

# Interim Core Map Documentation for the Sebastopol Meadowfoam

## Version 1

**Review Completed:** April 2026

**Core Map Developer:** U.S. Environmental Protection Agency (EPA) Office of Pesticide Programs (OPP)

## Species Summary

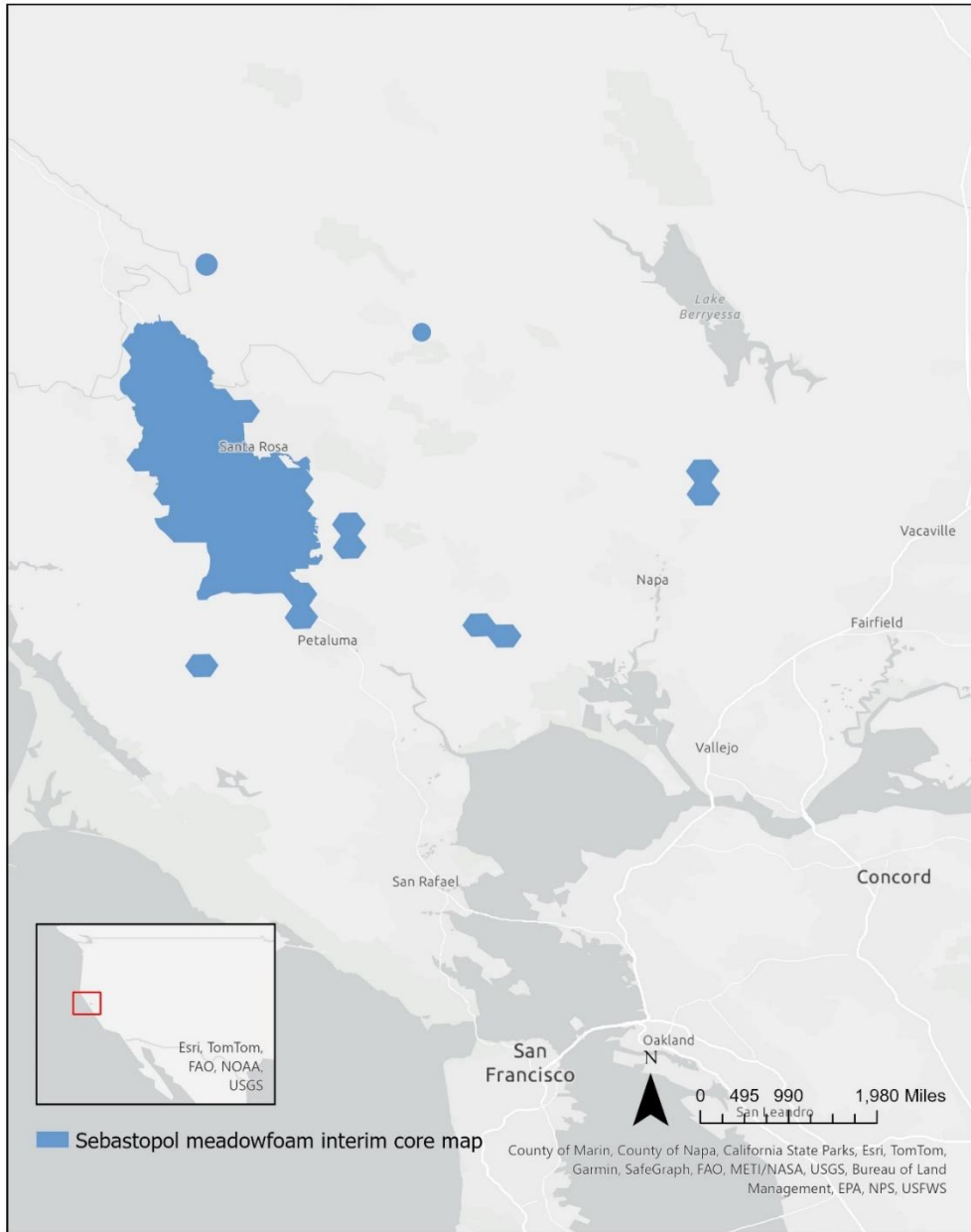
The Sebastopol meadowfoam (*Limnanthes vincularis*; Entity ID # 754) is an endangered terrestrial plant (dicot). This species is restricted to vernal pools in Sonoma and Napa Counties, CA, although most occurrences are in the Santa Rosa Plain in Sonoma County. This species blooms in March and April and is primarily pollinated by its specialist bee, *Andrena pulvera*. There is no designated critical habitat for this species. Additional information is provided in **Appendix 1**.

## Description of Core Map

The core map for the Sebastopol meadowfoam is biological information type based on the known occurrences of this species which occur within the Santa Rosa Plain Conservation Area as well as two extant populations that were observed outside of this area. Additionally, vernal pools within 100m of an iNaturalist research-grade occurrence were incorporated into the core map. Finally, cultivated lands were removed from the core map because the Sebastopol meadowfoam is a vernal pool specialist that cannot thrive on cultivated lands. A long-term recovery action for this species is to replicate core area occurrences of the species and to protect to protect the vernal pool acreage within these core areas. **Figure 1** depicts the interim core map for the Sebastopol meadowfoam (blue areas on map). The core map represents approximately 101,000 acres.

The Sebastopol meadowfoam inhabits vernal pools in Sonoma County, CA, mostly within the Santa Rosa Plain. Landcover categories within the core map area are included in **Table 1**. Landcover within the core map is predominantly grassland/herbaceous.

The core map developed for the Sebastopol meadowfoam is considered interim. This core map will be used to develop pesticide use limitation areas (PULAs) that include the Sebastopol meadowfoam. This core map incorporates information developed by the U.S Fish and Wildlife Service (FWS) and made available to the public; however, the core map has not been formally reviewed by FWS. This interim core map may be revised in the future to incorporate expert feedback from FWS. This interim core map has an “average” (3) best professional judgment classification because it consists of the species’ known locations and areas with its preferred habitat.



**Figure 1. Interim core map for the Sebastopol meadowfoam. The total acreage of the core map is approximately 101,000 acres.**

**Table 1. Percentage of Interim Core Map Represented by NLCD<sup>1</sup> Land Covers and Associated Example Pesticide Use Sites/Types.**

Example pesticide use sites/types	NLCD Class/Value	% Area
Forestry	Deciduous Forest (41)	0%
Forestry	Evergreen Forest (42)	2%
Forestry	Mixed Forest (43)	2%
Agriculture	Pasture/Hay (81)	9%
Agriculture	Cultivated Crops (82)	3%
Mosquito adulticide, residential	Developed Open Space (21)	11%
Mosquito adulticide, residential	Developed Low Intensity (22)	11%
Mosquito adulticide, residential	Developed Medium Intensity (23)	14%
Mosquito adulticide, residential	Developed High Intensity (24)	5%
Invasive species control	Woody Wetlands (90)	1%
Invasive species control	Emergent Herbaceous Wetlands (95)	0%
Invasive species control	Open Water (11)	1%
Invasive species control	Grassland/Herbaceous (71)	33%
Invasive species control	Shrub/Scrub (52)	7%
Invasive species control	Barren Land (31)	0%
Total Acres	Interim Core Map Acres	~ 101,000

## Evaluation of Known Location Information

There are four datasets with known location information for this species:

- Descriptions of locations provided by FWS
- Occurrence locations in iNaturalist
- Occurrence locations in the Global Biodiversity Information Facility (GBIF)
- Occurrence locations in NatureServe

EPA evaluated these sets of data before selecting the type of and developing the core map. FWS' most recent 5-year review (2024) detailed known locations of this species. FWS described 25 documented occurrences that are extant, status unknown, and extirpated. Currently, there are 19 extant populations, most of which have locations that are consistent with the critical habitat. iNaturalist had 13 research grade observations. NatureServe included four documented locations. GBIF contained no additional data that were not already included in iNaturalist or NatureServe. The iNaturalist and NatureServe data had a coarse resolution and EPA could not determine conclusively if these data fell within the critical habitat; however, they generally appear to be consistent with the locations of the range and critical habitat. **Appendix 1** includes more information on the available known location information.

## Approach Used to Create Core Map

The core map was developed using the “Process EPA Uses to Develop Core Maps for Draft Pesticide Use Limitation Areas for Species Listed by the U.S. Fish & Wildlife Service (FWS) and their Designated Critical Habitats” (referred to as “the process”). This core map was developed by EPA and was developed using the 4 steps described in the process document:

1. Compile available information for a species
2. Identify core map type
3. Develop the core map for the species
4. Document the core map

For step 1, EPA compiled available information for the Sebastopol meadowfoam from FWS as well as observational information available from various publicly available sources (discussed in previous section). The information compiled for the Sebastopol meadowfoam is included in **Appendix 1**.

Influential information that impacted the development of the core map included:

- This species is endemic to vernal pools in Sonoma and Napa Counties, CA, although most occurrences are in the Santa Rosa Plain in Sonoma County.

For step 2, EPA used the compiled information to identify the core map type, including the species range, core recovery areas, and known location information. EPA compared known location data to the range and core recovery areas and found that the FWS known locations of currently existing (extant) populations are consistent with the location of the vernal pools and the Santa Rosa Plain in Sonoma County, where the species is known to occur. The species range is not likely limited to the areas containing habitat of the species. The range is also much larger than the areas where known locations occur. Based on this information, EPA used biological information as the core map.

For step 3, EPA used spatial data of the Santa Rosa Plain, vernal pools in the Napa and Sonoma Counties, the Sebastopol meadowfoam core recovery areas identified by Sacramento FWS (see Appendix 2).

## Discussion of Approaches and Data that were Considered but not Included in Core Map

EPA did not explore approaches other than those described in this documentation.

## Appendix 1. Information Compiled for Species

- **Recent FWS Documents/Links**
  - 2016 Recovery Plan: [https://ecos.fws.gov/docs/recovery\\_plan/06012016\\_Final%20Santa%20Rosa\\_RP\\_signed\\_1.pdf](https://ecos.fws.gov/docs/recovery_plan/06012016_Final%20Santa%20Rosa_RP_signed_1.pdf)
  - 2024 5-Year Review: [https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public\\_docs/species\\_nonpublish/18360.pdf](https://ecosphere-documents-production-public.s3.amazonaws.com/sams/public_docs/species_nonpublish/18360.pdf)
  - 2024 California Natural Diversity Database (in 2024 5-Year Review)
- **Background information**
  - Status: federally listed as endangered in 1991
  - Resiliency, redundancy, and representation (the 3 Rs). Information below quoted directly from 2024 5-Year Review:
    - The current status of numerous *Limnanthes vinculans* occurrences is unknown; however, the most current information from CNDDDB, from survey data collected by the Adopt-a-Vernal Pool program, and from species experts is shown on Figure 7 and in Table 3 and indicates that there are 37 occurrences of *L. vinculans* that are presumed extant of which at least three have been introduced. Six occurrences are extirpated or possibly extirpated. Although many occurrences have been surveyed in recent years, several others have not been visited in over 20 years in part due to lack of access to the sites.
    - Genetic variability within *Limnanthes vinculans* is low compared to other *Limnanthes* species (Jain 1984). However, occurrences of this species do differ from each other in genetic makeup (Jain *in litt.* 1980).
    - A genetic survey of *Limnanthes vinculans* leaf-tissues from 16 natural and four created sites within the Plain and Napa Valley was conducted in 2006 and 2008 (Sloop *et al.* 2012b). The Napa Valley occurrence was clearly distinct from the Plain occurrences. Leaf morphology of the Napa plants differs from that of *L. vinculans* plants located on the Plain and in some respects, the Napa plants are more similar to other *Limnanthes* species. Within Sonoma County occurrences, gene flow seemed less restricted, indicating adequate pollen and/or seed movement. High genetic diversity was observed in *L. vinculans* at all sites, suggesting effective population sizes were large with low inbreeding and low or no genetic drift historically. No clear genetic trends or geographic groupings among Plain occurrences were found. Occurrences that are genetically distinct should be protected and are important for their potential ability to adapt to the effects of climate change. The range of *Limnanthes vinculans* has not increased since the time of listing.
- **Habitat, Life History, and Ecology (Source: 2016 Recovery Plan)**
  - “This species grows in northern basalt flow and northern hardpan vernal pools (Sawyer and Keeler-Wolf 1995), wet swales and meadows, on the banks of streams, and in artificial habitats such as ditches (Wainwright 1984; CNDDDB 2002). *Limnanthes vinculans* grows in both shallow and deep areas, but is most frequent in pools 25 to 51 cm (10 to 20 in) deep (Patterson *et al.* 1994). The species is most abundant in the margin habitat

at the edge of vernal pools or swales (Pavlik *et al.* 2000, 2001). Most confirmed occurrences of *L. vinculans* on the Plain grow on Wright loam or Clear Lake clay soils (Patterson *et al.* 1994, CNDDDB 2002). A few occurrences are on other soil types, including Pajaro clay loam, Cotati fine sandy loam, Haire clay loam (Patterson *et al.* 1994) and Blucher fine sandy loam (Wainwright 1984). The surrounding plant communities range from oak savanna, grassland, and marsh in Sonoma County to riparian woodland in Napa County (CNDDDB 2002). *Limnanthes vinculans* occurs at elevations of 15 to 41 m (50 to 135 ft) throughout most of its range, including Napa County. The Knights Valley occurrence, in Sonoma County, was at 116 m (380 ft) (CNDDDB 2013).”

- Flowering occurs in March and April
- Pollinated by its specialist bee, *Andrena pulvera*, as well as other bees and syrphid flies.

- **Taxonomy**

- Flowering dicot plant

- **Relevant Pesticide Use Sites in FWS Documents**

- “The Environmental Protection Agency (Agency) recently released final biological evaluations assessing the effects of labeled uses of three neonicotinoid pesticides on listed species (Agency 2022a, entire; Agency 2022b, entire; Agency 2022c, entire). The three pesticides (clothianidin, imidacloprid, and thiamethoxam) are registered for use on a variety of agricultural crops; there are also some non-agricultural applications. The three pesticides target insect species by acting on their neurotransmitters to cause excessive nervous stimulation, paralysis, and death. Sebastopol meadowfoam is primarily pollinated by its specialist bee, *Andrena pulvera*, but it is also visited by a diversity of other bees and syrphid flies (Gilmore 2018, pp. 4, 54–57). The Agency’s final biological evaluations determined that all three pesticides are highly toxic to bees, have the potential to result in bee brood and colony reductions, and if affected bee colonies decline near Sebastopol meadowfoam, there is a potential for the three pesticides to indirectly adversely affect the species (Agency 2022a, p. 4; Agency 2022b, p. 2; Agency 2022c, p. 3). The Agency anticipates releasing amended proposed interim decisions and a national consultation with the Agency is currently pending” (2024 Five-Year Review).

- **Relevant Recovery Criteria and Actions (Source: 2012 Recovery Plan)**

- De-listing criteria include:
  - At least 90% of all known occurrences of *Limnanthes vinculans* that are extant as of December 2014, have been protected in perpetuity.
  - All occurrences in management areas have been replicated at 1:2 at permanently protected at appropriate locations.
  - All replicate occurrences in management areas have achieved the same density (1,500 seeds per square meter) as the core area occurrences.
  - If *Limnanthes vinculans* is found at the Knights Valley site, the northernmost location, this occurrence should be replicated at 1:2 in permanently protected appropriate locations.
  - All genetically unique and isolated unprotected sites in management areas are permanently protected *in situ*. Identification of some

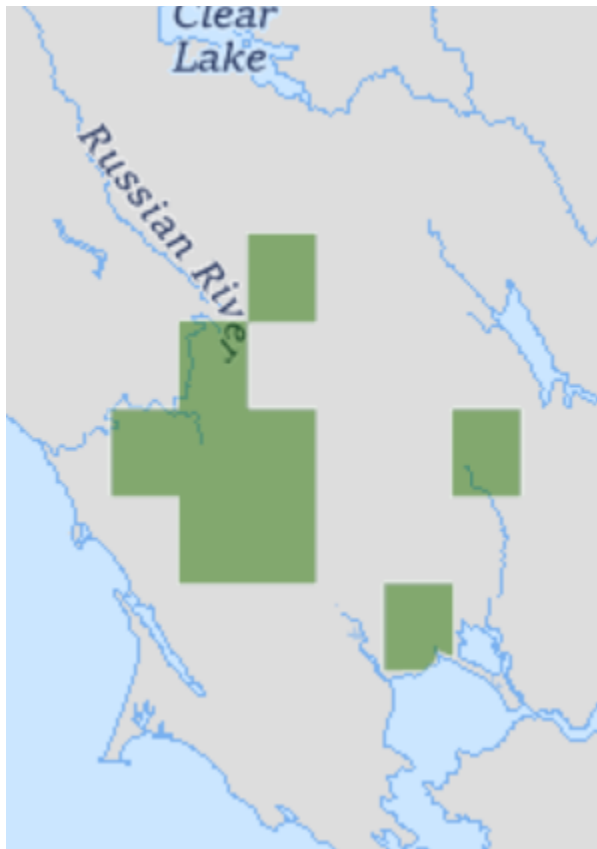
genetically unique occurrences is not yet known but will be determined during research listed in Table 6.

- Down-listing criteria include:
  - Of all extant, native occurrences in the Santa Rosa Plain not protected as of December 2014, 75 % of the Sebastopol meadowfoam Northern Core Area occurrences, and 80 % of the Sebastopol meadowfoam Southern Core Area occurrences are permanently protected to maintain the current geographic, elevational, and ecological distribution of the species. Priority should be given to occurrences that have been shown to be isolated and/or genetically unique.
  - New preserves protect a total of 500 acres (ac) in two general areas: 200 ac in the Northern Core Area and 300 ac in the Southern Core Area. These preserves consist of occupied habitat that was not protected as of December 2014. The ecological integrity (e.g., water quality, hydrology, and uplands condition) of these areas is not threatened by adverse habitat modification. Buffers between the protected habitat and incompatible land uses is sufficient to ensure that there are no significant adverse effects to the species, such as changes in hydrology of contamination by pesticides or herbicides, currently and into the foreseeable future.
  - New preserves (comprised of restored or created habitat) must be 10 ac or greater; however, preserves with existing native occurrences may be less than 10 ac. The preserves should be as near to new or existing preserves as possible.
  - The total new preserve acreage among all core areas consists of a minimum of 70 ac of vernal pools and swales (40 ac in the Northern Core Area and 30 ac in the Southern Core Area). However, new preserves are no more than 35 percent wetland which is based on general wetland to upland percentages.
  - Service-approved conservation and management plans that protect vernal pool and upland habitats and address effects of invasive plants are developed and are being effectively implemented.
  - Service shall work with Mosquito Abatement Districts so that their practices in the core and management areas are implemented to avoid impacts to the species.
  - All native occurrences, extant as of December 2014, in the Northern Core Area as well as the Theiller (owned by California Department of Fish and Wildlife) and Haroutunian (owned by Sonoma County Agricultural Preservation and Open Space District) sites in the southern portion of the Southern Core Area, are replicated at 1:3 (quadrupled in numbers of occurrences) in permanently protected appropriate sites. The remaining occurrences in the Southern Core Area are replicated at 1:1 because they are genetically similar. Replication is accomplished by collecting seed or inoculum from a natural occurrence and planting it at additional sites.
  - Service-approved conservation and management plans that protect vernal pool and upland habitats and address effects of small

occurrences of the listed plants and climate change, are developed and are being effectively implemented.

- **Description of the species range**

- Santa Rosa Plain in Sonoma County, CA and Napa Valley State Park in Napa County, CA.
- Figure A1-1 depicts the current FWS species range (last updated 03/21/2018).
- The species range is approximately 335,000 acres.



**Figure A1-1. FWS Range of Sebastopol meadowfoam.**

- **Known Locations**

- **Known Locations Described in FWS Recovery Documents**

- There are currently 57 known occurrences of Sebastopol meadowfoam, 49 of which are extant or presumed extant, and 8 of which are extirpated or presumed extirpated.
- **Table A1-1** lists the occurrences and survey data collected since the 2019 status review in the 2024 Five-Year Review Occurrences were validated by the 2024 California Natural Diversity Database (CNDDDB).
- **Figure A1-2** depicts the known location data and updated protected core areas in FWS' 2016 Recovery Plan.

**Table A1-1. Sebastopol meadowfoam occurrences and survey data collected since the 2019 status review (Diversity Database 2024, entire).**

Occurrence number	County	Whether occurrence was verified since 2019 status review; if yes, date last verified	Status as of 2019 status review	Status as of May 2024	Changes since 2019 status review; other comments
1	Sonoma	Yes; 4/30/2020	Presumed extant	Presumed extant	5,000 plants in 2019; thousands of plants in 2020
2	Sonoma	No	Presumed extant	Presumed extant	
3	Sonoma	No	Presumed extant	Presumed extant	
5	Sonoma	No	Merged with occurrence #1		
6	Sonoma	No	Presumed extant	Presumed extant	
7	Sonoma	No	Possibly extirpated	Possibly extirpated	
9	Sonoma	No	Presumed extant	Presumed extant	
10	Sonoma	No	Presumed extant	Presumed extant	
12	Sonoma	No	Presumed extant	Presumed extant	
14	Sonoma	No	Presumed extant	Presumed extant	
15	Sonoma	No	Presumed extant	Presumed extant	
16	Sonoma	No	Presumed extant	Presumed extant	
17	Sonoma	No	Presumed extant	Presumed extant	
18	Sonoma	No	Possibly extirpated	Possibly extirpated	
20	Sonoma	No	Possibly extirpated	Possibly extirpated	
21	Sonoma	Yes; 4/24/2020	Presumed extant	Presumed extant	Introduced back to native habitat; 5,000+ plants in 2020
22	Sonoma	Yes; 4/6/2021	Presumed extant	Presumed extant	100 plants in 2021
24	Sonoma	No	Presumed extant	Presumed extant	
25	Sonoma	No	Presumed extant	Presumed extant	
26	Sonoma	No	Presumed extant	Presumed extant	
27	Sonoma	No	Presumed extant	Presumed extant	
28	Sonoma	No	Presumed extant	Presumed extant	
29	Sonoma	No	Presumed extant	Presumed extant	
30	Sonoma	No	Presumed extant	Presumed extant	
31	Sonoma	No	Possibly extirpated	Possibly extirpated	
33	Sonoma	No	Presumed extant	Presumed extant	
34	Sonoma	No	Presumed extant	Presumed extant	

Occurrence number	County	Whether occurrence was verified since 2019 status review; if yes, date last verified	Status as of 2019 status review	Status as of May 2024	Changes since 2019 status review; other comments
35	Sonoma	No	Possibly extirpated	Extirpated	Change in status
36	Sonoma	No	Presumed extant	Presumed extant	
37	Sonoma	No	Presumed extant	Presumed extant	
38	Sonoma	No	Extirpated	Extirpated	
39	Napa	No	Presumed extant	Presumed extant	
40	Sonoma	No	Presumed extant	Presumed extant	
42	Sonoma	No	Presumed extant	Presumed extant	
43	Sonoma	No	Presumed extant	Presumed extant	
46	Sonoma	No	Extirpated	Extirpated	
47	Sonoma	No	Presumed extant	Presumed extant	
48	Sonoma	No	Presumed extant	Presumed extant	
49	Sonoma	No	Presumed extant	Presumed extant	
50	Sonoma	No	Presumed extant	Presumed extant	Introduced back to native habitat
52	Sonoma	No	Possibly extirpated	Possibly extirpated	
53	Napa	No	Presumed extant	Presumed extant	
54	Sonoma	Yes; 4/22/2021	Presumed extant	Presumed extant	2,010–8,250 plants in 2020; 743–1,930 plants in 2021
55	Sonoma	No	Presumed extant	Removed due to misidentification	
56	Sonoma	Yes; 4/27/2020	Presumed extant	Presumed extant	Transplanted outside native habitat; 50 plants in northernmost pool in 2020
57	Sonoma	Yes; 4/27/2020	Presumed extant	Presumed extant	Transplanted outside native habitat; Hundreds of plants in 2020
58	Sonoma	Yes; 5/10/2018	Not yet in Diversity Database	Presumed extant	
59	Napa	Yes; 5/1/2020	Not yet in Diversity Database	Presumed extant	Thousands of plants in 2020

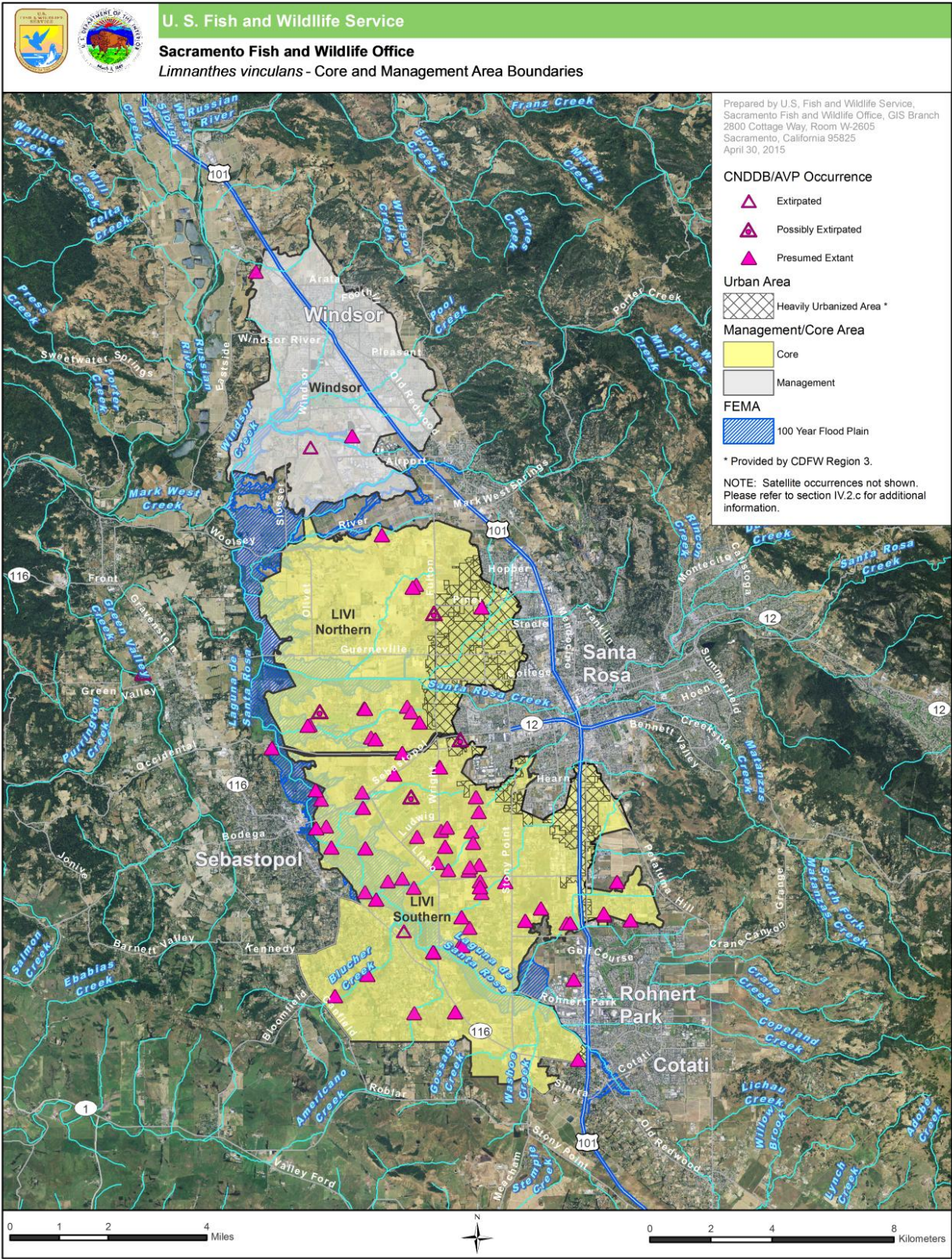
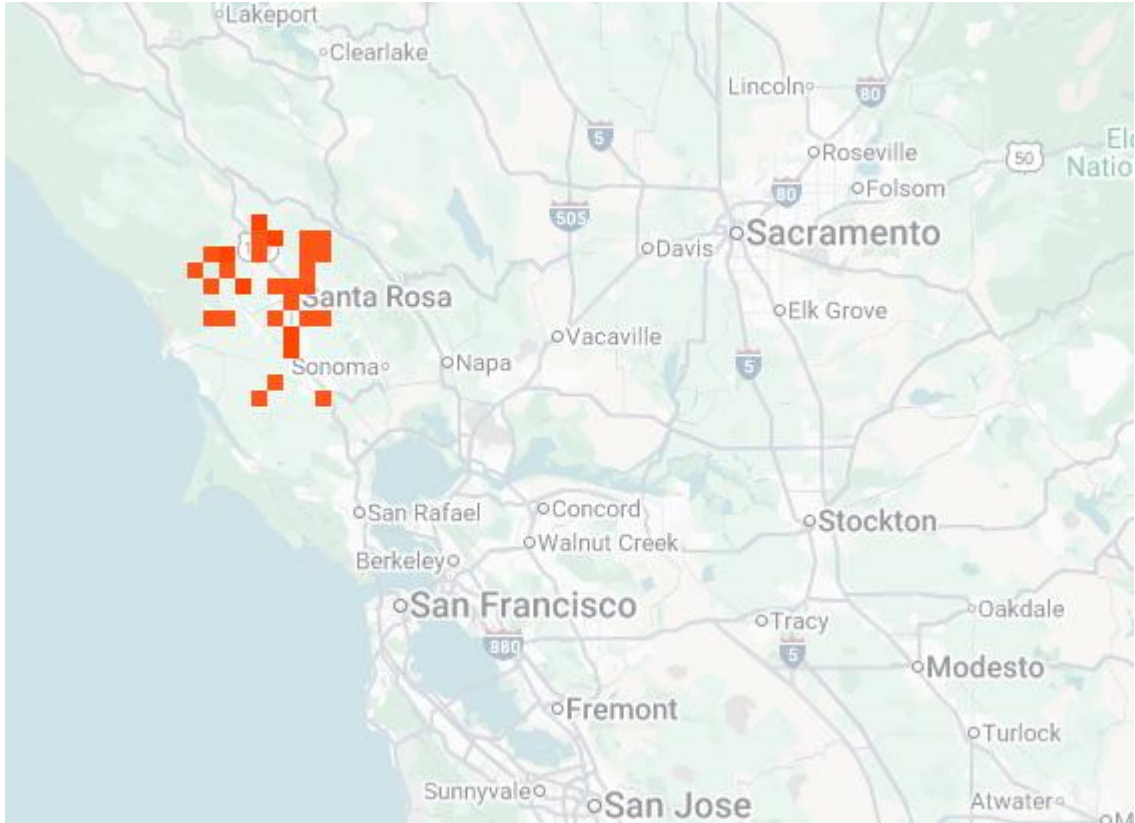


Figure A1-2. Known locations and core areas of the Sebastopol meadowfoam. Reproduced from FWS Recovery Plan (2016).

- **Occurrences in iNaturalist**
  - Searched on 09/05/2025
  - [https://www.inaturalist.org/observations?quality\\_grade=research&subview=map&axon\\_id=77750](https://www.inaturalist.org/observations?quality_grade=research&subview=map&axon_id=77750)
  - There are 39 research grade observations available from 2017 to 2025.
  - **Figure A1-4** depicts the locations of these observations.



**Figure A1-4. Screenshot from iNaturalist observations for the Sebastopol meadowfoam. Area depicted is on similar scale and location as species range depicted in Figure A1-1.**

**Occurrences in NatureServe**

- NatureServe was searched on 09/05/2025
- [https://explorer.natureserve.org/Taxon/ELEMENT\\_GLOBAL.2.160276/Limnanthes\\_vinculans](https://explorer.natureserve.org/Taxon/ELEMENT_GLOBAL.2.160276/Limnanthes_vinculans)
- NatureServe has 40 occurrences in Sonoma County, 7 of which had good estimated viability, and 8 of which are considered historic or extirpated.
- These locations are generally consistent with the location of the core map.

**Occurrences in GBIF**

- GBIF was searched on 09/05/2025
- There were 14 “human observations” available for this species between 2010 and 2025.

- [https://www.gbif.org/occurrence/search?basis\\_of\\_record=HUMAN\\_OBSERVATION&has\\_coordinate=true&has\\_geospatial\\_issue=false&taxon\\_key=5334530&year=2010,2025&occurrence\\_status=present](https://www.gbif.org/occurrence/search?basis_of_record=HUMAN_OBSERVATION&has_coordinate=true&has_geospatial_issue=false&taxon_key=5334530&year=2010,2025&occurrence_status=present)
- All observations were included in iNaturalist data.

Collectively, the occurrence data from iNaturalist, GBIF, and NatureServe are consistent with the core map and do not support further expanding the outer extent of the core map.

## Appendix 2. GIS Data Review and Method to Develop Core Map

This core map was created based on biological information, including species habitat and known locations. EPA used vernal pool habitat information, Sebastopol meadowfoam core recovery areas, and approximate known locations of extant populations occurring outside of the vernal pool habitats and/or core areas, according to the 2024 Five-Year Review.

### 1. Dataset References and Software

- Software used: ArcGIS Pro 3.3
- California Department of Fish and Wildlife’s ACE
  - Vernal Pools, Areas of Conservation Emphasis (ACE), version 3.0, last updated on 04/10/2025.
- Santa Rosa Plain Conservation Area shapefile
- Sacramento Fish and Wildlife Office Recovery Plans shapefiles
- FWS species range – updated 03/21/2018

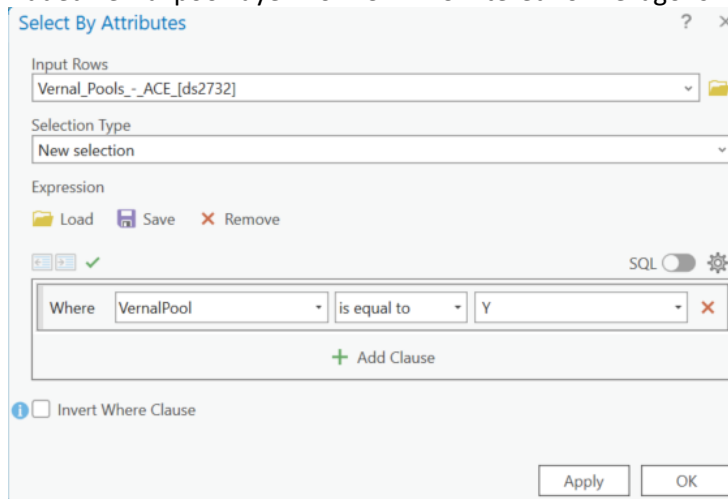
### 2. Datasets Used in Core Map Development

- All datasets used in core map development are described in EPA’s process document, including the California ACE dataset.

### 3. Core Map Development

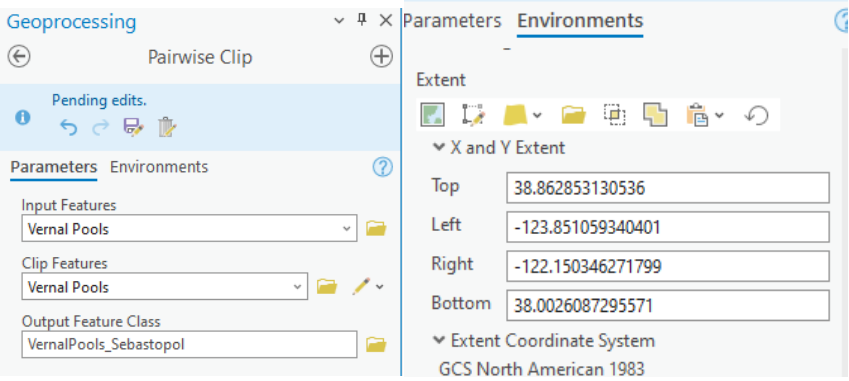
The core map for the Sebastopol meadowfoam is based on 1) vernal pools (habitat type) that are within the FWS-defined range or intersect with known locations from iNaturalist (if the habitat is outside of the range), 2) the Santa Rosa Plain Conservation Area (habitat type), 3) extant occurrences outside of the CA-FWS identified vernal pool areas, and 4) Sebastopol Meadowfoam core recovery areas identified by Sacramento FWS.

1. Added range, vernal pool habitats, core areas, iNaturalist occurrences, and Santa Rosa Conservation Area shapefiles to map.
2. Added vernal pool layer from CA FWS filtered for hexagons with vernal pools

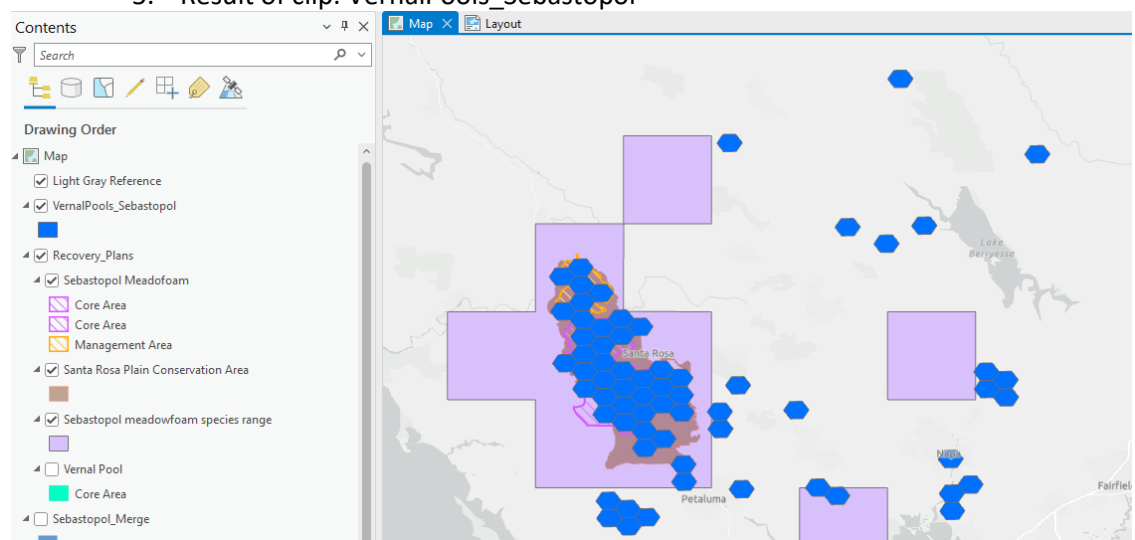


3. Created new layer from selected attributes called Vernal Pools.

4. Clipped the Vernal Pools layer to Sonoma/Napa County areas where the species occurs. Set processing extent to current display which was focused on these areas.

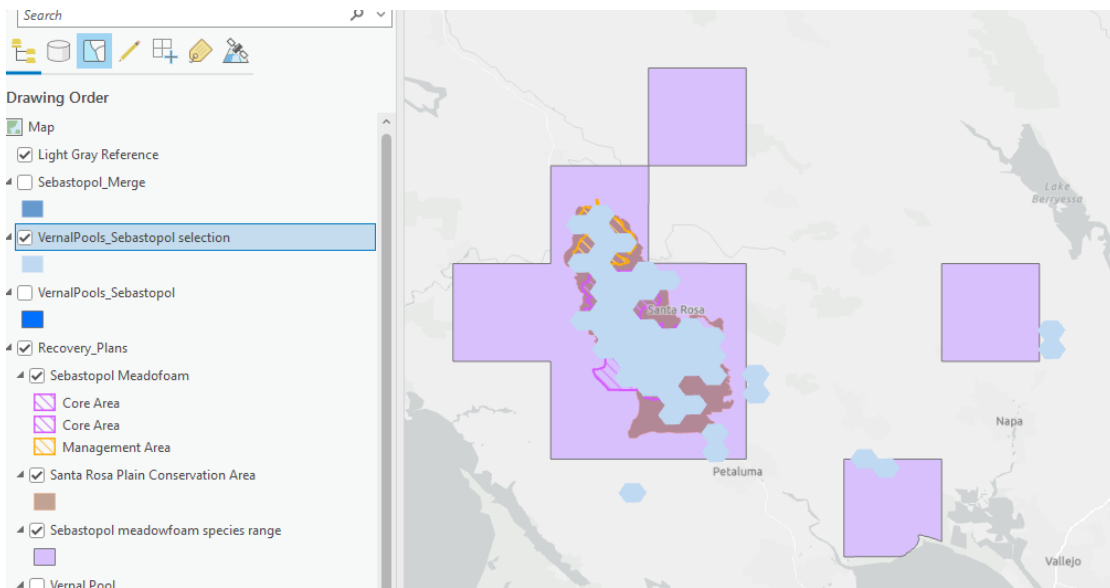


5. Result of clip: VernalPools\_Sebastopol

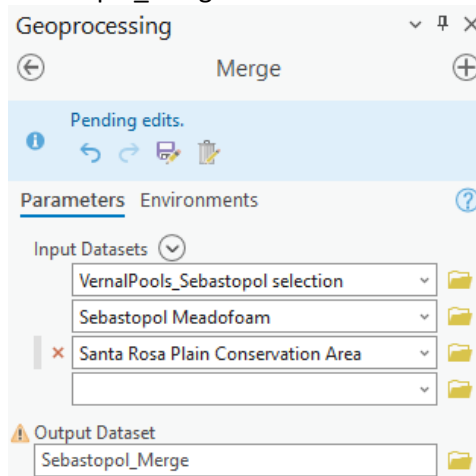


6. Selected all vernal pools (in VernalPools\_Sebastopol layer) within the range of the species and then additionally selected all vernal pools within 100 m of an iNaturalist observation. The purpose of this was to identify vernal pool habitat areas that are within the range or near where the species has been observed.

7. Created new layer from selected features called: VernalPool\_Sebastopol selection:



8. Merged selection layer with species core and management areas from Sacramento FWS recovery plan, as well as Santa Rosa Pain Conservation Area into new layer: Sebastopol\_Merge.



9. Added Polygons using Draw Polygon tool in the approximate locations of extant occurrences outside of the species range per the CNDBB/AVS Occurrences in the 2016 Recovery Plan. Renamed layer to Sebastopol meadowfoam interim core map

