (2011a), the final report for the 2010 North American Bumble Bee Species Conservation Planning Workshop. More research is needed to understand basic life history of *B. crotchii*, including nesting preferences, overwintering needs, and important host plants in California.

Management needs: Known and potential sites should be protected from threats. In the Central Valley, known populations should be protected from insecticide use. Practices such as livestock grazing and other factors that may interfere with the habitat requirements of this species (availability of nectar and pollen throughout the colony season and availability of underground nest sites and hibernacula) should be minimized where this species is extant. Carefully consider the placement of non-native European honey bees in areas that may be occupied by *B. crotchii* (see Hatfield et al. 2016 for more detail).

Franklin's bumble bee (Bombus franklini)

Inventory needs: Comprehensive surveys in *B. franklini*'s historic range should continue (Dr.

Robbin Thorp conducts annual bumble bee surveys within the range of this species).

Research needs: Research to address critical conservation questions for this species has been hindered by the fact that this bee may be extinct – it has not been observed since 2006 despite extensive annual surveys throughout its historic range. Should an extant population of *B. franklini* be discovered, more research would be recommended to gain a better understanding of the species' ecology, biology, and habitat requirements, especially any that might be limiting factors. Additionally, studying the pathology, control, and cross-infectivity of different suspected disease agents of *B. franklini*, including *Nosema bombi, Locustacarus buchneri, and Crithidia bombi* (Otterstatter et al. 2005; Colla et al. 2006) would allow for better understanding of the risks to the bumble bee populations and the preventative measures that should be taken.

Management needs: The habitat of *B. franklini* should be protected, including an abundance of suitable pollen and nectar sources such as, but not limited to: *Lupinus, Eschscholzia, Agastache, Monardella* as sources of pollen and nectar for the bees to feed on. Proximity to a natural source of fresh water would also be beneficial as it would increase the flowering season of the plants upon which the bees feed. Also, suitable nest sites are needed, such as abandoned rodent burrows.

Western bumble bee (Bombus occidentalis occidentalis)

Inventory needs: Once very common in the western United States and western Canada, *B. o. occidentalis* has recently undergone a dramatic decline in abundance and distribution, and is no longer present across the western portions of its historic range. In order to better understand the causes and extent of this species' decline, as well as the conservation needs of remaining populations, additional comprehensive surveys of this species at historic and potential sites are needed throughout California.

Research needs: Despite the widespread nature of this bumble bee, more research is needed to evaluate basic life history and ecological questions, including nesting preferences, overwintering needs, and important host plants in California.

Management needs: Protect known and potential sites from practices, such as livestock grazing, and threats such as conifer encroachment, that can interfere with the habitat requirements of this species (availability of nectar and pollen throughout the colony season and availability of underground nest sites and hibernacula). Carefully consider the placement of non-native European honey bees in areas that may be occupied by *B. o. occidentalis* (see Hatfield et al. 2016 for more detail).

Suckley bumble bee (Bombus suckleyi)

Research needs: *Bombus suckleyi* is a cuckoo bumble bee, dependent upon a bumble bee host species to complete its life-cycle; thus the disappearance, or increasing rarity of that host would represent a threat to species existence. *B. suckleyi* is dependent on bumble bees that have recently documented range declines. The continued decline of these host species are a severe and permanent threat to continued existence of these cuckoo bumble bees. Efforts to conserve their hosts should be prioritized. While this species has only been documented as reproducing in nests of *B. o. occidentalis* it has been observed in the nests of several other species. More research is needed to determine if *B. suckleyi* could use other species as a successful host would help to better understand this species ecology. Additional life history information would also help to better understand this species' biological needs. This includes important host plants, location and details of overwintering sites, and specific habitat associations.

Inventory needs: Records of this species in California have been quite rare in recent collections. This species would benefit from targeted or more general bumble bee surveys to better understand its distribution throughout the state.

Management needs: Protect known and potential sites from practices, such as livestock grazing, and threats such as conifer encroachment, that can interfere with the habitat requirements of this species and its host (availability of nectar and pollen throughout the colony season and availability of underground nest sites and hibernacula). Efforts to conserve hosts species should be prioritized.

IX. INADEQUACY OF EXISTING REGULATORY MECHANISMS

Current regulations and regulatory mechanisms are wholly inadequate to protect these four species of bumble bees against the immediate threats that they face, including pathogen infection from commercial bees and the use of pesticides such as systemic insecticides. As emerging infectious disease has been implicated as one of the main threats to bumble bees (Evans et al. 2008; Hatfield et al. 2015a; 2015b; 2015c; Goulson & Hughes 2015), and pesticides including systemic insecticides have also been implicated in bumble bee declines (Whitehorn et al. 2012; Gill & Raine 2014; Pisa et al. 2014; Goulson 2015; Rundlöf et al. 2015), existing regulations need to be strengthened in order to adequately protect imperiled bumble bees from threats that, if unaddressed, have the potential to drive these bumble bees to extinction. Inadequacy of regulations to protect bumble bees from these immediate threats are summarized below.

Disease

Due to the immediate and potentially catastrophic effect that emerging infectious disease can have on bumble bee populations, more careful screening for diseases in commercial bees, as well as better management strategies and policy are needed to protect native bees from the threat of pathogen spillover (Graystock et al. 2013b; Sachman-Ruiz et al. 2015). Since small, fragmented, and declining populations are especially susceptible to infectious disease (Fürst et al. 2014), and disease is already implicated as a likely causal factor of some native bee declines in North America (Cameron et al. 2011a), the emerging body of research summarized in Section V (Factors Affecting Ability to Survive and Reproduce) underscores the inadequacy of existing regulatory mechanisms to protect bumble bees from extinction.

The failing of current local and federal regulatory mechanisms is evidenced not just in their absence but in the continued decline of native bees across North America, including the western bumble bee, most likely caused by the spread of such pathogens that cause disease (Cameron et al. 2011a; Goulson & Hughes 2015). The emerging body of research linking decline of native bumble bees with the spread of pathogens underscores the inadequacy of existing regulatory mechanisms to protect bumble bees from extinction. Disease is a serious threat for bumble bees, as we explain above, because small, fragmented, and declining populations—which exist for all of the species included in this petition—are especially susceptible to infectious disease (Fürst et al. 2014).

Federal Regulations are Inadequate to Protect Wild California Bumble Bees

The Plant Protection Act

The Plant Protection Act (PPA) was passed in 2000 with the stated purpose of preventing the dissemination of plant pests. In order to control and prevent of the spread of plant pests for the protection of agriculture, the environment, and the U.S. economy, the PPA gives the Secretary of Agriculture the authority to facilitate “interstate commerce in agricultural products and other commodities that pose a risk of harboring plant pests or noxious weeds in ways that will reduce…the risk of dissemination of plant pests or noxious weeds. (7 USC § 7701(3))” The PPA authorizes the Secretary of Agriculture to promulgate regulations to prohibit or restrict the interstate movement of any plant pest if the Secretary determines the prohibition is necessary to prevent the dissemination of a plant pest within the U.S. The PPA broadly defines plant pests to include fungi, viruses, infectious agents and other pathogens, and any similar articles “that can directly or indirectly injure, cause damage to, or cause disease in any plant or plant product.” Articles such as pathogens and parasites that infect or attack bumble bees cause indirect injury to plants that rely on these bees for pollination.

Although the Act was intended to protect agricultural goods, it could potentially directly or indirectly help control the spread of bumble bee diseases and pathogens. However, it has not done so. Currently, the USDA does not regulate either the disease status or interstate movement of U.S. commercial bumble bees, despite repeated requests to use its authority under the PPA to do so (Xerces Society et al. 2010; Xerces Society et al. 2013, 2014a, 2014b). This lack of regulation is a fact reflected in the absence of bumble bees, or their pathogens, from the list of pests and diseases regulated by USDA APHIS (USDA 2018). There is no indication that this will change in the near future, and so the PPA, which provides for the facilitation of “interstate commerce in agricultural products," remains ineffective at slowing the spread of disease from commercial bumble bees to their native counterparts, including the bumble bees listed in this petition, and this inadequacy is reflected in the ongoing spread of disease from commercial to native bumble bees across the United States.

The USDA does regulate the international movement of Canadian bumble bees into the United States. Currently, the USDA allows the common eastern bumble bee (*Bombus impatiens*) and the western bumble bee (*Bombus occidentalis*) to be imported from Canada (7 CFR § 322.5). The USDA recently reviewed a request to allow Hunt's bumble bee (*B. huntii*) to also be imported into the U.S. from Canadian bumble bee production facilities (USDA 2014). The USDA regulations fail to protect the bumble bees included in this petition for two reasons: 1) Commercial colonies are not tested for pathogens upon importation (7 CFR § 322.5), and any pathogens present in commercial bumble bees could spread to bumble bees that visit the same flowers as commercial bumble bees (Graystock et al. 2015b); 2) Commercial bumble bees (*B. impatiens*) are produced both in Canada and the U.S., and colonies produced in the U.S. are also not required to be inspected for any pathogens.

The Honeybee Act

The Honeybee Act (7 USC 281) gives the Secretary of Agriculture the authority to regulate the interstate commerce of honey bees in order to control the spread of bee diseases: "The Secretary of Agriculture is authorized to prohibit or restrict the importation or entry of honeybees and honeybee semen into or through the United States in order to prevent the introduction and spread of diseases and parasites harmful to honeybees, the introduction of genetically undesirable germ plasm of honeybees, or the introduction and spread of undesirable species or subspecies of honeybees and the semen of honeybees." For example, the USDA uses its authority under the Honeybee Act to prevent movement of honey bees into Hawaii in order to control the spread of honey bee pests like the Varroa mite (summarized in Xerces Society et al. 2010). However, the Honey bee Act is specific to honey bees, and does not extend authority to the USDA to regulate diseases of managed bumble bees. Thus, the Honeybee Act fails to protect imperiled bumble bees from pathogens harbored by commercial bumble bees that are used throughout North America.

There is clear evidence that honey bees can transmit pathogens to bumble bees (Graystock et al. 2013a, 2013b; Graystock et al. 2015a, 2015b; Fürst et al. 2014; McMahon et al. 2015). However, any indirect protection of bumble bees flowing from regulation of honey bees under the Honeybee Act is limited in scope, and inadequate for protection. First, pathogens that impact the bumble bees may come from multiple sources beyond honey bees; second, the Honeybee Act does not apply to the movement of pollen for use by the commercial bumble bee trade (the risks of this practice are reviewed in Manley et al. 2015); and third, the laws seeking to prevent the spread of disease among honey bees suffer in their lack of uniformity and enforcement. State laws regulating interstate movement of honey bees vary considerably from state to state (Gegner 2003). For example, Massachusetts requires bees imported into the state to be certified disease free within 60 days (State of Massachusetts 2018), while Minnesota does not have any similar requirements, and only offers fee for service apiary inspections (State of Minnesota 2017). In addition, responsibility for disease control remains with the beekeeper, who should routinely examine colonies for disease as a regular part of his or her management program and do what is necessary when disease is found. Yet there are not clear regulations that determine how often hives should be screened, or for which pathogens. Significantly, there are not consistent, effective mitigative actions for beekeepers to employ upon disease discovery (Graystock et al. 2015a).

California State Regulations Governing Commercial Bumble Bees

The California Department of Food and Agriculture currently allows multiple species of managed, commercial bumble bees to be imported for commercial use in the state – the nonnative common eastern bumble bee (*B. impatiens*) for greenhouse use, and the native Hunt's bumble bee (*B. huntii*) and yellow faced bumble bee (*B. vosnesenskii*) for open field or greenhouse use. Although the Hunt's and yellow faced bumble bees are native to California, they are currently produced outside of their native ranges, in facilities that also rear common eastern bumble bees, and thus could be exposed to nonnative pathogens, which they then could spread to wild bumble bees, including the four bumble bees included in this petition. Thus, CDFA's regulations are currently inadequate to protect these for species of wild bumble bees from the threat they face from pathogen infection from managed bumble bees.

In addition, CDFA routinely allows honey bees to be imported into California for use in open field settings, where pathogens (in particular, RNA viruses) may spill over and infect wild bumble bees.

Although the state of California has passed regulations to protect bees (https://www.cdfa.ca.gov/plant/pollinators/docs/Regulations-for-Protection-of-Bees.pdf), these regulations only consider effects of pesticides on honey bees, and how to mitigate those effects, and thus are inadequate to protect these four species of wild bumble bees.

Pesticide Regulations

In June 2014, the US EPA published the *Guidance for Assessing Pesticide Risks to Bees* (U.S. EPA 2014). The guidelines provide recommendations to assist researchers in designing studies to evaluate the risks that pesticides pose to bees. Such studies are in turn used by the EPA to assess risk and determine appropriate regulation. This new guidance document could add new research to the current battery of tests required for pesticides. Still, it fails to address many concerns specific to bumble bees and other native bees. As such, pesticide risk assessments performed by the EPA could underestimate risk to bumble bees and other native bee species. For example, the guidelines state: “This section summarizes the overall risk assessment process for characterizing the risks of pesticides to honey bees (*Apis mellifera*), which are used as a surrogate species for other *Apis* and non-*Apis* bees and other insect pollinators.” (USEPA 2014). However, the differential physiological, biological and behavioral differences of honey bees from other native bees (Osborne 2012; Vaughan et al. 2014) make honey bees poor surrogates for assessing toxicity of pesticides to bumble bees. In particular, the life-history of many non-*Apis* species (including bumble bees) including nest site location, foraging time and distance, food sources, life-cycle, and size may expose bumble bees and other non-*Apis* bee species to alternative exposure routes not considered when tests are only applied to honey bees (Wisk et al. 2014). Furthermore, unlike honey bees, bumble bees do not process pollen or nectar before feeding it to immature bees, which exposes developing bumble bees to a greater concentration of pesticides than honey bees—whose larvae are fed primarily royal jelly (processed secretions from nurse bees), and perhaps a small amount of pollen and nectar (Fischer & Moriarty 2011). For example, bumble bees appear to be affected by dietary concentrations of the systemic insecticide imidacloprid at levels lower than honey bees, perhaps because, unlike honey bees, bumble bees do not metabolically degrade imidacloprid effectively while continuing to ingest it (Cresswell et al. 2014). This range of exposure routes was not considered during the EPA’s registration process for neonicotinoids (USEPA 2012). Thus, the current mechanism that regulates the safety of pesticides to bees fails to take into account attributes specific to bumble bees and is therefore inadequate to protect bumble bees from the threat of pesticides.

Further demonstrating how current federal pesticide regulation fails to address risks to bumble bees is underscored by the fact that the EPA has not adequately responded to the numerous bumble bee kills caused by on-label, legal uses of neonicotinoid insecticides to *Tilia* trees. Specifically, in most of these cases, large numbers of bumble bees were killed by the legal applications of neonicotinoid insecticides; in one case more than 50,000 bumble bees were killed in a single incident (Hilburn 2013). Since June of 2013, there have been numerous completed investigations into bumble bee kills that occurred in Oregon. Responding to the risks associated with two of the incidents, U.S. EPA halted foliar use of nitroguanidine neonicotinoids on non-agricultural plants (including *Tilia* trees) while plants are flowering (US EPA 2013). However, because neonicotinoid insecticides can remain in plant tissue for weeks to months, and in some cases even years (Mach et al 2017), this change in regulation remains inadequate to protect bumble bees from nitroguanidine neonicotinoids applied to bumble bee-attractive plants prior to flowering. No federal action has been taken in response to the risks demonstrated by five other bee-kill incidents in Oregon caused by non-foliar, systemic applications weeks to months prior to flowering. Of these five incidents, only one was linked with an off-label use. The state of Oregon did respond to this risk by halting all uses of nitroguanidine neonicotinoids to *Tilia* trees within the state of Oregon (ODA 2015). However, not all imperiled bumble bees listed in this petition have a range that includes the state of Oregon, and therefore are not protected by this state’s regulation. Even after the Oregon Department of Agriculture wrote to EPA to point out the inadequacy of the federal regulation, the EPA did not take action to protect bumble bees from long-term residues of systemic insecticides in woody plants such as *Tilia*.

An additional failure of the federal regulations to protect imperiled bumble bees from the threat of pesticides is that the U.S. EPA's Office of Pesticide Program conducts chemical-specific risk assessments for bees. Yet, research has begun to elucidate threats that pesticide mixtures pose to bees. While the majority of studies have been conducted on honey bees, these studies demonstrate an area of significant uncertainty that could lead to an underestimation of risk to other species of bees. For example, there can be different risks between active ingredients and full formulations (Mullin et al. 2015). There are also additive and synergistic effects between chemicals that might be found jointly in tank mixes or in the field. For example, research has raised concern for synergistic effects of the combination of ergosterol biosynthesis inhibiting fungicides and pyrethroids (Vandame and Belzunces 1998). Neonicotinoids are also known to be additively or synergistically toxic when they occur together (Andersch et al. 2010). The findings by Zhu et al. (2014) led the researchers to recommend that pesticide mixtures in pollen be evaluated by adding their toxicities together until complete data on interactions can be accumulated. Further, a recent study by Hladik et al. (2015) showed that within a single sample that non-*Apis* bees are exposed to mixtures of several pesticides, including neonicotinoids, pyrethroids, and fungicides. This provides clear evidence that native bees are exposed to multiple pesticides in their foraging bouts, yet, because of a lack of appropriate regulatory mechanisms and testing protocols, the EPA does not understand how exposure to multiple pesticides affects bumble bees – despite evidence that there are significant deleterious effects (See references above). Current EPA risk assessment regulations for pesticide effects on bees do not consider additive, or synergistic effects of pesticides, and are therefore inadequate to protect bumble bees from the threat of pesticides.

In summary, it is clear that 1) different species of bees have different responses to different insecticides; 2) current regulations for insecticide approval from the EPA only consider the effects of insecticides on honey bees – which are used as a surrogate for non-*Apis* bees; 3) the EPA has not adequately responded to a known and realized threat that nitroguanidine neonicotinoids applied to cosmetic plantings pose to bees; 4) EPA does not address the known synergistic and additive effect of multiple pesticides, despite evidence that bees are exposed to multiple chemicals in their foraging bouts. As such, current regulatory mechanisms and testing protocols for pesticides are inadequate to protect the four species of bumble bees in this petition from the widespread and prophylactic use of insecticides that are highly toxic to them.

X. AVAILABILITY AND SOURCES OF INFORMATION

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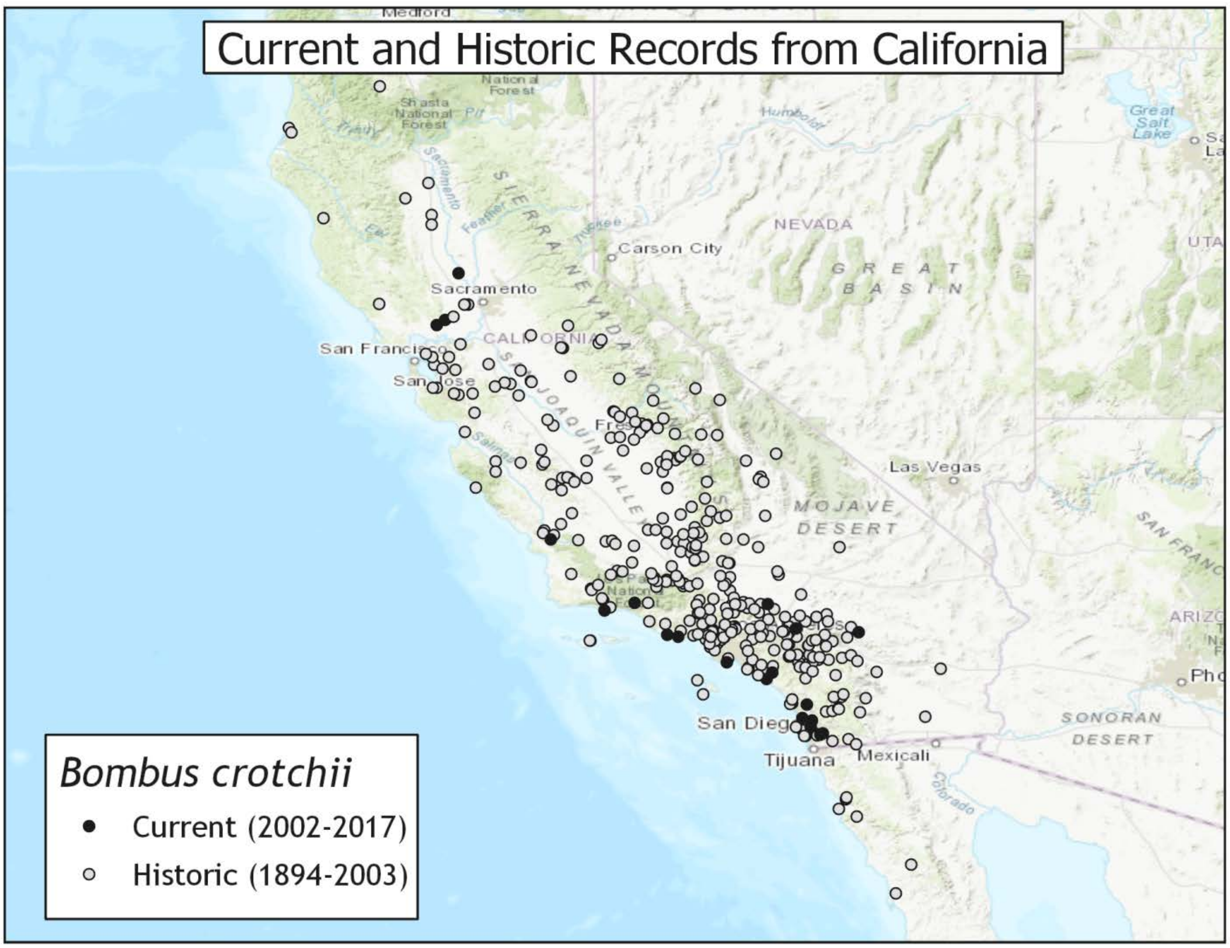
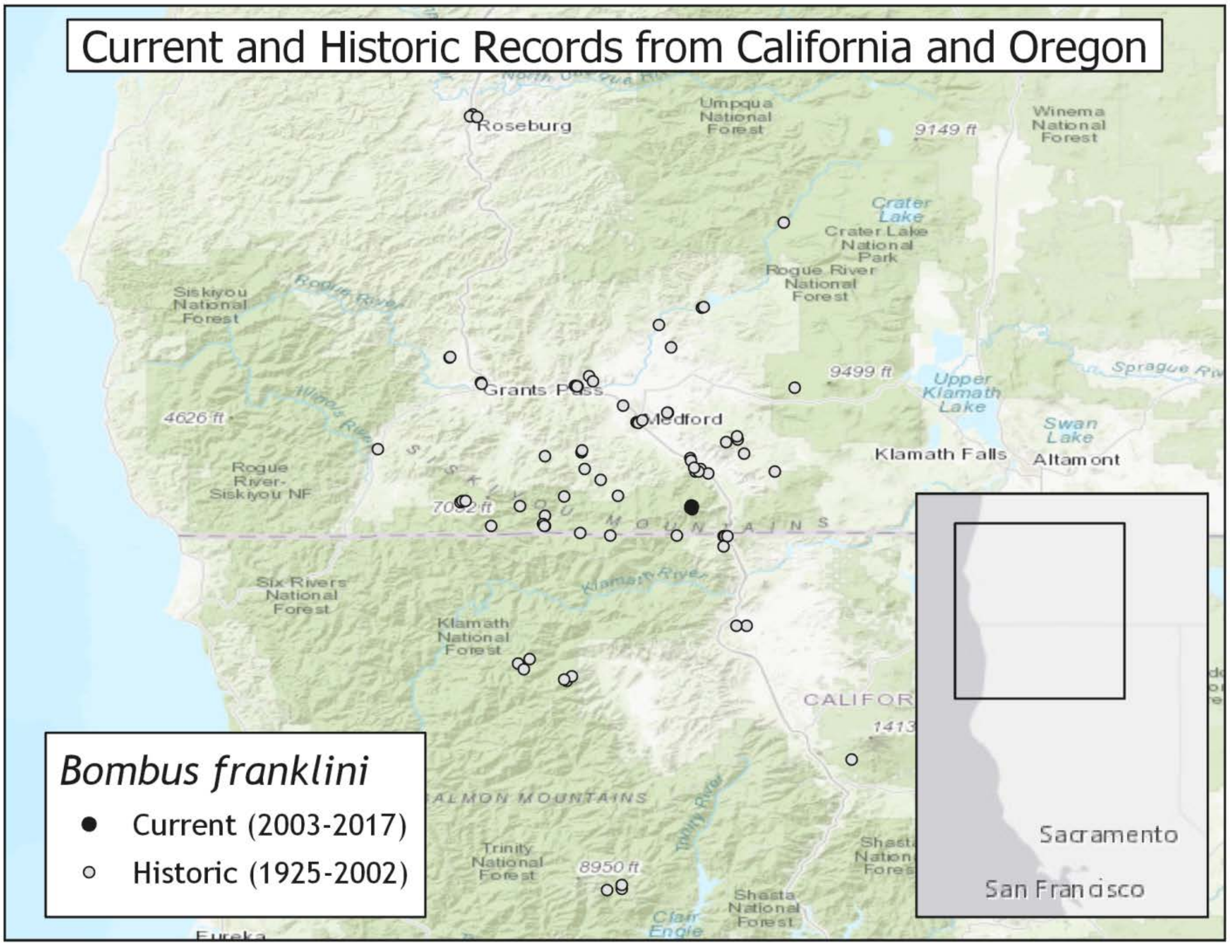
XI. DETAILED DISTRIBUTION MAPS

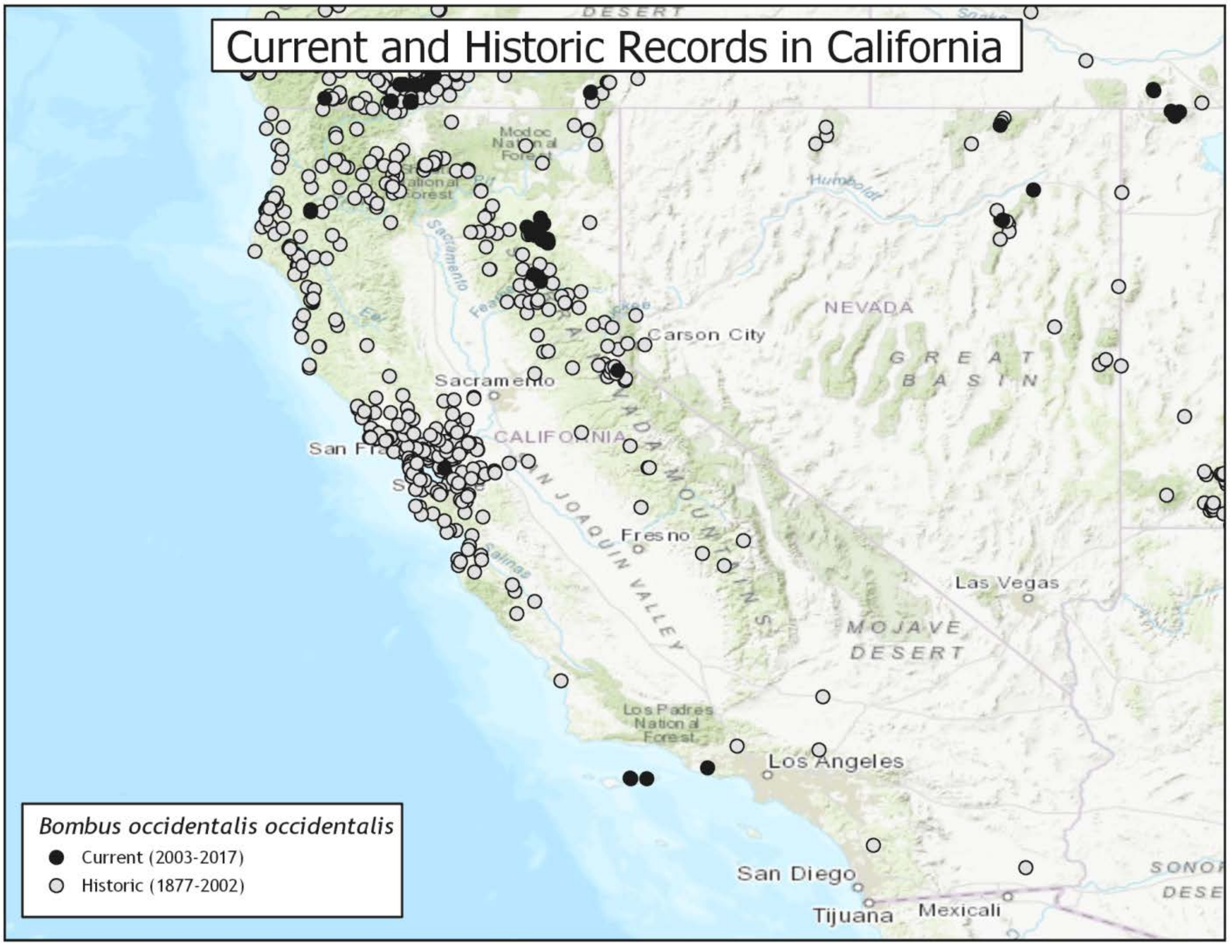
Crotch bumble bee (*Bombus crotchii*) Global Distribution



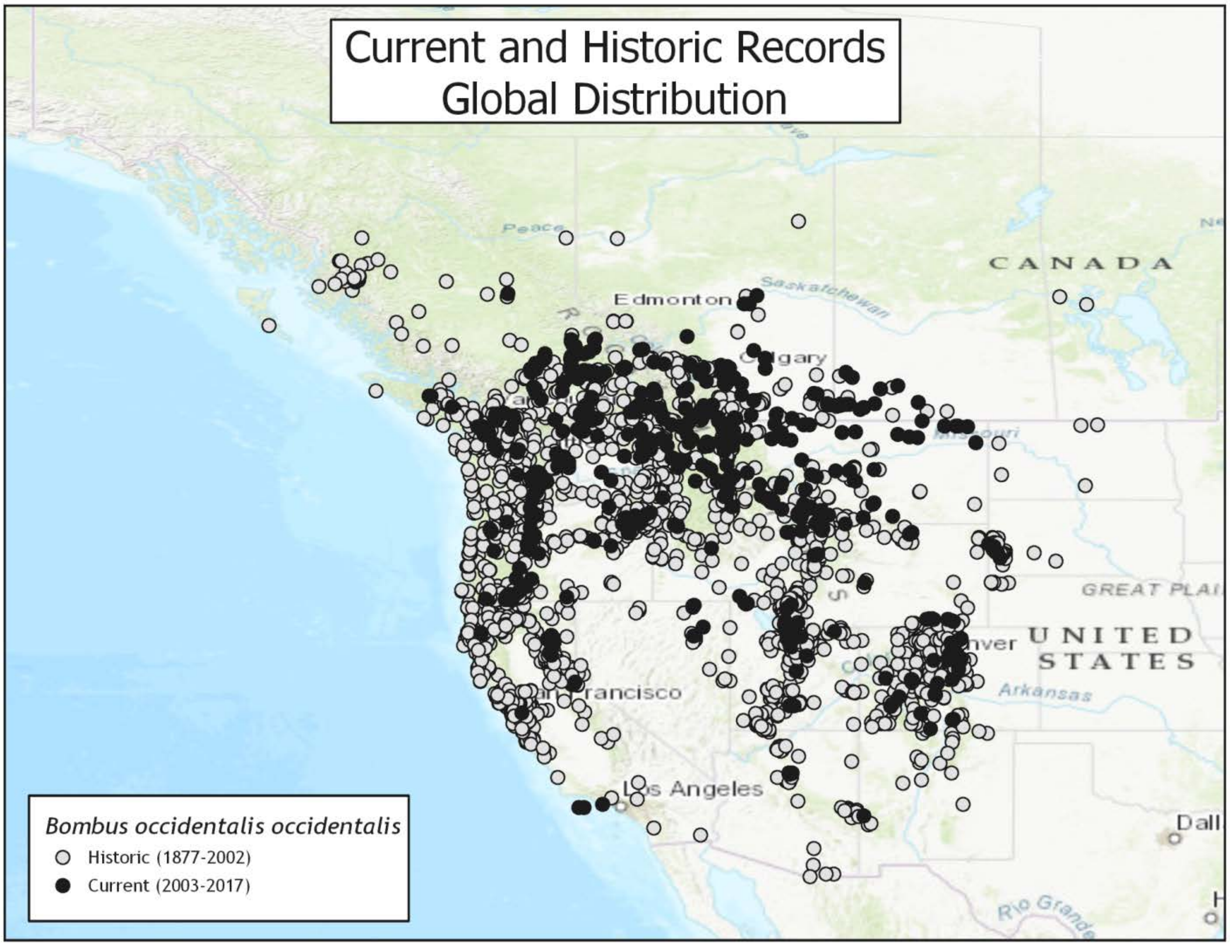
Franklin's bumble bee (*Bombus franklini*) Global Distribution



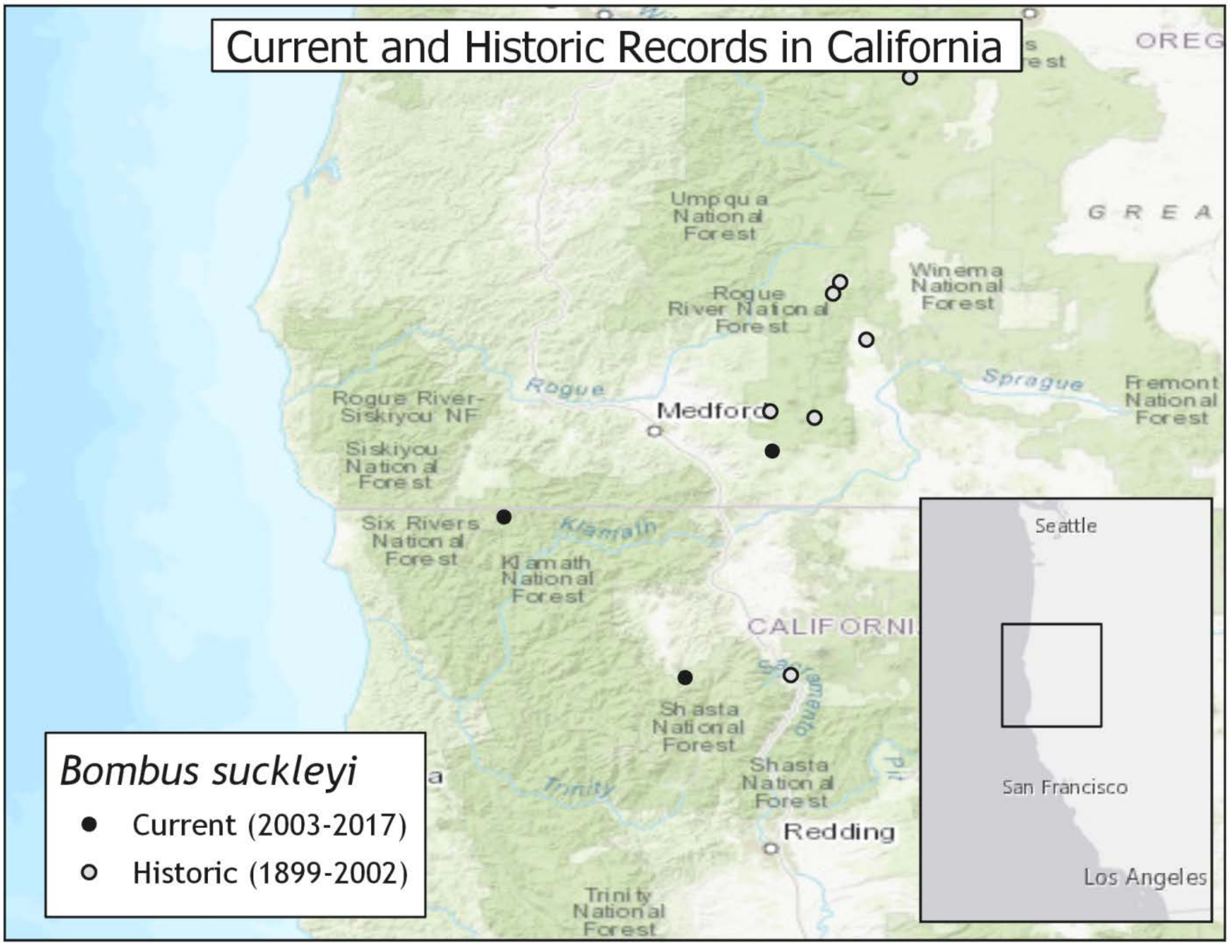
Western bumble bee (*Bombus occidentalis occidentalis*) California Distribution



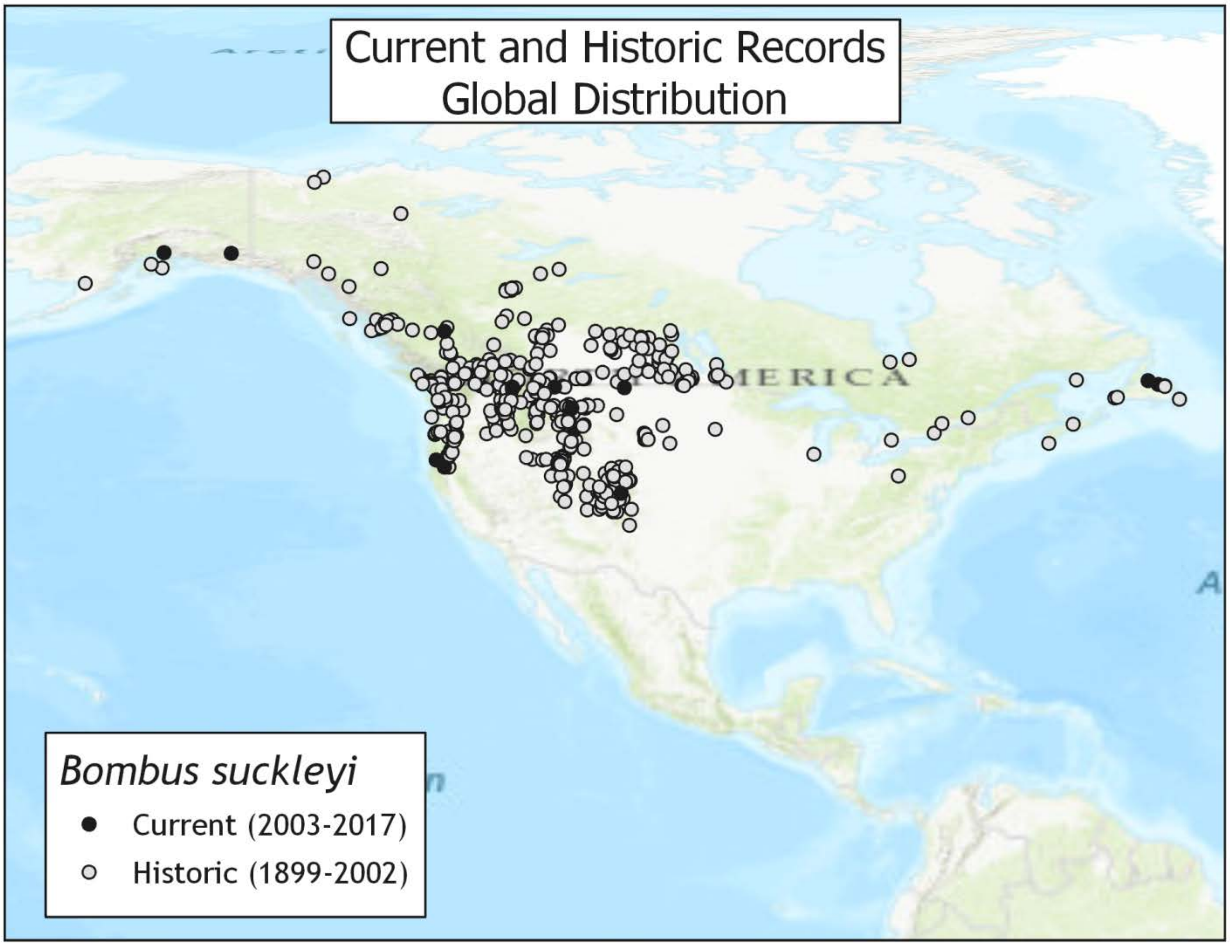
Western bumble bee (*Bombus occidentalis occidentalis*) Global Distribution



Suckley Cuckoo Bumble Bee (*Bombus suckleyi*) California Distribution



Suckley Cuckoo Bumble Bee (*Bombus suckleyi*) Global Distribution



Attachment 5. Conditions of Santa Clara Valley Habitat Plan

Condition 1. Avoid Direct Impacts on Legally Protected Plant and Wildlife Species - Condition 1 requires project proponents to avoid direct impacts on legally protected plant and wildlife species, including federally endangered Contra Costa goldfields and fully protected wildlife species including the golden eagle, bald eagle, American peregrine falcon, southern bald eagle, white-tailed kite, California condor, and ring-tailed cat. Condition 1 also protects bird species and their nests that are protected under the Migratory Bird Treaty Act (MBTA).

The proposed project will comply with this condition. There are no expected impacts to Contra Costa goldfields or other special-status plants. Additionally, the project proponent will include pre-construction survey for nesting birds, including raptors and burrowing owls. Habitat for ring-tailed cats does not exist at the subject site.

Condition 2. Incorporate Urban-Reserve System Interface Design Requirements - Condition 2 provides design requirements for projects that interface urban-reserves.

The proposed project is not at- or in- an urban-reserve interface.

Condition 3. Maintain Hydrologic Conditions and Protect Water Quality - Condition requires projects to comply with NPDES permit requirements, to provide stormwater quality control, and to avoid and minimize effects to local waterways. This includes measures, performance standards, and control measures to minimize increases of peak discharge of stormwater and pollutant discharge to protect water quality, including during project construction.

The proposed project will comply with this condition. All NPDES permit requirements will be implemented.

Condition 4. Avoidance and Minimization for In-Stream Projects

The proposed project is not an “in-stream” project.

Condition 5. Avoidance and Minimization Measures for In-Stream Operations and Maintenance

The proposed project does not include any structures that require any in-stream operation or maintenance.

Condition 6. Design and Construction Requirements for Covered Transportation Projects

The proposed project is not a Transportation Project.

Condition 7. Rural Development Design and Construction Requirements

The proposed project is not a rural development.

Condition 8. Implement Avoidance and Minimization Measures for Rural Road Maintenance

The proposed project is not a rural project.

Condition 9. Prepare and Implement a Recreation Plan - Condition 9 requires providing public access to all reserve lands owned by a public entity.

The proposed project does not abut or adjoin any reserve lands.

Condition 10. Fuel Buffer - Condition 10 provides requirements for fuel buffers between 30 and 100 feet of structures. Requirements include measures relating to fuel buffers near structures and on reserve lands.

The proposed project is an in-fill (urban setting) residential development. It will comply with required setbacks defined by the City of Morgan Hill, but the project site does not abut reserve lands or vegetated open space.

Condition 11. Stream and Riparian Setbacks - Condition 11 provides requirements for stream and riparian setbacks.

The proposed project does not include riparian or stream corridors either on or adjacent to the property boundary.

Condition 12. Wetland and Pond Avoidance and Minimization - Condition 12 provides measures to protect wetlands and ponds, including planning actions, design, and construction actions.

The proposed project would comply with this condition. The project proponent has determined that it is impracticable to avoid permanent impacts to all the wetlands on the project site, so wetland fees will be paid to cover the costs of compensatory mitigation required by the SCVHP.

Condition 13 (page 6-58). Serpentine and Associated Covered Species Avoidance and Minimization - Condition 13 requires surveys for special status plants and the Bay checkerspot butterfly as well as its larval host plant in appropriate areas that support serpentine bunchgrass grassland, serpentine rock outcrops, serpentine seeps, and serpentine chaparral.

The project site does not include any serpentine soils, nor does it constitute habitat for special-status species that are dependent on serpentine soils.

Condition 14. Valley Oak and Blue Oak Woodland Avoidance and Minimization - Condition 14 provides requirements for project planning and project construction, including avoidance of large oaks, guidance on irrigation near oak trees, and a buffer around the root protection zone, roads and pathways within 25 feet of the dripline of an oak tree, trenching, and pruning activities.

The project site does not include valley oak or blue oak stands. The project proponents will work with the City *of Morgan Hill and the SCVHP to ensure protective measures are applied to any existing on-site oak trees that are proposed to be preserved.*

Condition 15. Western Burrowing Owl - Condition 15 requires preconstruction surveys for burrowing owls in appropriate habitat prior to construction activities, provides avoidance measures for owls and nests in the breeding season and owls in the non-breeding season, and requirements for construction monitoring.

The project will comply with this condition. Western burrowing owls are not known to occur at the project site, but preconstruction surveys for burrowing owls will be included.

Condition 16. Least Bell's Vireo - Condition 16 requires preconstruction surveys in appropriate habitat for the least Bell's vireo prior to construction activities and provides avoidance and construction monitoring measures.

The project site does not contain habitat suitable for least Bell's vireo. There is no riparian habitat present. A pre-construction bird survey will be included.

Condition 17. Tricolored Blackbird - Condition 17 requires preconstruction surveys in appropriate habitat for the tricolored blackbird prior to construction activities and provides avoidance and construction monitoring measures.

Habitat for tricolored blackbird is present on an adjacent property but not on the subject property. A preconstruction survey for this species will be included.

Condition 18 (page 6-71) San Joaquin Kit Fox - Condition 18 requires preconstruction surveys in appropriate habitat for the San Joaquin kit fox prior to construction activities and provides avoidance and construction monitoring measures.

The project site is an in-fill site in the City of Morgan Hill. The site is not appropriate habitat for San Joaquin kit fox.

Condition 19 (page 6-74). Plant Salvage when Impacts are Unavoidable - Condition 19 provides salvage guidance and requirements for covered plants.

There is no habitat for any covered plants known to exist at the site.

Condition 20 (page 6-76). Avoid and Minimize Impacts to Covered Plant Occurrences - Condition 20 provides requirements for preconstruction surveys for appropriate covered plants (per habitat).

There is no habitat for any covered plants known to exist at the site.

Tree Inventory, Assessment, And Protection

Morgan Hill
APN - 764-10-013
APN - 764-10-015
(Monterey Road)

Prepared for:

City Ventures
4441 Spear Street, Suite 200
San Francisco, CA 94105

October 17, 2022

Prepared By:

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Table of Contents

Summary

The plans are to develop the lots into 49 residential and 5 commercial units. The inventory contains all the trees with trunk diameters greater than six inches (18 inches in circumference). The inventory contains thirteen trees comprised of eight different species. Five trees are in good condition, six fair, and two are in poor shape. Six trees have fair suitability and seven poor. Eight trees are to be highly impacted and caused to be removed which include #401, #402, #403, #409, #410, #411, #412 and #413. The plans indicate the trees #404, #405, #406, #407 and #408 near the south end will not be affected. Tree protection would consist of fence at a radius of about eight times the trunk diameter distance in feet.

Introduction

Background

City Ventures asked me to assess the site, trees, and proposed footprint plan, and to provide a report with my findings and recommendations to help satisfy planning requirements.

Assignment

- Provide an arborist's report including an assessment of the trees within the project area and on the adjacent sites where necessary. The assessment is to include the species, size (trunk diameter), condition (health, structure and form), and suitability for preservation.

Limits of the assignment

- The information in this report is limited to the condition of the trees during my inspection on October 13, 2022. No tree risk assessments were performed.
- The plans reviewed for this assignment were as follows: Vesting Tentative Map Existing and Proposed Conditions "The Gates" C.1 and C.2, Tentative Utility and Grading Plans C.4, C.5, C.6, and C.7 dated 6/28/22 provided by MH Engineering Co.

Purpose and use of the report

The report is intended to identify all the trees within the plan area that could be affected by a project. The report is to be used by the property owners, owner's agents, and the City of Morgan Hill as a reference for existing tree and site conditions to help satisfy planning requirements.

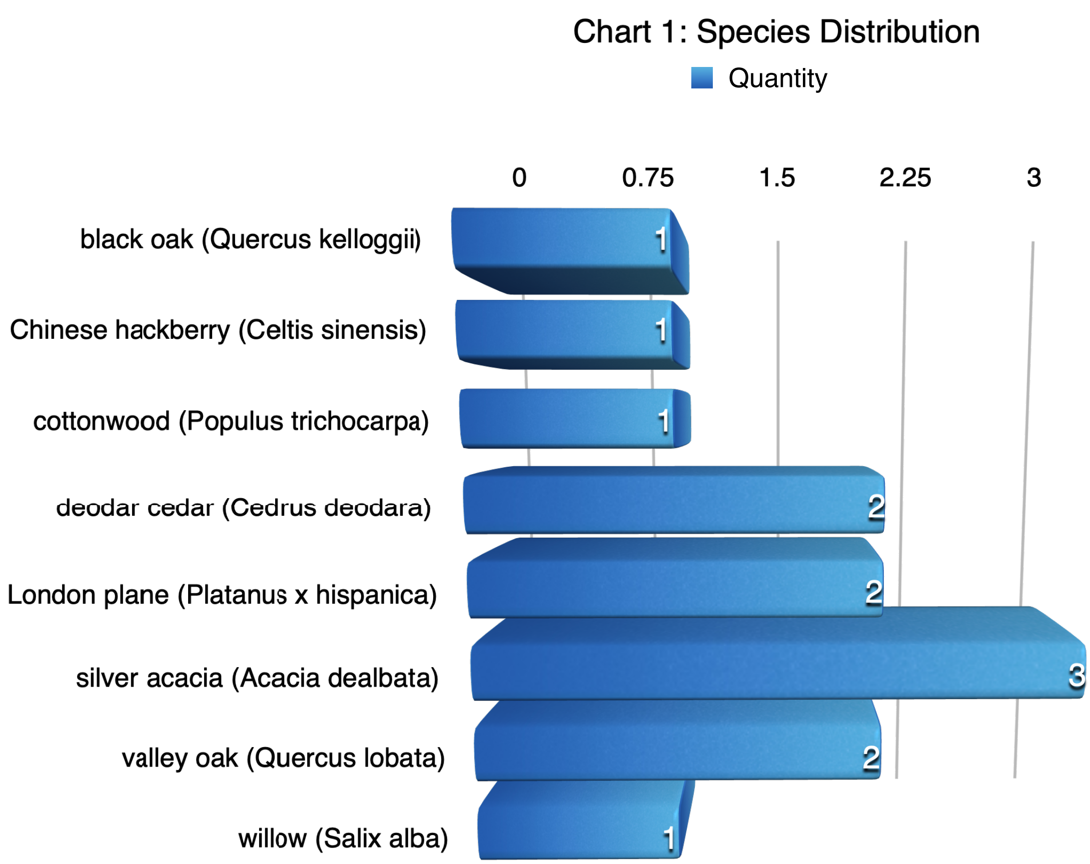
Observations

Plans

The plans are to develop the lots into 49 residential and 5 commercial units.

Tree Inventory

The inventory contains all the trees with trunk diameters greater than six inches (18 inches in circumference). The inventory contains thirteen trees comprised of eight different species with only the valley oaks being native to the region (Chart 1).



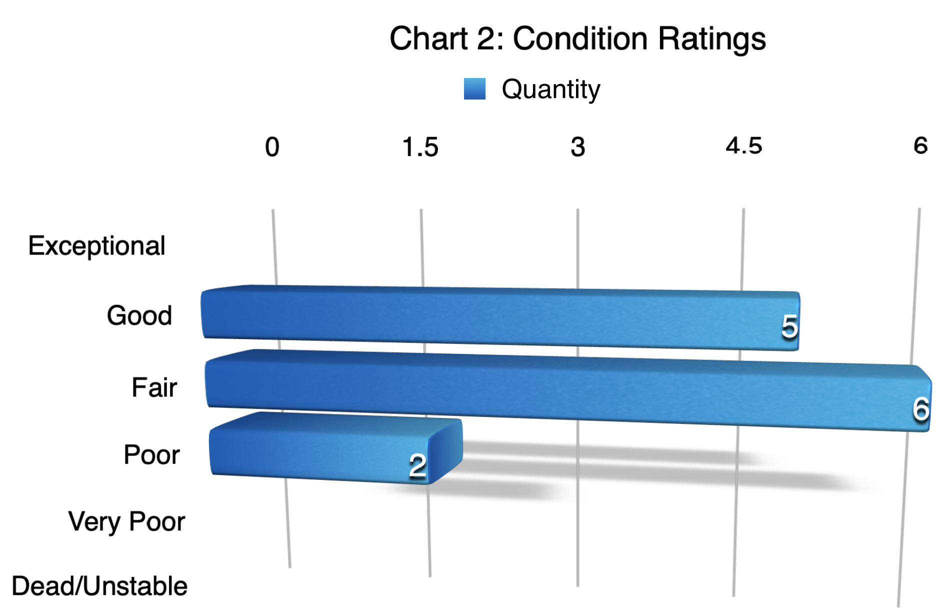
Discussion

Condition Rating

A tree's condition is a determination of its overall health, structure, and form (ISA 2018). The assessment considered all three characteristics for a combined condition rating.

- 100% - Exceptional = Good health and structure with significant size, location or quality.
- 61-80% - Good = Normal vigor, well-developed structure, function and aesthetics not compromised with good longevity for the site.
- 41-60 % - Fair = Reduced vigor, damage, dieback, or pest problems, at least one significant structural problem or multiple moderate defects requiring treatment. Major asymmetry or deviation from the species normal habit, function and aesthetics compromised.
- 21-40% - Poor = Unhealthy and declining appearance with poor vigor, abnormal foliar color, size or density with potential irreversible decline. One serious structural defect or multiple significant defects that cannot be corrected and failure may occur at any time. Significant asymmetry and compromised aesthetics and intended use.
- 6-20% - Very Poor = Poor vigor and dying with little foliage in irreversible decline. Severe defects with the likelihood of failure being probable or imminent. Aesthetically poor with little or no function in the landscape.
- 0-5% - Dead/Unstable = Dead or imminently ready to fail.

Five trees are in good condition, six fair, and two are in poor shape (Chart 2).

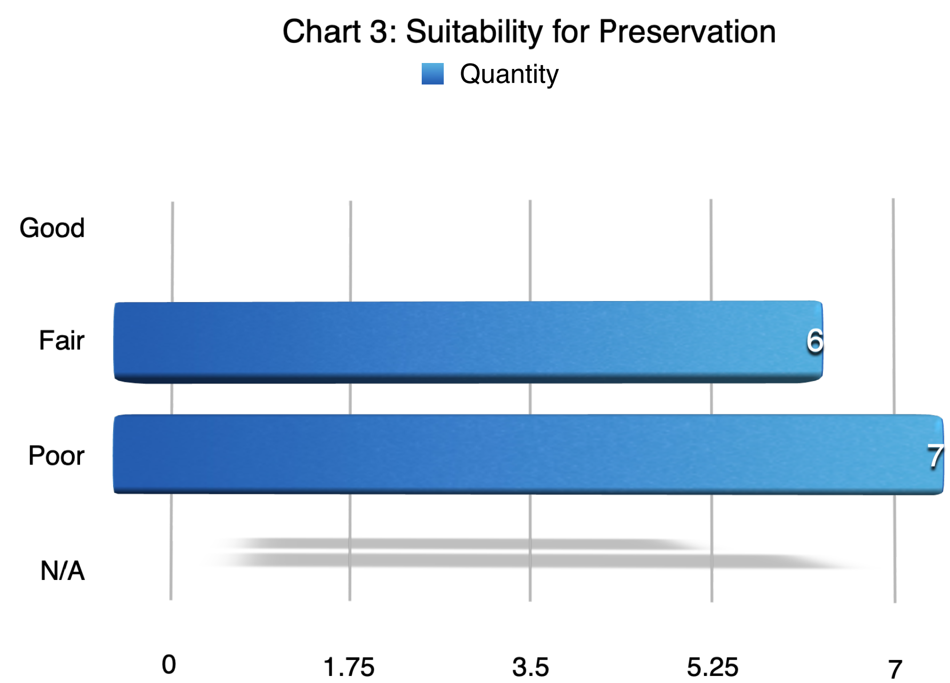


Suitability for Preservation

A tree's suitability for preservation is determined based on its health, structure, age, species and disturbance tolerances.

- Good = Trees with good health, structural stability and longevity after construction.
- Fair = Trees with fair health and/or structural defects that may be mitigated through treatment. These trees require more intense management and monitoring, before, during, and after construction, and may have shorter life expectancy after development.
- Poor = Trees are expected to decline during or after construction regardless of management. The species or individual may possess characteristics that are incompatible or undesirable in landscape settings or unsuited for the intended use of the site.

Six trees have fair suitability and seven poor. Trees poorly suited for preservation include invasive species such as the acacia, willow and cottonwood along with those with poor structure or health such as the black oak (Chart 3).



Expected Impact Level

Impact level defines how a tree may be affected by construction activity and proximity to the tree, and is described as low, moderate, or high. The following scale defines the impact rating:

- Low = The construction activity will have little influence on the tree.
- Moderate = The construction may cause future health or structural problems, and steps must be taken to protect the tree to reduce future problems.
- High = Tree structure and health will be compromised and removal is recommended, or other actions must be taken for the tree to remain. The tree is located in the building envelope.

Eight trees are to be highly impacted and caused to be removed which include #401, #402, #403, #409, #410, #411, #412 and #413. The plans indicate the trees #404, #405, #406, #407 and #408 near the south end will not be affected.

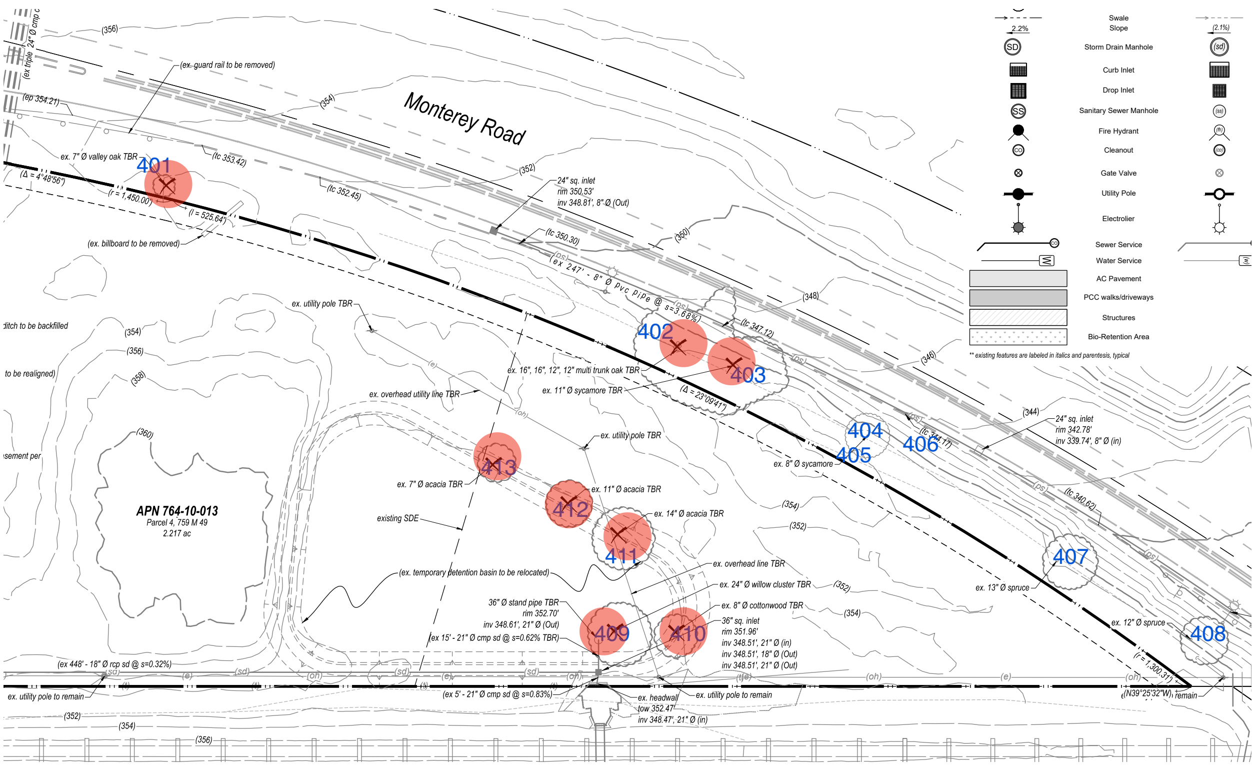
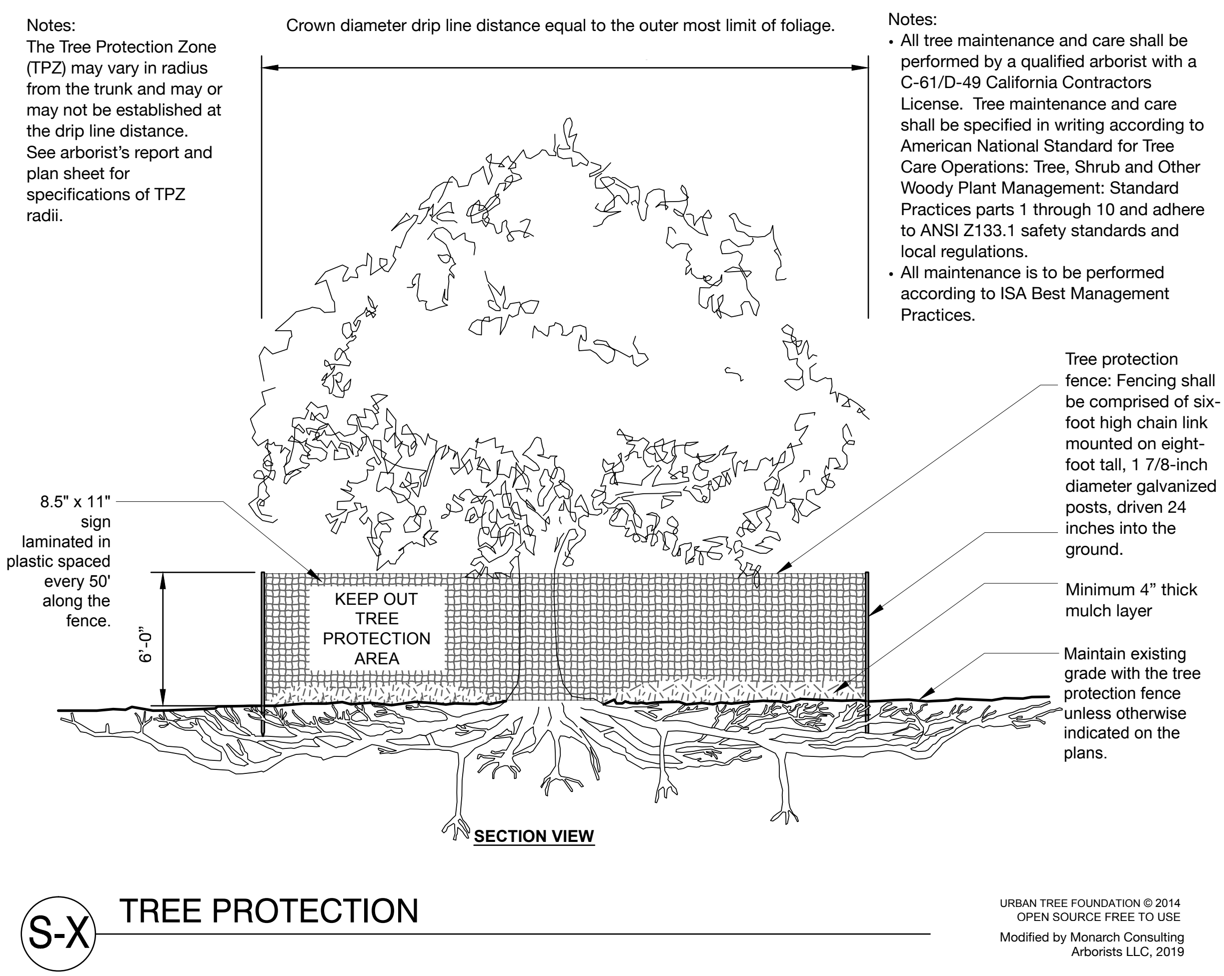


IMAGE 1: TREES HIGHLY IMPACTED INDICATED IN RED

Tree Protection

Tree protection focuses on avoiding damage to the roots, trunk, or scaffold branches from heavy equipment (Appendix D). The tree protection zone (TPZ) is the defined area in which certain activities are prohibited to minimize potential injury to the tree. The most current accepted method for determining the TPZ radius is to use a formula based on species tolerance, tree age/vigor/health, and trunk diameter (Matheny, N. and Clark, J. 1998) (Fite, K, and Smiley, E. T., 2016).

Trees #404 through #408 are located at the top or on the slope adjacent to Monterey Road. These trees would only require protection on one side if the slope is to be maintained intact. Tree protection would consist of fence at a radius about eight times the trunk diameter distance in feet.



Conclusion

The plans are to develop the lots into 49 residential and 5 commercial units. The inventory contains all the trees with trunk diameters greater than six inches (18 inches in circumference). The inventory contains thirteen trees comprised of eight different species. Five trees are in good condition, six fair, and two are in poor shape. Six trees have fair suitability and seven poor. Trees poorly suited for preservation include invasive species such as the acacia, willow and cottonwood along with those with poor structure or health such as the black oak. Eight trees are to be highly impacted and caused to be removed which include #401, #402, #403, #409, #410, #411, #412 and #413. The plans indicate the trees #404, #405, #406, #407 and #408 near the south end will not be affected. Trees #404 through #408 are located at the top or on the slope adjacent to Monterey Road. These trees would only require protection on one side if the slope is to be maintained intact. Tree protection would consist of fence at a radius of about eight times the trunk diameter distance in feet.

Recommendations

1. Place tree identification numbers and protection fence locations on all the plans (Appendix A).

2. Fence should be placed around the trees to be retained at a radius of 8x the DBH in feet as follows: #404 = 8 feet, #405 = 8 feet, #406 = 8 feet, #407 = 11 feet, #408 = 8 feet.

3. Install temporary irrigation or soaker hoses in the TPZ's. Monitor watering times or amounts to ensure adequate soil saturation. (A 5/8" soaker hose requires about 200 minutes to deliver one inch of water to a garden. This number is affected by the length of the hose and the overall rate of flow from the faucet. A good rule of thumb is to expect about ½ GPM as a standard faucet flow rate.). Infrequent deeper watering is preferred.

4. All tree maintenance and care shall be performed by a qualified arborist with a C-61/D-49 California Contractors License. Tree maintenance and care shall be specified in writing according to American National Standard for Tree Care Operations: *Tree, Shrub and Other Woody Plant Management: Standard Practices* parts 1 through 10 and adhere to ANSI Z133.1 safety standards and local regulations. All maintenance is to be performed according to ISA Best Management Practices.

5. Refer to Appendix D for general tree protection guidelines including recommendations for arborist assistance while working under trees, trenching, or excavation within a trees drip line or designated TPZ/CRZ.

6. Place all the tree protection fence locations and guidelines on the plans including the grading, drainage, and utility plans. Alternatively create a separate plan sheet that includes all three protection measures labeled "T-1 Tree Protection Plan."

7. Provide a copy of this report to all contractors and project managers, including the architect, civil engineer, and landscape designer or architect. It is the responsibility of the owner to ensure all parties are familiar with this document.

8. Arrange a pre-construction meeting with the project arborist or landscape architect to verify tree protection is in place, with the correct materials, and at the proper distances.

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Appendix A: Tree Locations, Protection, and Disposition

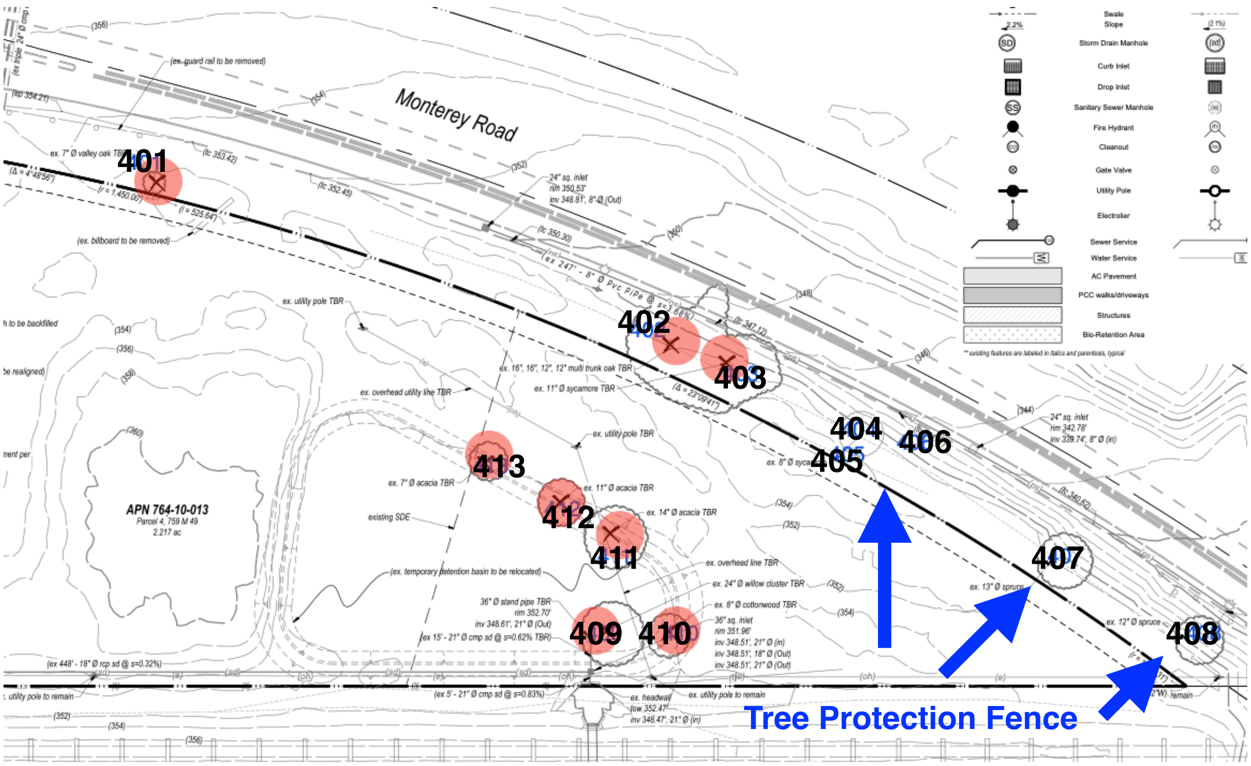

IMAGE 2: TREES IN RED TO BE REMOVED, TREE PROTECTION SHOULD BE ESTABLISHED AT EIGHT TIMES THE TRUNK DIAMETER RADIUS OF #404 = 8 FEET, #405 = 8 FEET, #406 = 8 FEET, #407 = 11 FEET, #408 = 8 FEET

Appendix B: Tree Inventory Summary Table

Table 1

Tree Species	I.D. #	Trunk Diameter (in.)	~ Height (ft.)	~ Canopy Diameter (ft.)	Condition	Suitability	Expected Impact
valley oak (*Quercus lobata)*	401	5, 5	10	10	Good	Fair	High
black oak (*Quercus kelloggii*)	402	13, 13, 11, 16, 18	45	35	Fair	Poor	High
London plane (*Platanus x hispanica*)	403	10	25	10	Good	Fair	High
London plane (*Platanus x hispanica*)	404	9	25	25	Good	Fair	Low
valley oak (*Quercus lobata)*	405	4, 3, 3, 2	10	10	Fair	Fair	Low
Chinese hackberry (*Celtis sinensis*)	406	7, 8 Or 12	20	20	Good	Poor	Low
deodar cedar (*Cedrus deodara*)	407	16	25	20	Poor	Fair	Low
deodar cedar (*Cedrus deodara*)	408	12	25	20	Good	Fair	Low
willow (*Salix alba*)	409	10, 8, 8, 8, 6, 6	40	25	Fair	Poor	High
cottonwood (*Populus trichocarpa*)	410	9	45	25	Fair	Poor	High
silver acacia (*Acacia dealbata*)	411	7, 8, 5, 5, 5, 5, 5, 5, 3, 3	35	25	Poor	Poor	High
silver acacia (*Acacia dealbata*)	412	6, 6, 5	35	25	Fair	Poor	High
silver acacia (*Acacia dealbata*)	413	5, 7	35	25	Fair	Poor	High

Appendix C: Photographs
C1: Tree #401

C2: trees #402 and #403

C3: Trees #404 and #406

C4: Trees #407 and #408

C5: Trees #409 through #413

Appendix D: Tree Protection Guidelines

Prohibited Activities

The following are prohibited activities within the TPZ:

- Grade changes (e.g. soil cuts, fills);
- Trenches;
- Root cuts;
- Pedestrian and equipment traffic that could compact the soil or physically damage roots;
- Parking vehicles or equipment;
- Burning of brush and woody debris;
- Storing soil, construction materials, petroleum products, water, or building refuse; and,
- Disposing of wash water, fuel or other potentially damaging liquids.

Pre-Construction Meeting with the Project Arborist

Tree protection locations should be marked before any fencing contractor arrives.

Prior to beginning work, all contractors involved with the project should attend a pre construction meeting with the project arborist to review the tree protection guidelines. Access routes, storage areas, and work procedures will be discussed.

Tree Protection Zones and Fence Specifications

Tree protection fence should be established prior to the arrival of construction equipment or materials on site. Fence should be comprised of six-foot high chain link fence mounted on eight-foot tall, 1 7/8-inch diameter galvanized posts, driven 24 inches into the ground and spaced no more than 10 feet apart. Once established, the fence must remain undisturbed and be maintained throughout the construction process until final inspection.

The fence should be maintained throughout the site during the construction period and should be inspected periodically for damage and proper functions. Fence should be repaired, as necessary, to provide a physical barrier from construction activities.

Monitoring

Any trenching, construction or demolition that is expected to damage or encounter tree roots should be monitored by the project arborist or a qualified ISA Certified Arborist and should be documented.

The site should be evaluated by the project arborist or a qualified ISA Certified Arborist after construction is complete, and any necessary remedial work that needs to be performed should be noted.

Restrictions Within the Tree Protection Zone

No storage of construction materials, debris, or excess soil will be allowed within the Tree Protection Zone. Spoils from the trenching shall not be placed within the tree protection zone either temporarily or permanently. Construction personnel and equipment shall be routed outside the tree protection zones.

Root Pruning

Root pruning shall be supervised by the project arborist. When roots over two inches in diameter are encountered they should be pruned by hand with loppers, handsaw, reciprocating saw, or chain saw rather than left crushed or torn. Roots should be cut beyond sinker roots or outside root branch junctions and be supervised by the project arborist. When completed, exposed roots should be kept moist with burlap or backfilled within one hour.

Boring or Tunneling

Boring machines should be set up outside the drip line or established Tree Protection Zone. Boring may also be performed by digging a trench on both sides of the tree until roots one inch in diameter are encountered and then hand dug or excavated with an Air Spade® or similar air or water excavation tool. Bore holes should be adjacent to the trunk and never go directly under the main stem to avoid oblique (heart) roots. Bore holes should be a minimum of three feet deep.

Timing

If the construction is to occur during the summer months supplemental watering and bark beetle treatments should be applied to help ensure survival during and after construction.

Tree Pruning and Removal Operations

All tree pruning or removals should be performed by a qualified arborist with a C-61/D-49 California Contractors License. Tree pruning should be specified in writing according to ANSI A-300A pruning standards and adhere to ANSI Z133.1 safety standards. Trees that need to be removed or pruned should be identified in the pre-construction walk through.

Tree Protection Signs

All sections of fencing should be clearly marked with signs stating that all areas within the fencing are Tree Protection Zones and that disturbance is prohibited. Text on the signs should be in both English and Spanish (Appendix E).

Appendix E: Tree Protection Signs
E1: English

WARNING
Tree Protection Zone

This Fence Shall not be moved without approval. Only authorized personnel may enter this area!

Project Arborist

E2: Spanish

CUIDADO
Zona De Arbol Pretejido

Esta cerca no sera removida sin aprobacion. Solo personal autorizado entrara en esta area!

Project Arborist

Qualifications, Assumptions, and Limiting Conditions

Any legal description provided to the consultant is assumed to be correct. Any titles or ownership of properties are assumed to be good and marketable. All property is appraised or evaluated as though free and clear, under responsible ownership and competent management.

All property is presumed to be in conformance with applicable codes, ordinances, statutes, or other regulations.

Care has been taken to obtain information from reliable sources. However, the consultant cannot be responsible for the accuracy of information provided by others.

The consultant shall not be required to give testimony or attend meetings, hearings, conferences, mediations, arbitration, or trials by reason of this report unless subsequent contractual arrangements are made, including payment of an additional fee for such services.

This report and any appraisal value expressed herein represent the opinion of the consultant, and the consultant's fee is not contingent upon the reporting of a specified appraisal value, a stipulated result, or the occurrence of a subsequent event.

Sketches, drawings, and photographs in this report are intended for use as visual aids, are not necessarily to scale, and should not be construed as engineering or architectural reports or surveys. The reproduction of information generated by architects, engineers, or other consultants on any sketches, drawings, or photographs is only for coordination and ease of reference. Inclusion of said information with any drawings or other documents does not constitute a representation as to the sufficiency or accuracy of said information.

Unless otherwise expressed: a) this report covers only examined items and their condition at the time of inspection; and b) the inspection is limited to visual examination of accessible items without dissection, excavation, probing, or coring. There is no warranty or guarantee, expressed or implied, that structural problems or deficiencies of plants or property may not arise in the future.

Certification of Performance

I Richard Gessner, Certify:

That I have personally inspected the tree(s) and/or the property referred to in this report, and have stated my findings accurately. The extent of the evaluation and/or appraisal is stated in the attached report and Terms of Assignment;

That I have no current or prospective interest in the vegetation or the property that is the subject of this report, and I have no personal interest or bias with respect to the parties involved;

That the analysis, opinions and conclusions stated herein are my own;

That my analysis, opinions, and conclusions were developed and this report has been prepared according to commonly accepted Arboricultural practices;

That no one provided significant professional assistance to the consultant, except as indicated within the report.

That my compensation is not contingent upon the reporting of a predetermined conclusion that favors the cause of the client or any other party, nor upon the results of the assessment, the attainment of stipulated results, or the occurrence of any other subsequent events;

I further certify that I am a Registered Consulting Arborist® with the American Society of Consulting Arborists, and that I acknowledge, accept and adhere to the ASCA Standards of Professional Practice. I am an International Society of Arboriculture Board Certified Master Arborist®. I have been involved with the practice of Arboriculture and the care and study of trees since 1998.

Richard J. Gessner

ASCA Registered Consulting Arborist® #496
ISA Board Certified Master Arborist® WE-4341B

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