LONG-TERM MONITORING AND MANAGEMENT PLAN
ALTON LANE CONSERVATION BANK
SONOMA COUNTY, CA

Prepared for:

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I INTRODUCTION

The purpose of this Long-term Management Plan (Long-term Plan) is to maintain habitat values for seasonal wetland habitat, California tiger salamander (*Ambystoma californiense*, CTS), and special-status plant species that may be present at the Alton Lane Conservation Bank (ALCB),[1] and to manage for the benefit of these resources. This Long-term Plan describes the management activities for ALCB designed to maintain and enhance the present habitat values of the site for CTS and special-status plant species. The key element of the Long-term Plan is the managed grazing of ALCB, which will be implemented according to the prescriptions of the grazing plan prepared by Dr. Stephanie Larson, a certified rangeland manager.

Prior to Bank Establishment, Alton Preserve, LLC will fully fund the long-term management endowment, which will be established and managed by the National Fish and Wildlife Foundation (NFWF).

ALCB supports suitable CTS upland habitat, and natural and constructed seasonal wetland habitat, consisting of vernal pools, seasonal wetlands and swales. Colonies of Burke's goldfields and Sonoma sunshine occur in some of the wetlands, and CTS are known to breed in a number of the deeper vernal pools at ALCB, which has been documented by the long-term studies by Mr. Dave Cook and his colleagues[2].

A ROLES AND RESPONSIBILITIES

The roles and responsibilities pursuant to the Conservation Bank Enabling Instrument (CBEI) are summarized below for the Property Owner, Land Manager, Bank Sponsor and Approving Agencies. Alton Preserve, LLC (a California limited liability company) is the Bank Sponsor and the current Property Owner. During the Interim Period and until such time as ownership of the Bank Property is transferred to another entity approved by the Approving Agencies, the Laguna de Santa Rosa Foundation (Laguna Foundation) will serve as the Land Manager. Once fee title is transferred to CDFW or to another entity, the responsibilities for management of the Bank Property as defined in the CBEI and summarized below will still apply.

The Property Owner shall ensure that the Bank Property is managed and maintained in accordance with this Long-term Management Plan, the CBEI, and its Exhibits.

Land Manager

The Land Manager will be responsible for the day-to-day management of the Bank Property pursuant to this Long-term Plan, the CBEI, and its Exhibits.

[1] The site where the Alton Lane Conservation Bank will be established was formerly known as the Alton Lane Mitigation Site (ALMS).

[2] D. Cook, D. Stokes and J. Meisler. California Tiger Salamander Larval Density and Survival at Natural and Constructed Breeding Pools, Sonoma County. Report prepared for U.S. Fish and Wildlife Service, Sacramento Field Office, Final Report, Grant Agreement No. F 13AP00010. January 2016

Bank Sponsor

The Bank Sponsor will be responsible for all activities and costs associated with the establishment and operation of the Bank, including documentation, maintenance, management, monitoring, and reporting, until completion of the Interim Management Period. The Interim Management Period is defined in the CBEI as the period from the Bank Establishment Date until Performance Standards have been met and the third anniversary of the full funding of the Endowment Amount has occurred.

Upon completion of the Interim Management Period, the Long-term Management Period will begin during which time the Bank Property is to be managed, monitored, and maintained pursuant to this Long-term Plan. Funding for the actions described in the Long-term Plan will be obtained from the Endowment Fund.

Approving Agencies (Conservation Bank Review Team)

The U.S. Fish and Wildlife Service (Service) and California Department of Fish and Wildlife (CDFW) collectively constitute the Approving Agencies. The Approving Agencies are responsible for overseeing of the performance and conducting compliance inspections, as necessary, to assess compliance with the provisions of the CBEI and its Exhibits, including this Long-term Plan.

This Long-term Plan is an adaptive management plan and, as such, the Approving Agencies will make a good faith effort to review the annual reports and Remedial Action plans within 60 calendar days from the date of receipt of complete submittal, including any changes in management activities recommended in the annual reports.

II PROPERTY DESCRIPTION

A GEOGRAPHIC SETTING AND LOCATION

ALCB consists of approximately 41.13 acres along Alton Lane (APN 034-042-081), near its western terminus, in northwest Santa Rosa (Bank Property) (Figure 1). Specifically, the Bank Property is located west of Fulton Road and north of Piner Road (Figure 2). The Bank Property's western boundary is adjacent to the Alton North Conservation Bank (ANCB) and the proposed Alton South Conservation Site (ASCS)[3] (Figure 2).

B HISTORY AND LAND USE

Based on a review of a 1942 aerial photograph[4] that covers the Bank Property, other agricultural uses (e.g., pasture or hay production) preceded the cultivation of vineyards at the Bank Property. Part of the Bank Property still supported vineyards when the initial construction of mitigation wetland began in the early 1990's based on the earliest aerial photographs on Google Earth (photo date: July 10, 1993). Approximately 9.33 acres of vernal pools and other seasonal wetland habitats were constructed at the Bank Property in the early 1990's as mitigation for several development projects. The Bank Property has remained fallow since wetlands were first constructed in the early 1990's.

There are a number of easements attached to ALCB (Figure 3). There are two pole line easements, one for PG&E (2743 OR 329 and 333) and one for California Telephone Light Company (51 DEEDS 195) (Figure 3). Sonoma County has a Septic Inspection Easement (DN 1987-23263) at the southern end of the Bank Property, but there are no septic systems on the Bank Property (Figure 3). Sonoma County also has two Scenic Easements on the Bank Property (DN 1989-70989 and DN 1990-18522).

There are four conservation easements held by CDFW recorded over 35.42 acres of the Bank Property (Figure 3). These easements were recorded over parts of the Bank Property between December 1989 and December 1999. The conservation easements were recorded over parts of the Bank Property that were used as mitigation for nearby development projects. A detailed discussion of the conservation easements is presented in Exhibit K-2 (Summary and Supplemental Information About the ALCB Property) of the Conservation Bank Enabling Instrument (BEI).

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[3] Alton South Conservation Site (ASCS) refers to the entire 8.39-acre parcel which includes the 6.92-acre Alton South Conservation Bank (ASCB) and 1.47-acre Alton South Mitigation Site. ASCB was approved in 2008 but was never formed. The Bank Sponsor has submitted documents to amend ASCB and form ASCS, which will include ASCB and the Alton South Mitigation Site.

[4] Sonoma County Vegetation Mapping and Lidar Program (www.sonomavegmap.org).

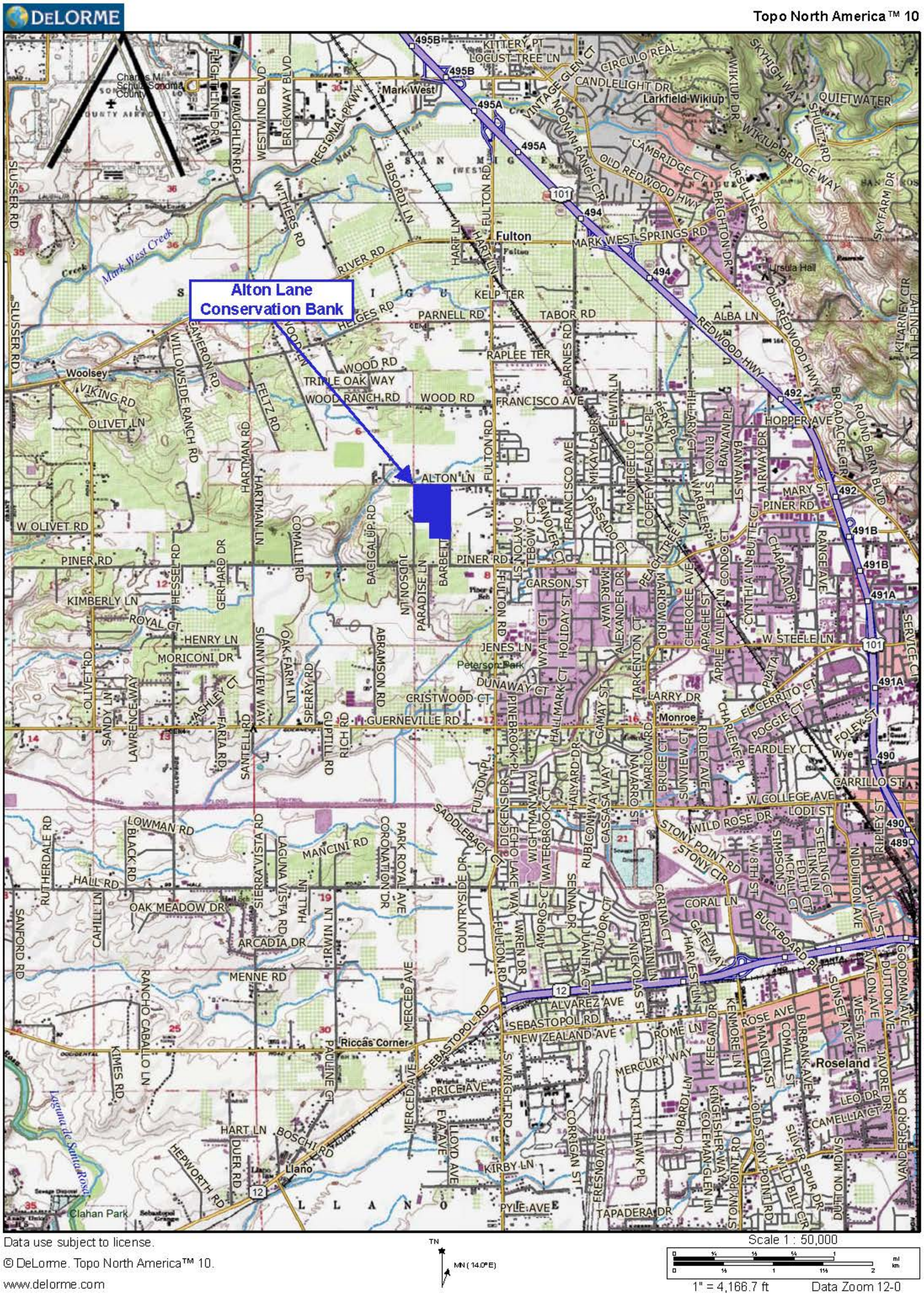

Figure 1. Location map for the Alton Lane Conservation Bank.

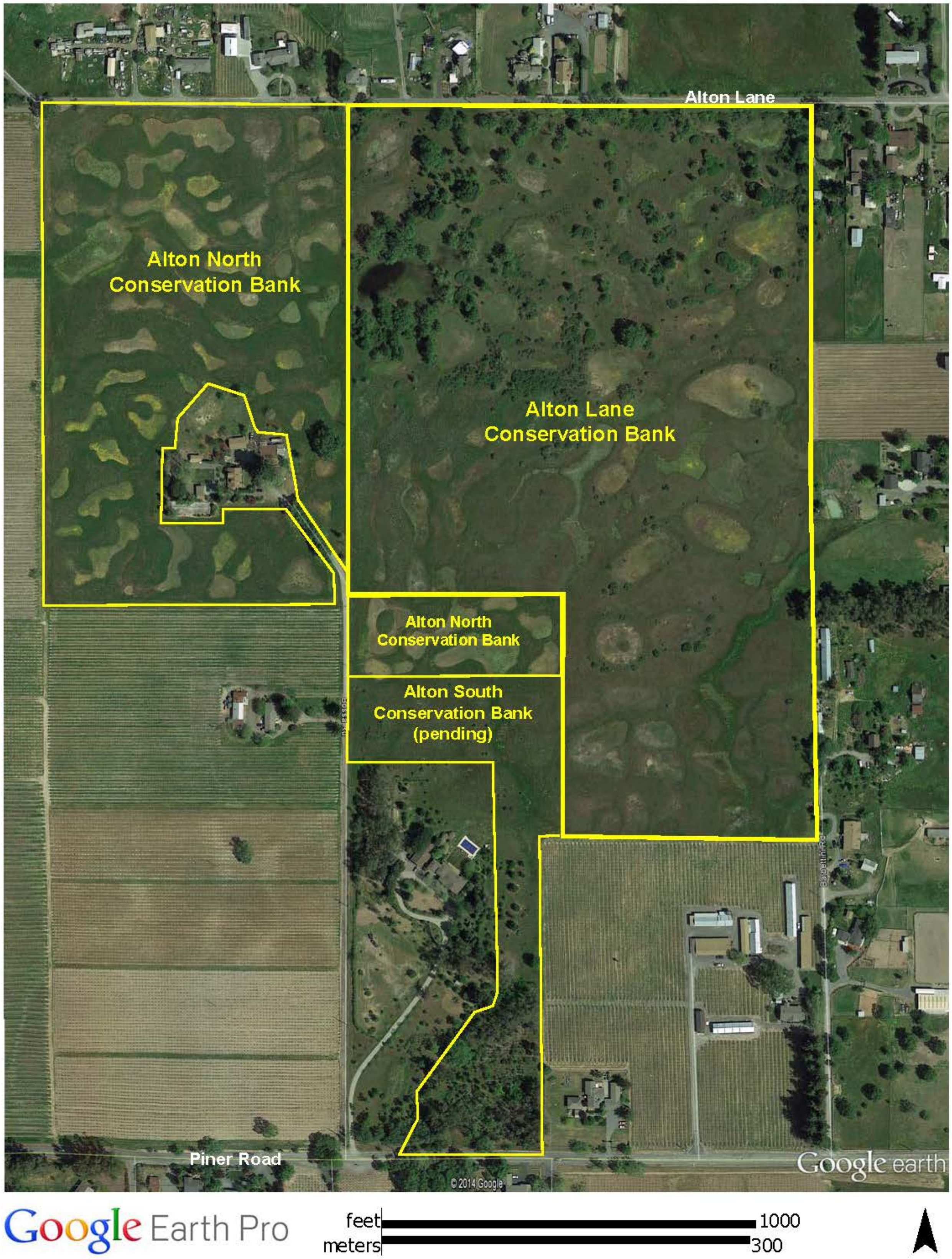

Figure 2. Vicinity map of the Alton Lane Conservation Bank.

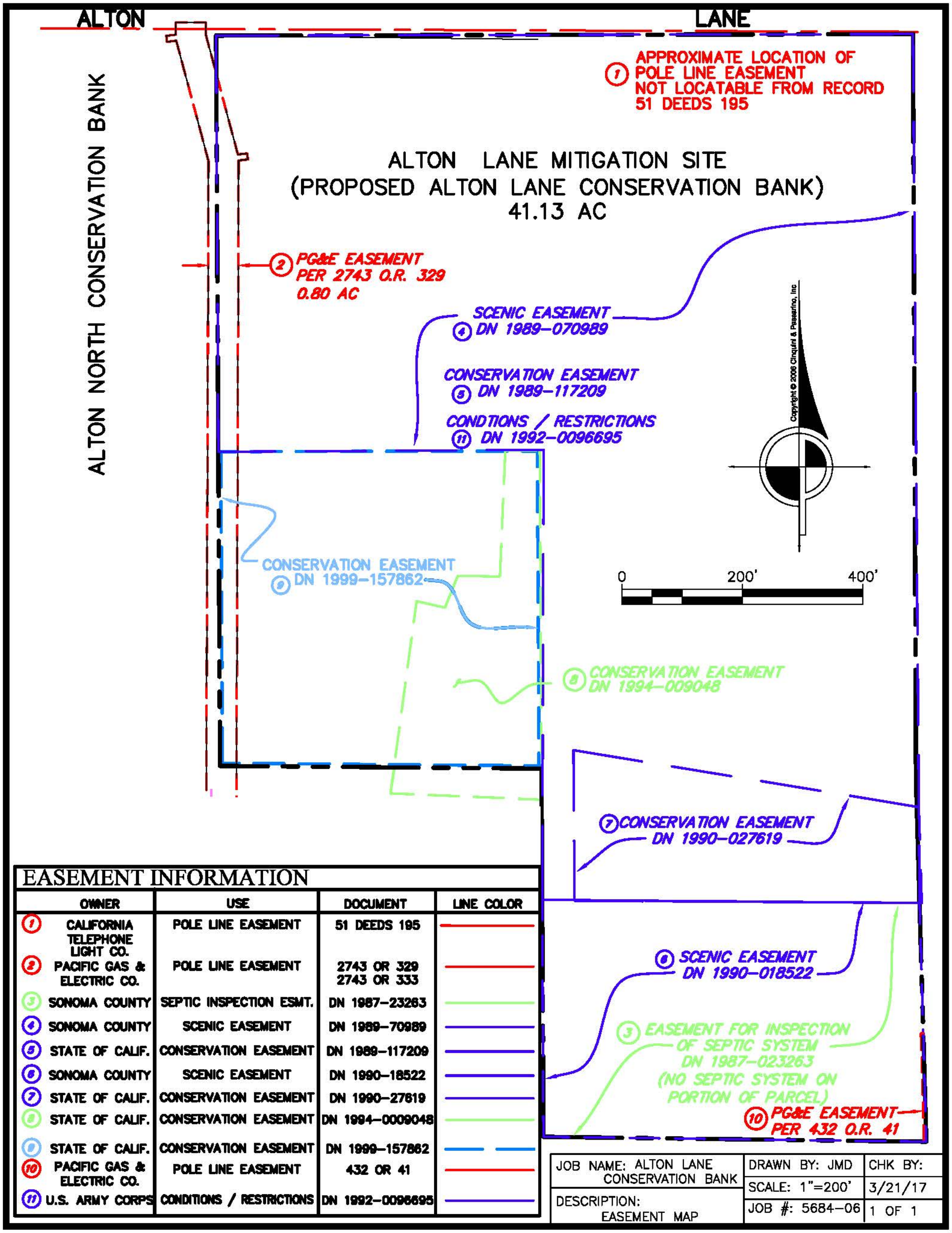

Figure 3. Easement map of the proposed Alton Lane Conservation Bank.

C SOILS AND HYDROLOGY

The soils of ALCB consist of several variants of Huichica Loam (NRCS Online Soil Survey, 2008). Most of the Bank Property consists of Huichica Loam, shallow, ponded, 0 to 5 percent slope, with smaller areas of Huichica Loam, 0 to 2 percent slopes, Huichica Loam, shallow, 0 to 9 percent slopes, and Huichica Loam, 2 to 9 percent slopes. Huichica soils possess a clay horizon at a depth of about two feet and occasionally a cemented hardpan below the clay. Together, they form an effective barrier to deep percolation and perch water near the surface. Although the surface relief appears to have been modified, particularly in the southern part of ALCB, the properties that affect ponding at the surface appear to remain intact on the property. The Huichica loam series is considered a vernal pool soil by the Vernal Pool Task Force (CH2M Hill 1995).

III HABITAT AND SPECIES DESCRIPTION

A VEGETATION COMMUNITIES, HABITATS AND PLANT SPECIES

ALCB consists of approximately 13.89 acres of seasonal wetlands, including approximately 9.33 acres of constructed vernal pools and other seasonal wetland habitat (seasonal wetlands, swales) and approximately 2.86 acres of "natural" wetlands, and approximately 27.24 acres of upland habitat. The wetlands at ALCB are known to support both the endangered Burke's goldfields (*Lasthenia burkei*) and Sonoma sunshine (*Blennosperma bakeri*), and dwarf downingia (*Downingia pusilla*), a special-status plant species in California.

Construction of the vernal pools was accomplished by pushing dirt from the excavated area and piling it up at the pool margins. Since no outlets directing water into intended flow paths were installed water flowed out at the lowest point(s) along the piled dirt berms. Because the dirt was piled up and compacted using standard engineering practices, water flows through the dirt and appears to have caused soil piping through the piled dirt in some of the berms.

The berms have also been compromised by small mammal burrowing activities. Gopher tunnels and soil pipes (products of soil piping) that have developed can lead to the collapse of the overlying soil with the introduction of livestock. The collapse would lower the functional outlets to the bottoms of the pipes or tunnels, which in some locations could result in the outlet barrier elevations being at the same level as the pool bottoms. The results could be substantial reductions in the depths and durations of ponding, the loss of habitat for Burke's goldfields and breeding habitat for CTS, and conversion of the pools to upland flats. The number of compromised outlets is unknown and would need to be determined during the winter months when ponded water is present.[5]

The following is a general description of vegetation at the Bank Property based on Patterson, Guggolz and Waaland (1994), and personal observation and discussions with Drs. Steve Talley and Larry Stromberg. A more detailed and up-to-date vegetation description will be developed during the Interim Management Period.

Seasonal Wetlands

The edges of the shallow to medium depth pools support a number of native vernal pool plant species, including Burke's goldfields, Sonoma sunshine, smooth goldfields (*Lasthenia glaberrima*), popcorn flower (*Plagiobothrys* spp.), toad rush (*Juncus bufonius*) and other rush species (*Juncus* ssp.), coyote thistle (*Eryngium* ssp.), hair grass (*Deschampsia danthonioides*), and a number of non-native species, including perennial ryegrass (*Festuca perennis*), Mediterranean barley (*Hordeum marinum* ssp. *gussoneanum*), rabbits-foot grass (*Polypogon monspeliensis*), spiny-fruited buttercup (*Ranunculus muricatus*), and pennyroyal (*Mentha pulegium*). In the deeper sections of the pools and in the deeper pools that remain inundated for a longer period of time, many of the same native species occur in addition to brown-headed rush (*Juncus*

[5] The location of the pools with berms of concern are shown in Figure 5.

phaeochephalus), Lobb's aquatic buttercup (*Ranunculus lobbii*), downingia (*Downingia* ssp.), water starwort (*Callitriche* ssp.), spike rush (*Eleocharis palustris*), and hedge hyssop (*Gratiola ebracteata*).

Upland Vegetation

The upland habitat at ALCB is dominated by annual grasses and forbs and weedy species typically associated with ruderal land, including wild and slender oats (*Avena fatua, A. barbata)*, soft chess (*Bromus hordeaceus*), ripgut brome (*Bromus diandrus*), wild radish (*Raphanus sativa*), Mediterranean barley, parentucellia (*Parentucellia viscosum*), tall fescue (*Festuca arundinacea*), subterranean and shamrock clover (*Trifolium subterraneum* and *T. dubium*), filaree (*Erodium* ssp.), vetch (*Vicia* sp.), six-weeks fescue *(Festuca bromoides*), lupines (*Lupinus bicolor* and *L. nanus*), cutleaf geranium (*Geranium dissectum*), hedge bindweed (*Convolvulus arvensis*), hare barley (*Hordeum murinum*), and little rattlesnake grass (*Briza minor*). Several species of oaks, including valley oak (*Quercus lobata*), black oak (*Quercus kelloggii*) and coast live oak (*Quercus agrifolia*), occur scattered throughout the northern half of the Bank Property, and there are patches of Himalayan blackberry (*Rubus armeniacus*) and other exotic shrubs (e.g., *Cotoneaster* sp.) at ALCB, especially in the northern end. Coyote bush (*Baccharis pilularis*) is scattered throughout the entire Bank Property, with larger shrubs being found at the northern part of ALCB. California oatgrass (*Danthonia californica*) is common around many of the vernal pool wetlands at the Bank Property, especially in the northern part of the Bank Property.

B SPECIAL-STATUS SPECIES

Special-status Plants. The vernal pools and other seasonal wetland habitats at the Bank Property support the endangered Burke's goldfields and Sonoma sunshine. The ALCB site has been used as a reference site for Burke's goldfields and Sonoma sunshine for special-status plant surveys conducted pursuant to survey protocols of the Service and CDFW, but there does not appear to have been multi-year comprehensive surveys of the wetlands to document the extent and abundance of Burke's goldfields and Sonoma sunshine in the vernal pools/seasonal wetlands at ALCB. The one record that provides information on the presence of Burke's goldfields and Sonoma sunshine in the pools that were surveyed at the time (circa 2010) is shown in Figure 4.[6]

Between 1989 and 1994 vernal pool and other seasonal wetland habitat was constructed at ALCB, which was known as the ALMS at the time, as mitigation for development of several parcels located east of the ALCB site. The mitigation for these projects included construction of vernal pool and other seasonal wetland habitat and inoculating the constructed wetlands with inoculum for Burke's goldfields and Sonoma sunshine collected from the vernal pools and other seasonal wetland habitat impacted by the nearby development projects.

[6] The locations in this figure are from a map produced by LSA titled Alton Lane Special-status Plants 2010. Based on the notations on the figure not all of the pools appeared to have been surveyed.

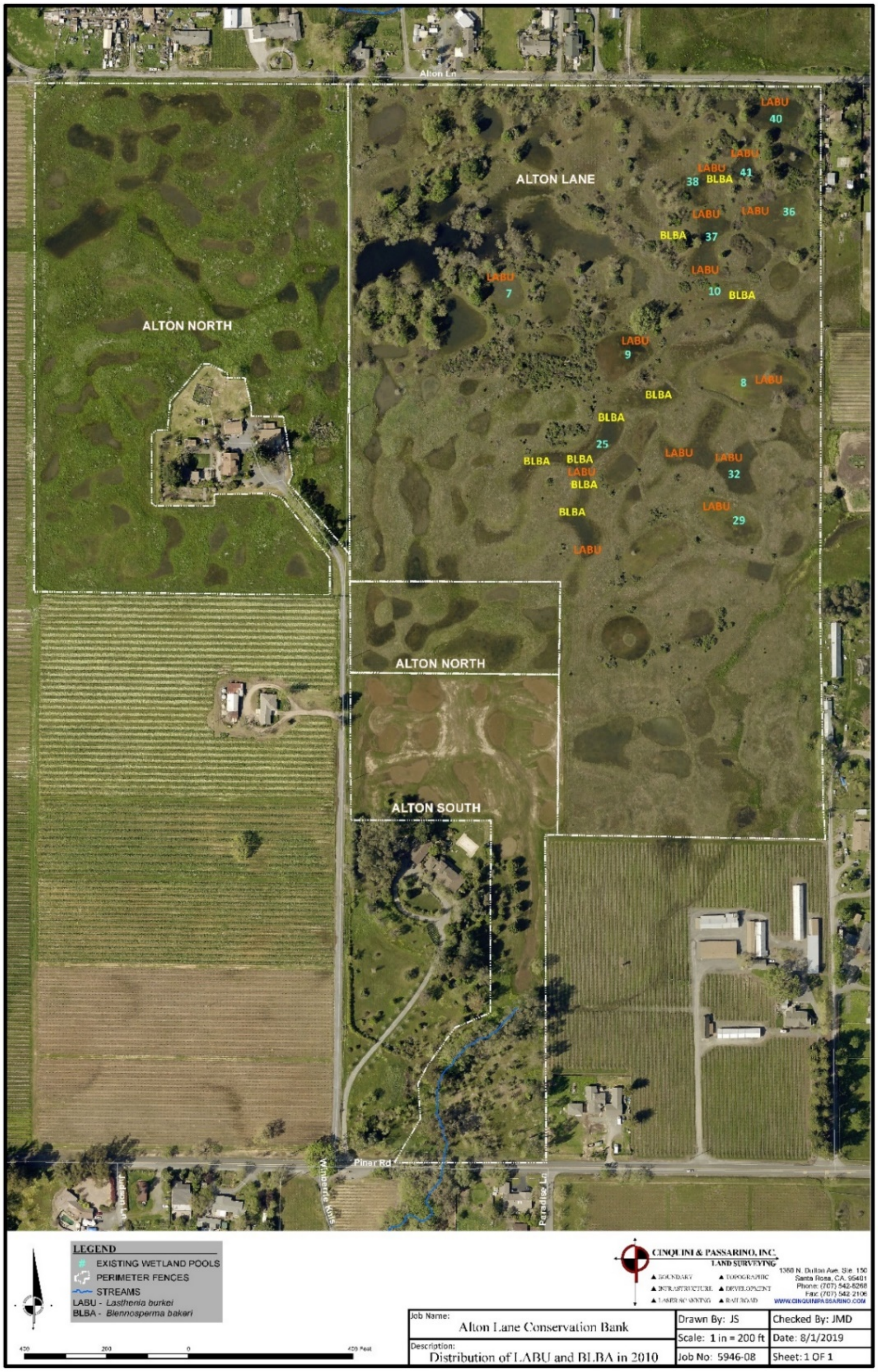

Figure 4. Vernal pools supporting populations of Burke's goldfield and Sonoma sunshine in 2010. Pool numbers from Cook and Stokes (2019).

Since the establishment of populations of Burke's goldfields and Sonoma sunshine, the vernal pools and other seasonal wetland habitat at ALCB have been used as a source of inoculum as a means of establishing populations of these two endangered plant species at mitigation and conservation banks that have been established on the Santa Rosa Plain. Inoculum collected from ALCB has been used to establish these two endangered plant species at the Hale Mitigation Bank (2004), Horn Mitigation Bank (2004, 2007), Woodbridge Preserve (2005), Slippery Rock Conservation Bank (2006) and ANCB (2010).

Populations have become established at these bank sites and inoculum has been collected and used at other bank sites to establish populations of these two endangered plant species elsewhere on the Santa Rosa Plain. For example, inoculum was collected in 2017 from ANCB to inoculate the vernal pools that were constructed at ASCS, and inoculum was collected from Woodbridge Preserve in 2017 to inoculate the vernal pools that were constructed at the Fulton Road Mitigation Site.

California Tiger Salamander. The Bank Property provides breeding and upland habitat for CTS, as this is the northern-most documented occurrence of CTS on the Santa Rosa Plain. Stokes et al. (2016)[7] have documented the steady increasing trend in the number of pools at the Bank Property where CTS larvae have been detected in any one year as well as a steady increasing trend in the larval abundance index between 2002 and 2015. These studies are ongoing, and Figure 5 shows the location of pools where CTS have been observed at least once in surveys conducted between 2002 and 2019 based on a recent report by Cook and Stokes (2019) summarizing the CTS surveys that have been conducted at ALCB since 2002.[8] A copy of the Cook and Stokes (2019) report is presented in Appendix A.

According to Stokes et al (2008)[9], the CTS breeding population at ALCB was thought to have originated with the introduction of approximately 15 larvae to Pool No. 1 in 1996 (C. Patterson pers. comm., cited in Stokes et al. 2008) (see Figure 5 for pool numbers). Dipnet surveys were conducted on March 29, 1996 by Cox (CDFW unpublished data; cited in Stokes et al. 2008) and he captured two CTS larvae that were presumed to be some of the 15 CTS larvae transplanted earlier in the year. Additional dipnet surveys were conducted by Cox on April 1, 1998 (30 min) and April 7, 1999 (15 minutes) but no

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[7] Stokes, D.L., D.G. Cook and J. Meisler. 2016. Preserving habitat remnants: an inadequate conservation strategy for an endangered amphibian *Ambystoma californiense* in an urbanizing area. In: Cook, D, D. Stokes and J. Meisler. 2016. California Tiger Salamander Larval Density and Survival at Natural and Constructed Breeding Pools, Sonoma County, CA. Report prepared for U.S. Fish and Wildlife Service, Sacramento Field Office. Final Report, Grant Agreement No. F13AP00010. January 2016.

[8] Information on Figure 5 from Dave Cook and David Stokes. 2019. California Tiger Salamander Resources at the Alton Lane Mitigation Site. Report prepared for Alton Preserve, LLC.

[9] Stokes, D., D.G. Cook and P.C. Trenham. 2008. Sonoma California Tiger Salamander Population Ecology and Preserve Management: An Eight-Year Study. Prepared for U.S. Fish and Wildlife Service, 2800 Cottage Way, W- 2605, Sacramento, CA 95825; FWS Agreement No.: 814206J158. Report dated February 5, 2008.

CTS larvae were detected (Stokes et al. 2008).

Stokes et al. (2008) initiated their long-term study of CTS larvae in 2002 and found CTS larvae in Pool No. 1. They surmise that since CTS first breed at about age four or five (Trenham et al. 2000, cited in Stokes et al. 2008) larvae from the 1996 translocation probably returned to breed in Pond No. 1 in 2000 or 2001.

A second introduction of CTS to Pool No. 1, consisting of 65 adults (28 females, 37 males), occurred during the winter of 2004 (W. Cox, pers. comm., cited in Stokes et al. 2008). These adults had been salvaged from the current location of Lowes Hardware Store in west Cotati, approximately 10.2 miles (16.4 km) southeast of ALCB.

Since the initiation of the initiation of CTS larvae surveys at ALCB in 2002, CTS breeding has been confirmed in 14 of the pools, and CTS larvae have been detected in Pool No. 1 during every survey over the 18 years that surveys have been conducted Cook and Stokes (2019). Since the initiation of the CTS larvae surveys in 2002 there has been a steady progression in the occurrence of CTS breeding in the other pools located at ALCB. CTS breeding was also documented at ANCB in the spring 2011 at several of the vernal pools constructed in the summer/fall 2010 (Cook and Stokes 2019).

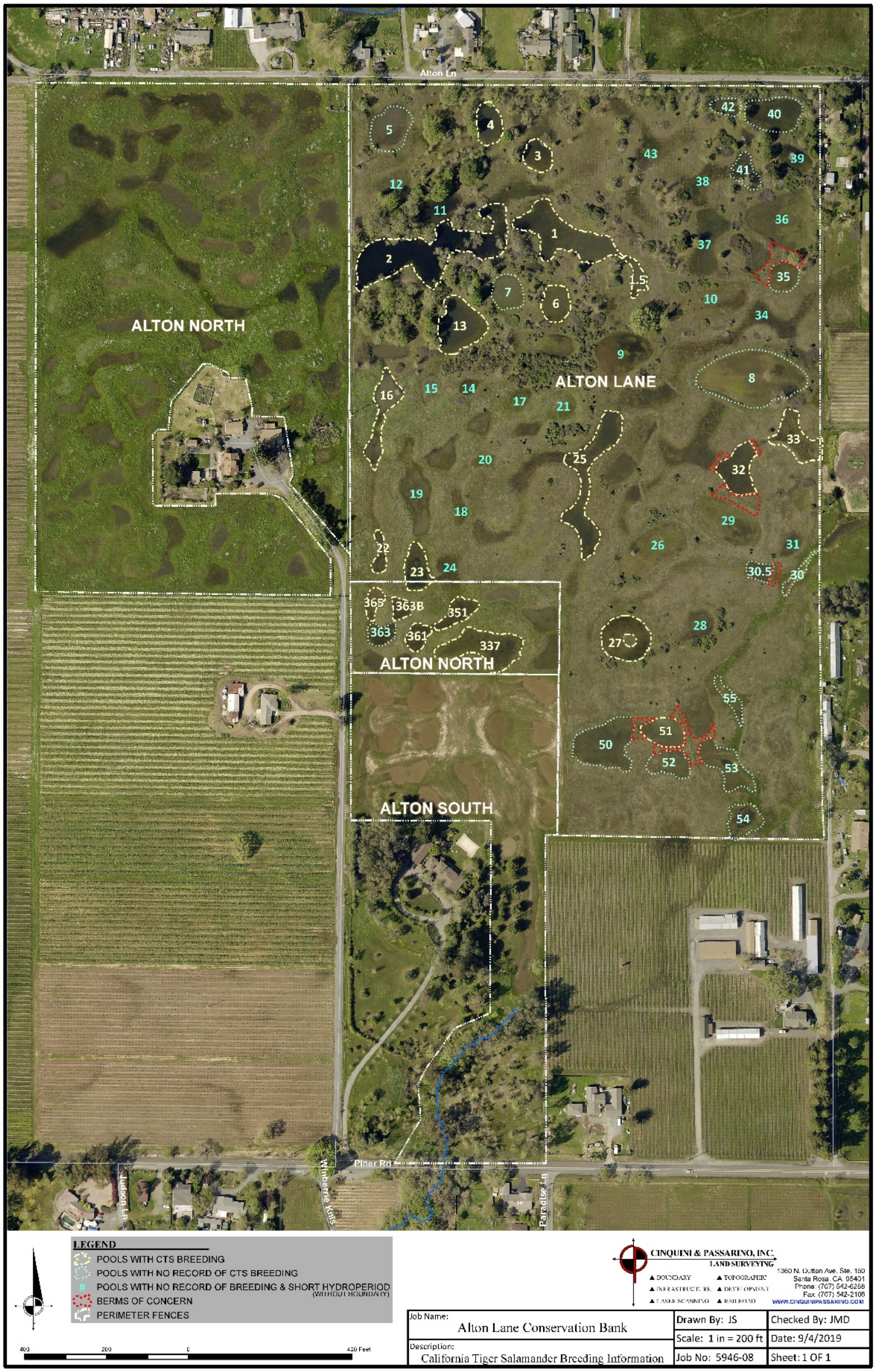

Figure 5. Aerial photograph of ALCB showing pools where CTS larvae have been observed. Pool numbers and status from Cook and Stokes (2019).

IV MANAGEMENT AND MONITORING: ELEMENTS, GOALS AND TASKS

The following section provides details of the management and monitoring at ALCB. Management and monitoring issues are classified into Super Elements and Elements. Each numbered Element has one to several goals and a list of specific tasks for implementation. Task implementation will also produce a record of the site, which will allow for periodic assessment and the potential development of adaptive management strategies.

Adaptive management was developed as a strategy to address complex environmental problems. The strategy was developed in the recognition that initial management steps may not work, that first ideas may not be the best ideas, that effective long-term management requires recognition of successes and failures, and that managers must adapt their strategy to new information. The six main steps in adaptive management are assessment of the problem, design of a management strategy (solution), implementation of the management strategy, monitoring, evaluation, and adjustment.

Adaptive management is a pragmatic approach, given the limited existing information and experience in managing and maintaining habitat for the listed species at ALCB. Initial strategies may appear ecologically sound, but in practice they may be impractical, ineffective, or inefficient. Management and maintenance methods may be adjusted to improve the effectiveness and efficiency of long-term management and maintenance and to adjust performance criteria.

Over time, the specific tasks may be revised, added, or deleted as determined appropriate by the Approving Agencies. It is anticipated that these management and monitoring tasks will be adapted to the needs of the biological resources on the Bank Property, new information, and changes on the Bank Property and the surrounding environment.

The schedule for implementation of the tasks described in this Long-term Plan is presented in Table 1 at the end of this section. The timing of each activity shown in Table 1 will likely vary based on a number of factors, such as rainfall patterns, and should only be used as a general guidance. Table 2, located at the end of this section, identifies the general conditions associated with initiation of each of the long-term activities.

Until fee title to the Bank Property is transferred to CDFW or another approved entity, the Bank Sponsor will be responsible for implementation of the Long-term Plan and the resulting data collected during the monitoring activities will be summarized on the standardized **Management and Monitoring Reporting Forms** and the Service's **Monitoring Report Checklist,** which are presented in Section VI of this document. The completed forms and checklist will be included in the annual report, which will be uploaded into the Regulatory In-lieu Fee and Bank Information Tracking System (RIBITS) database or an electronic copy submitted to the Approving Agencies, by December 15 each year. Following fee title transfer to the new landowner, they will be responsible for implementation of the Long-term Plan and preparation of the annual report.

A SUPER ELEMENT 1 – BIOLOGICAL RESOURCES

Element 1-1: Listed Species

Goal: Planning and Coordination of Listed Species Survey Activities.

Objective: Plan annual activities associated with monitoring surveys of listed species conducted at the Bank Property.

Task 1-1-1: Prepare annual schedule of monitoring activities for listed species surveys.

Goal: Document successful breeding of CTS

Objective: Determine whether CTS continue to persist at the Bank Property by documenting the presence of CTS.

Task 1-1-2: Every other year conduct CTS egg surveys at appropriate time of the year based on rainfall pattern.

Task 1-1-3: In the same year that CTS egg surveys are performed conduct a CTS larval survey between March 15 and April 15 based on rainfall patterns and extent of ponding in CTS breeding pools.

Task 1-1-4: Every other year and during the same year in which Tasks 1-1-2 and 1-1-3 are performed, monitor CTS breeding pool condition by recording depth of CTS breeding pools biweekly starting when the pools begin to pond water to when the pools have dried up using the staff gauges installed in each CTS breeding pool.

Task 1-1-5: In at least one of every four years and in a year when Tasks 1-1-2, 1-1-3, 1-1-4 are performed, conduct larval surveys timed to detect larvae which are at a stage of development which indicates they will be able to complete metamorphosis (e.g. show remnant gill stubs, have near complete absorption of tail fin, etc.) or prior to the pool drying or becoming otherwise unfavorable for larval development.

Data recorded will include date, pool identification number, water depth and turbidity, CTS life stage, whether CTS are fully gilled or beginning the process of gill resorption, and presence and type of food resources, and predators. Decontamination procedures must follow the Declining Amphibian Populations Task Force Fieldwork Code of Practice (USFWS 2005) when moving between watersheds.

Task 1-1-6: Validate data collected in the field, transcribe and store data in a secure format (e.g., spreadsheet) that can be used to analyze the data and incorporate into annual reports (Data Reduction/Management).

Goal: Document occurrence of Burke's goldfields and Sonoma sunshine.

Objective: Determine whether Burke's goldfields and Sonoma sunshine continue to persist on the property, by documenting the presence of Burke's goldfields and Sonoma sunshine.

Task 1-1-7: Survey annually for occurrence:

- Survey for Sonoma sunshine in March-April during the peak flowering period, which will vary annually depending on rainfall patterns;
- Survey for Burke's goldfields in April-June during the peak flowering period, which will vary annually depending on rainfall patterns;
- Estimate the approximate number of plants in each pool using the following density classes:

Category	Range of Plant Numbers
1	0
2	1-50
3	51-100
4	101-500
5	501-1,000
6	1,001 – 5,000
7	5,001 – 10,000
8	10,001 – 100,000
9	> 100,001

Task 1-1-8: Validate data collected in the field, transcribe and store data in a secure format (e.g., spreadsheet) that can be used to analyze the data and incorporate into annual reports (Data Reduction/Management).

Element 1-2: Invasive Species

Managed grazing as described in the approved Grazing Plan will be the primary approach to control the growth of herbaceous invasive plant species at ALCB. Manual removal of localized occurrences of invasive species, mostly woody and shrubby invasive species, will also be used to control the occurrence of invasive species. Control of invasive plants also may include the use of specific herbicides. The following procedure will be adhered to prior to application of herbicides at ALCB:

Prior to the use of any herbicides, Property Owner shall consult a Licensed Pest Control Advisor (PCA) who shall prepare a recommendation on specific herbicides, application rates, application method and equipment *used. Pesticide application activities shall conform to all applicable local, state and federal regulations.*

The PCA will include consideration of the possible effects of the recommended herbicide on sensitive species occurring at ALCB, including CTS, Burke's goldfields and Sonoma sunshine, when evaluating and identifying recommended herbicide(s) to apply to control targeted invasive plant species.

Goal: Planning and Coordination of Long-term Plan activities for control of invasive species.

Objective: Plan annual activities associated with control on invasive species at the Bank Property.

Task 1-2-1: Prepare annual schedule of monitoring and implementing activities for controlling invasive species.

Goal: Control the presence of invasive plant species.

Objective: Identify which invasive species should be subject to control or eradication actions based on abundance and threat to the habitat values of ALCB.

Task 1-2-2: Once annually, at an appropriate time (generally late spring to summer), identify areas of significant invasive species populations.

Objective: Develop and implement treatments for invasive species.

Task 1-2-3: Prioritize treatments at least annually, based on: 1) location and distribution of targeted invasive species, 2) potential threat of the invasive species and potential treatment impacts upon CTS, listed plant species, and wetland habitats, 3) probability of treatment success, and 4) cost and effort of treatment.

Task 1-2-4: Implement specific treatment methods.

Element 1-3: Vegetation Management and Enhancement

The elements of the grazing plan will be implemented to maintain and enhance the value of the Bank Property for native upland habitat, CTS upland and breeding habitat and habitat for special-status plant species. The Bank Sponsor will be responsible for implementing the elements of the grazing plan until fee title is transferred to CDFW or another approved entity at which time the new landowner will be responsible for implementing the grazing plan.

Goal: Planning and Coordination of Long-term Plan activities for vegetation management and enhancement activities.

Objective: Plan annual activities associated with vegetation management and enhancement at the Bank Property.

Task 1-3-1: Prepare annual schedule of monitoring activities for listed species surveys.

Goal: Implement the Grazing Plan by achieving the goals and objectives described therein.

Objective: Ensure that the grazing regime is resulting in the desired level of biomass removal, reducing fire fuel loads to an acceptable level, controlling targeted undesirable grasses and forbs, and maintaining viable habitat for CTS movement.

Task 1-3-2: Develop and administer grazing lease.

Task 1-3-3: Administer professional advisor contracts (Certified Rangeland Manager-CRM).

Task 1-3-4: Implement grazing plan.

Task 1-3-5: Determine residual dry matter (RDM) each fall before the rainy season begins.

Task 1-3-6: Evaluate results of RDM monitoring and coordinate with grazing lessee to make any necessary changes in stocking rate or modifications to grazing period; consult with CRM.

Task 1-3-7: Mow perimeter if required by Fire Marshall to manage fuel load if grazing not sufficient.

B SUPER ELEMENT 2 – SCIENTIFIC RESEARCH AND SITE SECURITY

Element 2-1: Scientific Research

There may be on occasion requests to access the site to conduct research or monitoring related to the management, and enhancement of habitat for CTS and special-status plants, and other biological resources occurring on the Santa Rosa Plain. Unless and until CDFW becomes Property Owner, written approval for such activities will be subject to agreement by the approving agencies and Bank Sponsor. Persons requesting to conduct research will be required to provide a summary of project objectives and methods, duration and timing, justification of the need for the project, contact information or persons/entity conducting research on the Bank Property, and to produce a final summary report which includes management recommendations based on the finding of the research.

Goal: Support research that will contribute to management of ALCB for CTS and special-status plants, and other biological resources occurring at ALCB

Objective: Allow research that will provide data to increase knowledge of CTS and special-status plants life history parameters at ALCB.

Task 2-1-1: Administer agreements with those conducting research at ALCB.

Element 2-2: Trash and Trespass

Goal: Manage Occurrence of Trash

Objective: Collect and remove trash.

Task 2-2-1: Collect and remove trash when encountered.

Goal: Project site from trespass

Objective: Monitor and repair vandalized structures and repair impacts resulting from trespass.

Task 2-2-2: At least once yearly or when encountered, identify areas of trespass and damage resulting from trespass.

Task 2-2-3: Formulate actions based on: 1) best use of available funds, 2) impacts to biological resources on site, and 3) other related issues.

Task 2-2-4: Implement actions to repair trespass damage.

Element 2-3: – Fire Control

Implementation of the prescriptions in the grazing plan should eliminate the need for a separate fire control element; however, in years when grazing does not occur, or otherwise as needed, an area along the edge of the perimeter of ALCB as prescribed by the local fire protection district, will be mowed in the late spring or early summer for the purposes of fire control. This Element is addressed in Task 1-3-7 under Element 1-3 (Vegetation Management).

C SUPER ELEMENT 3 – INFRASTRUCTURE AND FACILITIES

Element 3-1: Fences, Gates and Livestock Water Infrastructure

Goal: Protect site and facilitate grazing.

Objective: Monitor and maintain in good condition fences, gates, and livestock water supply, delivery and storage structures. Maintain fences, gates to prevent casual trespass, allow necessary access, and facilitate grazing program.

Task 3-1-1: Communicate condition of fences and gates to grazing lessee when repairs are needed during active grazing season.

Task 3-1-2: Make repairs to fences and gates as needed during the non-grazing season when grazing lessee is not present.

Task 3-1-3: Maintain and repair water infrastructure as needed.

Task 3-1-4: Replace fences and grazing infrastructure.

- Replace fences every 30 years or as needed. The fencing to be replaced include the fencing along the northern, eastern and parts of the southern perimeter of ALCB, and the interior fencing. Fencing along the western boundary of ALCB that borders on ANCB was installed when ANCB was constructed in 2010 and will be replaced when the perimeter fencing around ANCB is replaced although a $3.00/linear foot expenses has been added to the ALCB endowment to cover the increased cost in fencing materials since the ANCB perimeter fence was installed. The perimeter fencing along the southwestern end of ALCB that shares a common border with ASCS will be included in the ASCS endowment. See Appendix B for figure showing the fencing that will be replaced as part of the Long-term Plan.
- Replace corner/tension posts every 30 years.
- Replace gates every 20 years or as needed.
- Replace water pump/solar panels every 15 years or as needed.
- Replace pump house every 20 years or as needed.
- Replace water troughs every 20 years or as needed.

Task 3-1-5: Monitor groundwater used for livestock and pay water usage fee to County.

Element 3-2: Other Bank Property Infrastructure

<u>Goal: Maintain site infrastructure</u>

<u>Objective:</u> Monitor and maintain any signs, measuring or monitoring devices, temporary structures, or other site infrastructure.

Task 3-2-1: Observe conditions of signs, measuring or monitoring devices, temporary structures, or other site infrastructure.

Task 3-2-2: As necessary, replace signs that have been damaged or lost.

Task 3-2-3: As necessary, and as funding allows, repair damage to measuring or monitoring devices, temporary structures, or other site infrastructure.

D SUPER ELEMENT 4 – REPORTING AND ADMINISTRATION

Element 4-1: Annual Report

Goal: Communicate status to Approving Agencies.

Objective: Provide annual report on activities conducted and general site conditions to agencies and other parties.

Task: 4-1-1 Prepare annual report and relevant supplemental information.

Task:4-1-2 Upload complete report into RIBITS data base or provide electronic copy to Approving Agencies by December 15 of each year.

Element 4-2: Administration

Goal: Administration of Long-term Plan activities.

Objective: Complete administrative tasks for long-term management of Bank Property.

Task 4-2-1: Project management.

Task 4-2-2: Administer infrastructure repair and replacement contracts.

Task 4-2-3: Office space, insurance and related administrative costs.

Table 1. Long-term Management and Monitoring Schedule for ALCB.

LONG-TERM ACTIVITIES	**MONTH**											
Element 1-1: Listed Species Surveys	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Task 1-1-1: Planning & Coordination of Monitoring Activities	■	■	■								■	■
Task 1-1-2: CTS Monitoring-Egg Surveys	■	■										
Task 1-1-3: CTS Monitoring-Larval Survey			■	■								
Task 1-1-4: Monitor CTS Breeding Pool Condition	■	■	■	■	■	■						
Task 1-1-5: Late Season CTS Surveys (once every 4 years)					■	■						
Task 1-1-6: CTS Monitoring Data Reduction/Management							■	■				
Task 1-1-7: Listed Plant Surveys-Burke's Goldfields					■							
Task 1-1-7: Listed Plant Surveys-Sonoma Sunshine			■	■								
Task 1-1-8: Listed Plant Surveys-Data Reduction/Management							■	■				
Element 1-2: Invasive Species Management												
Task 1-2-1: Planning & Coordination-Prepare Activity Schedule	■	■	■	■	■	■	■	■	■	■	■	■
Task 1-2-2: Survey & Map Invasive Plants			■	■	■	■	■					
Task 1-2-3: Prioritize Treatment				■	■	■	■	■				
Task 1-2-4: Invasive Weed Control-Manual Removal	■	■	■	■	■	■	■	■	■	■	■	■
Task 1-2-4: Invasive Weed Control-Supervision of Manual Removal	■	■	■	■	■	■	■	■	■	■	■	■
Task 1-2-4: Invasive Species Eradication-Herbicide Application	■	■				■	■	■	■			■
Element 1-3: Vegetation Management												
Task 1-3-1: Planning & Coordination- Prepare Activity Schedule	■	■	■	■	■	■	■	■	■	■	■	■
Task 1-3-2: Develop & Administer Grazing Lease	■	■	■									■
Task 1-3-3: Administer Professional Advisor Contracts (CRM)								■	■	■	■	
Task 1-3-4: Implement Grazing Plan	■	■	■	■	■	■	■	■	■	■	■	■
Task 1-3-5: RDM Monitoring									■	■		
Task 1-3-6: Evaluate Results of RDM											■	■
Task 1-3-6: Consult with Certified Rangeland Manager										■	■	■
Task 1-3-7: Mowing (Fire Control)					■	■						
Element 2-1: Scientific Research												
Task 2-1-1: Administer Agreements for Research	■	■	■	■	■	■	■	■	■	■	■	■
Element 2-2: Trash and Trespass												
Task 2-2-1: Trash Monitoring & Removal	■	■	■	■	■	■	■	■	■	■	■	■
Task 2-2-2: Identify Damages Resulting from Trespass	■	■	■	■	■	■	■	■	■	■	■	■
Task 2-2-3: Planning and Coordination/Administration of Repair	■	■	■	■	■	■	■	■	■	■	■	■
Task 2-2-4: Repair Trespass Damage	■	■	■	■	■	■	■	■	■	■	■	■
Element 3-1: Fences, Gates and Livestock Infrastructure												
Task 3-1-1: Coordinate Repair with Grazer during Grazing Season		■	■	■	■	■	■	■	■			
Task 3-1-2: Repair Fences & Gates during Non-grazing Season	■									■	■	■
Task 3-1-3: Maintain/Repair Water Infrastructure	■	■	■	■	■	■	■	■	■	■	■	■
Task 3-1-4: Replace Major Infrastructure	■	■	■	■	■	■	■	■	■	■	■	■
Task 3-1-5: Monitor Groundwater Usage by Livestock	■	■	■	■	■	■	■	■	■	■	■	■
Element 3-2: Other Bank Site Infrastructure												
Task 3-2-1: Monitor Condition of Other Infrastructure	■	■	■	■	■	■	■	■	■	■	■	■
Task 3-2-2: Replace Signs as Necessary	■	■	■	■	■	■	■	■	■	■	■	■
Task 3-2-3: Repair/Replace Measuring Devices/Temporary Structures	■	■	■	■	■	■	■	■	■	■	■	■
Element 4-1: Annual Report												
Task 4-1-1: Prepare Annual Report										■	■	■
Task 4-1-2: Submit Annual Report by December 15th												■
Element 4-2: Administration												
Task 4-2-1: Project Management	■	■	■	■	■	■	■	■	■	■	■	■
Task 4-2-2: Prepare/Administer Contracts for Infrastructure Repair	■	■	■	■	■	■	■	■	■	■	■	■
Task 4-2-3: Administrative Cost (Office Space, Insurance, etc.)	■	■	■	■	■	■	■	■	■	■	■	■

Table 2. Conditions for Initiating Long-term Activities at ALCB.

LONG-TERM ACTIVITIES	INITIATION OF ACTIVITY
Element 1-1: Listed Species Surveys	
Task 1-1-1: Planning & Coordination of Monitoring Activities	This task will occur prior in the fall and early winter/spring months depending on rainfall patterns and ponding in the pools.
Task 1-1-2: CTS Monitoring-Egg Surveys	Surveys will be conducted every other year once pools fill in the winter and CTS breeding migration has been documented.
Task 1-1-3: CTS Monitoring-Larval Survey	Larval survey will be conducted the same year as the egg surveys between March 15 and April 15 depending on rainfall pattern.
Task 1-1-4: Monitor CTS Breeding Pool Condition	This task will be conducted every other year during the same year that egg and larval surveys are conducted; reading of staff gauges in each pool will be initiated biweekly (every other week) once the pools begin to fill in December/January and continue until pools are dry in the spring/early summer.
Task 1-1-5: Late Season CTS Surveys (once every 4 years)	Late season larval surveys will be conducted once every four years during a year when Tasks 1-1-2, 1-1-3 and 1-1-4 are conducted.
Task 1-1-6: CTS Monitoring Data Reduction/Management	This task will be implemented once the egg and larval surveys, and monitoring of CTS breeding pool condition have been completed for the year.
Task 1-1-7: Listed Plant Surveys-Burke's Goldfields	Surveys will be conducted in May during the peak flowering period for Burke’s goldfields based on field observations.
Task 1-1-7: Listed Plant Surveys-Sonoma Sunshine	Surveys will be conducted in March-April during the peak flowering period for Sonoma sunshine based on field observations.
Task 1-1-8: Listed Plant Surveys-Data Reduction/Management	Following completion of the field surveys, data will be reduced and evaluated
Element 1-2: Invasive Species Management	
Task 1-2-1: Planning & Coordination	This will be an ongoing task
Task 1-2-2: Survey & Map Invasive Plants	This task will occur in the spring once species are identifiable.
Task 1-2-3: Develop/Prioritize Treatment	This task will occur once the extent of invasive species has been mapped.
Task 1-2-4: Invasive Weed Control-Manual Removal	Manual removal may occur anytime during the year depending on the extent of particular species and ease of manually removing the species.
Task 1-2-4: Invasive Weed Control-Supervision of Manual Removal	The work of those manually removing larger areas of invasive species will be supervised, if necessary, depending on the experience of those manually removing invasive species.
Task 1-2-4: Invasive Species Eradication-Herbicide Application	The use of herbicides will be based on the species of invasive plant, the extent of such species, and the likelihood of success using herbicide; such action will be based on consultation with a PCA and consideration of collateral injury of non-target species (e.g., native species)

LONG-TERM ACTIVITIES	INITIATION OF ACTIVITY
Element 1-3: Vegetation Management	
Task 1-3-1: Planning & Coordination	This will be an ongoing task.
Task 1-3-2: Develop & Administer Grazing Lease	The grazing leases will be developed prior to initiation of the grazing season in late winter/early spring depending on the growth of forage and other factors.
Task 1-3-3: Administer Professional Advisor Contracts	Contract with the CRM will be developed prior to the initiation of grazing to confirm the stocking rate and pattern of grazing in the different grazing units, and to evaluate the results of RDM data.
Task 1-3-4: Implement Grazing Plan	This will be an ongoing task.
Task 1-3-5: RDM Monitoring	RDM monitoring will occur in the fall at the end of the grazing season
Task 1-3-6: Evaluate Results of RDM/Data Management	The results of the RDM monitoring will be evaluated with the CRM to establish initial stocking rates and grazing pattern for the next grazing season.
Task 1-3-6: Consult with Certified Rangeland Manager	Consultation with the CRM will occur in the late fall/winter months once RDM data has been collected and analyzed.
Task 1-3-7: Administer Contract for Mowing	Mowing, if deemed necessary, would occur in late May or June depending of the amount of potential fuel (plant material) is present.
Element 2-1: Scientific Research	
Task 2-1-1: Administer Agreements for Research	This task will occur only when a request for conducting research at ALCB is submitted to the landowner/Approving Agencies.
Element 2-2: Trash and Trespass	
Task 2-2-1: Trash Monitoring & Removal	This will be an ongoing task; trash will be removed when encountered.
Task 2-2-2: Identify Damages Resulting from Trespass	This will be an ongoing task and damage noted when observed.
Task 2-2-3: Planning & Coordination/Administration of Repair	This will be an ongoing task; the need to immediately repair or defer repair will be made once damages have been observed.
Task 2-2-4: Repair Trespass Damage	This will be an ongoing task and based on decisions made under Task 2-2-3.

LONG-TERM ACTIVITIES	INITIATION OF ACTIVITY
Element 3-1: Fences, Gates and Livestock Infrastructure	
Task 3-1-1: Coordinate Repair with Grazer during Grazing Season	Any damage to gates, fencing and other infrastructure will be the responsibility of the grazing leasee during the grazing season.
Task 3-1-2: Repair Fences & Gates during Non-grazing Season	Damages to gates, fencing, and other infrastructure during the non-grazing season will be responsibility of the landowner.
Task 3-1-3: Maintain/Repair Water Infrastructure	This will be an ongoing task and the responsibility of the landowner (e.g., well repair).
Task 3-1-4: Replace fences and grazing Infrastructure	Fences, gates and grazing infrastructure will be replaced as follows or on an as needed basis: Replace fences every 30 years; Replace gates every 20 years; Replace water pump/solar panels every 15 years; Replace pump house every 20 years ; and Replace water troughs every 20 years.
Task 3-1-4: Monitor Groundwater Usage by Livestock	This will be an ongoing activity
Element 3-2: Other Bank Site Infrastructure	
Task 3-2-1: Monitor Condition of Other Infrastructure	This will be an ongoing activity
Task 3-2-2: Replace Signs as Necessary	This will be an ongoing activity.
Task 3-2-3: Repair/Replace Measuring Devices/Temporary Structures	This will be an ongoing activity.
Element 4-1: Annual Report	
Task 4-1-1: Prepare Annual Report	The annual report will be prepared following the completion of the long-term monitoring and maintenance activities.
Task 4-1-2: Submit Annual Report by December 15th	The annual report will be finalized and submitted to the Approving Agencies by December 15 of each year.
Element 4-2: Administration	
Task 4-2-1: Project Management	This will be an ongoing task.
Task 4-2-2: Prepare/Administer Contracts for Infrastructure Repair	This task will be implemented when it is necessary to contract with outside firms to maintain or repair infrastructure.
Task 4-2-3: Office Space, Insurance, other Admin. Costs	This will be an ongoing task.

V OPERATIONS FUNDING

The management endowment will be funded in full by the Bank Sponsor and established and managed by NFWF to provide funds for the long-term monitoring and management of ALCB. The management endowment presented in Appendix C provides a breakdown of the overall management endowment to identify those costs associated with long-term activities at ALCB. Additional adaptive management activities that may be developed are not included in the endowment calculation because prior knowledge of what these activities may entail cannot be known at this time.

Unforeseen circumstances may necessitate prioritization of tasks, including tasks resulting from new requirements, if insufficient funds are available to accomplish all tasks. The Preserve Manager and Preserve Monitor, if not CDFW, Easement Holder and the agencies will meet and confer to discuss task priorities and funding availability to determine which tasks will be implemented. In general, tasks will be prioritized in this order: (1) those required by a local, State, or federal agency; (2) those necessary to maintain or remediate habitat quality; and (3) tasks involving monitoring of resources. Resources that have been shown to be stable or increasing will have lower priority for monitoring than those exhibiting downward trends. Equipment and materials necessary to implement priority tasks will be obtained as needed to meet objectives. Final task priorities will be determined by CDFW in consultation with the Service and authorized in writing by both parties. If a longer-term solution is needed, an amendment to this Management Plan may be made.

VI MANAGEMENT AND MONITORING REPORTING FORMS

MANAGEMENT and MONITORING REPORTING FORM – PRIMARY

Site: **Alton Lane Conservation Bank** County: **Sonoma** Date: ____________________

Staff: ____________________

Scientific Research and Site Security

Research

Observation: ____________________

Action: ____________________

Result/Recommendation: ____________________

Trash and Trespass

Observation: ____________________

Action: ____________________

Result/Recommendation: ____________________

____

Fire Control

Observation: ____________________

Action: ____________________

Result/Recommendation: ____________________

Infrastructure and Facilities

Fence and Gate

Observation: ____________________

Action: ____________________

Result/Recommendation: ____________________

Other Infrastructure

Observation: ____________________

Action: ____________________

Result/Recommendation: ____________________

BIOLOGICAL ELEMENT REPORTING FORM

Additional pages attached? _____ yes _____ no ____

No. of additional pages, if applicable _______

Site: ALCB **County: Sonoma** **Date: _____________**

Observation: ____

Action: ____

Result/Recommendation: ____

Comments: ____

____

VEGETATION MANAGEMENT (GRAZING)

Type of vegetation management: ____

Average forage height___________________Average residual dry matter _________________________

Grazing Information (if implemented as a control activity)

Number of Animals present _________ Total AUMs: ____________________________________

Type of grazing animal: Cattle _______or Other (Provide Species): ______________________________

Area of Use: ________________________

Other factors: ____

Observation: ____

Action: ____

Result/Recommendation: ____

Comments: ____

Sacramento Fish and Wildlife Office
Checklist for Mitigation Site Annual and Monitoring Reports

Please include the following information in the report, as applicable to the type of habitat/species on the conservation bank or mitigation site. Biological Monitoring Reports may be included as a subpart of the Annual Report, in those years where biological monitoring is required. **The checklist does not replace the report.** Reports should be submitted in bound hard copy and on a cd, with a completed copy of this checklist included. Reports for conservation banks should also be uploaded into the RIBITS cyber repository.

☐ **Site Management** (Long-term Management☒)

- ☐ Photos documenting the current condition of the site;
- ☐ Grazing (include supporting data and current photographs, RDM monitoring, etc.);
- ☐ Other Vegetation/Thatch Management (include details of all actions taken or explain why no action was taken);
  - ☐ Mowing;
  - ☐ Herbicide Application;
  - ☐ Exotic/Invasive/Non-Native Species Management (including amount of such species, maps indicating where the species are present, and actions taken/to be taken- if no action is to be taken explain and include supporting data);
- ☐ Fencing/Signage/Unauthorized Access (include description of actions taken/to be taken and a description and photos of current fencing and signage condition and any evidence noted of unauthorized access);
- ☐ Trash Removal;
- ☐ Authorized Visitation/Use of the Site (Please include an explanation of authorized visitation/usage of the site including dates, description of visit/usage, effect on the Bank);
  - ☐ Research.
  - ☐ Easement Holder/Agency Visits.
  - ☐ Monitoring.
- ☐ Discussion/schedule of actions/tasks to be undertaken in the coming year;
- ☐ Expenses incurred in carrying out management plan and monitoring activities;

☐ **Species and Performance Monitoring**- Methodologies, Results, and Photos – Check all that apply (if this report is for a year requiring performance monitoring please include data collected during surveys, success criteria, and discussion relating observations to achievement of performance standards and reference sites);

For conservation bank sites with Vernal Pools (check all that apply):

- ☐ California Tiger Salamander Surveys;
- ☐ Vernal Pool Floristics;

☐ Vernal Pool Hydrology;
☐ Plant Species (please list species below):
Burke's goldfields (*Lasthenia burkei*)
Sonoma sunshine (*Blennosperma bakeri*)

Non-Vernal Pool Species (check all that apply):
☐ California Tiger Salamander;

☐ If no species monitoring was required please indicate if:

☐ Monitoring is not required at this site ☐ this year ☐ at all;
☐ What years monitoring has been/will be done: ____________________

☐ **Financial**

☐Is endowment fully funded? ☐Yes ☐ No;
☐ Current Balance (as of submittal);
☐ Deposits and/or withdrawals made to/from the Endowment Account;
☐ Expenses and Reimbursements;
☐ Interest and earnings on endowment account;

Interim Management Security - indicate whether: ☐funded ☐ released;

Banks only: credit sale reporting - indicate whether: ☐included in report ☐ provided separately;

☐ **Documentation**

☐ Photo Point Photos, with a map of the photo points;
☐ Copies of completed data sheets and/or copies of field notes for all surveys;
☐ Other: ____

VII REFERENCES

CH2M Hill. 1995. *Santa Rosa Plain Vernal Pool Ecosystem Preservation Plan.* Prepared for the Santa Rosa Plain Vernal Pool Task Force. June 20, 1995.

CH2M Hill. 1998. Final training manual to evaluate habitat quality of vernal pool ecosystem sites in Santa Rosa Plain. Prepared for the U S. Army Corps of Engineers. December 1998.

Cook, D.G. and D.L. Stokes. 2019. California Tiger Salamander Resources at the Alton Lane Mitigation Site. Prepared for Alton Preserve, LLC.

COOK, D. G., P. C. TRENHAM, AND D. L. STOKES. 2005. Sonoma County California tiger metapopulation, preserve requirements, and exotic predator study. Sacramento: U. S. Fish and Wildlife Service, Sacramento Field Office. Agreement 114203J110. 36 p.

NRCS. 2008. Web Soil Survey. Online access to soils information generated by the Natural Resources Conservation Service. (websoilsurvey.nrcs.usda.gov/app/).

Patterson, C.A., B. Guggolz, and M. Waaland. 1994. Seasonal wetland baseline report for the Santa Rosa Plain, Sonoma County. Report prepared for Ann Howald, California Department of Fish and Game, DFG Contract No. FG 2241R3.

Stokes, D.L., D.G. Cook and J. Meisler. 2016. Preserving habitat remnants: an inadequate conservation strategy for an endangered amphibian *Ambystoma californiense* in an urbanizing area. In: Cook, D, D. Stokes and J. Meisler. 2016. California Tiger Salamander Larval Density and Survival at Natural and Constructed Breeding Pools, Sonoma County, CA. Report prepared for U.S. Fish and Wildlife Service, Sacramento Field Office. Final Report, Grant Agreement No. F13AP00010. January 2016.

APPENDIX A. COOK, D.G. AND D.L. STOKES. 2019. CALIFORNIA TIGER SALAMANDER RESOURCES AT THE ALTON LANE MITIGATION SITE. PREPARED FOR ALTON PRESERVE, LLC.

California Tiger Salamander Resources at the Alton Lane Mitigation Site

Prepared by

Dave Cook and Dr. David Stokes

June 30, 2019

Table of Contents

TABLES and FIGURES

EXECUTIVE SUMMARY

The purpose of this technical report is to describe California tiger salamander (*Ambystoma californiense;* CTS) aquatic habitats at the Alton Lane Mitigation Site and the southern portion of the Alton North Conservation Site study area (ALT) and how these habitats are utilized by CTS. ALT is part of a complex of wetland mitigation sites and conservation banks that includes many constructed vernal pools and is the site of the most northern population of CTS on the Santa Rosa Plain, Sonoma County. We studied 56 vernal pools and the larval ecology of CTS at ALT from 2002-2019 and have produced a long-term dataset that spans several generations of breeding adult salamanders over a range of climate conditions that include years of both severe drought and above-normal rainfall. This long-term record allows us to evaluate long-term population trends, colonization patterns, and preserve productivity for CTS, a species with highly variable yearly breeding activity and reproductive success. We have conducted similar studies at three other CTS preserves in Sonoma County, allowing comparisons among preserves and determination of the viability of ALT relative to other CTS preserves.

The CTS population at ALT has grown substantially since its introduction of a few larvae released in a pool in 1996. Since 2002, CTS have spread across the preserve, based on larval detections at a total of 19 pools. In addition, CTS eggs were detected in a 20th pool. The breeding pools at ALT have been more productive, with greater larval abundance and more frequent breeding activity than those at the other preserves we have studied. ALT still has several unoccupied pools with appropriate characteristics (size, depth, hydroperiod) for CTS breeding that may be colonized in the future. The CTS population at ALT will likely continue to expand and colonize suitable unoccupied pools.

The success of ALT is largely attributable to Pools 1 and 2 that are very productive CTS breeding pools. Pool 1 is the only pool that was active annually for 18 years without interruption, despite conditions of extreme drought. During the 2015 drought, Pool 2 produced four times the number of CTS larvae as high-value breeding pools at other studied preserves. Given their high value for CTS reproduction, the physical characteristics of ALT Pools 1 and 2 should be used as models when designing breeding pools for CTS conservation and recovery on the Santa Rosa Plain.

The ALT population of CTS has shown resilience through several years of severe drought. We detected CTS larvae at ALT even in the years of lowest seasonal rainfall. For example, during the severe drought in winter 2018, ALT produced larvae of metamorphic size. In comparison, we observed complete reproductive failure at other preserves in 2018.

The ALT population of CTS has continued to expand since its introduction in 1996. In contrast, other CTS preserves appear to be in decline. One main difference between the preserves is that

ALT has two large and deep pools that are consistently productive. It is anticipated that the ALT population will continue to increase by colonizing suitable pools. As such, the ultimate population size at ALT may depend on other limiting factors, including adequate terrestrial habitat and connectivity to nearby habitats.

California Tiger Salamander Resources at the Alton Lane Mitigation Site

INTRODUCTION

Report purpose

The purpose of this technical report is to describe California tiger salamander (*Ambystoma californiense;* CTS) habitats at the Alton study area (ALT, see Methods) and how these habitats are utilized by CTS. ALT is part of a complex of wetland mitigation banks that includes many constructed vernal pools and is the site of the most northern population of CTS on the Santa Rosa Plain, Sonoma County. We have studied the larval ecology of CTS at ALT for nearly two decades, and have produced a long-term dataset that spans several generations of breeding adult salamanders over a range of climate conditions that include years of both severe drought and above normal rainfall. This long-term record allows us to evaluate long-term population trends, colonization patterns, and preserve productivity for CTS, a species with highly variable yearly breeding activity and reproductive success. We have conducted similar studies at several other CTS preserves in Sonoma County, allowing comparisons among preserves and determination of the viability of ALT relative to other CTS preserves.

Background

Endangered Status

The California tiger salamander is an imperiled, pond-breeding amphibian endemic to central California. The Sonoma County California tiger salamander forms a disjunct population of the species occupying parts of the Santa Rosa Plain, northern Petaluma River watershed, and adjacent lowlands in Sonoma County, California. CTS in Sonoma County are listed as endangered by the U.S. Fish and Wildlife Service (USFWS) and as threatened by the California Department of Fish and Wildlife (CDFW) under the federal and California Endangered Species Acts. In December 2005 the USFWS approved the locally developed Santa Rosa Plain Conservation Strategy Plan (USFWS 2005). This plan specifies steps necessary to establish and maintain nine CTS conservation areas totaling between 3,450 and 4,250 acres. ALT is a key component of the Alton Conservation Area identified in the Conservation Plan.

CTS on the Santa Rosa Plain are threatened by loss and degradation of habitat (USFWS 2003, 2005, 2016). The species requires vernal pools and other temporary bodies of water for breeding and larval development and terrestrial upland habitat for growth and survival from metamorphosis to maturity and between breeding events. Both aquatic and terrestrial habitats have been greatly reduced and degraded on the Santa Rosa Plain. As of 1994, it was estimated that vernal pool habitat on the Santa Rosa Plain had been reduced by more than 85% (Patterson et al. 1994). In addition to outright loss of habitat, the fragmented condition of the remaining habitat is likely to restrict CTS migration between breeding and terrestrial habitats and dispersal among breeding sites. Non-native aquatic predators and altered hydrologic regime are additional threats (Cook et al. 2016).

CTS Breeding Biology

Winter rainfall and pool inundation, typically beginning between November and January, trigger migration of adult CTS from upland habitats to breeding pools (Loredo and Van Vuren 1996; Trenham et al. 2000; Cook et al. 2006). CTS eggs deposited in pools hatch in approximately two weeks and develop into aquatic larvae, with survivors metamorphosing and emerging from the pools after a minimum post-hatching development period of 10 weeks (Jennings and Hayes 1994), although a larval period of 4-5 months is common (Petranka 1998). On the Santa Rosa Plain, rain during late winter and early spring (February through April) is usually necessary to maintain adequate water levels through the aquatic larval period in shallower pools (Cook, personal observation). Because rainfall triggers CTS breeding, determines suitability of pools for reproduction, and sustains pool water levels necessary for development, inter-annual variation in the timing and magnitude of precipitation events results in highly variable yearly breeding activity and reproductive success (Trenham et al. 2000, Cook et al. 2006).

METHODS

Study Areas

As part of a long-term population ecology study of CTS, we studied CTS larval presence and density in vernal pools at several wetland preserves from 2002 to 2019, including ALT, located on the Santa Rosa Plain, Sonoma County, California (Figure 1). This study focuses on evaluating ALT as CTS habitat, and where possible compares ALT with other preserves on the Santa Rosa Plain: Broadmore North (BMN), Engel (ENG), FEMA, Hall/Wright (HAL), and Yuba south (YUB).

The dominant habitats at all preserves are oak savannah/grassland with varying numbers of vernal pools. These reference sites were selected because of their long-term record of larval surveys, relatively high productivity for CTS, and relatively undisturbed habitat conditions (Cook, unpublished data). ENG, HAL, and FEM provide the best comparison with ALT, as all four were sampled annually for the same period (2002-2019).

The ALT study area is part of a complex of protected lands (Figure 2). The study area consists of the Alton Lane Mitigation Site and the southern portion of the Alton North Conservation Bank (Figure 3). The other protected lands adjacent to ALT consist of Alton North Conservation Bank to the west and Alton South Conservation Site to the south.

The six preserves studied range in area from 4.9 ha to 70.4 ha and contain 1 to 56 vernal pools (Table 1). All pools with a maximum depth of at least 10 cm were included in our study. Pools shallower than 10 cm were considered unlikely to support CTS breeding. These preserves include natural, constructed, and altered vernal pools. Natural vernal pools are naturally occurring shallow depressions over thick clayey soils or soils with a clay layer horizon. Constructed pools were designed to mimic natural vernal pools and were created as mitigation for the loss of natural wetlands and/or habitat for protected vernal pool plants. None of these constructed pools were designed specifically for CTS reproduction. Altered pools were likely natural wetland features that were hydrologically altered prior to our study. All study pools are shallow seasonal wetlands which, during the wet (winter) season, are characterized by conditions ranging from open water to dense submergent and low-stature emergent vegetation. These pools dry annually, typically between April and June.

Pool Sampling

We used a Trimble GeoExplorer 3 hand-held GPS device in the field or satellite imagery to delineate the perimeter of study pools and determine surface areas. We determined maximum depth of study pools by measuring the elevation difference between the pool perimeter and the deepest point of the pool using a level mounted on a staff or by recording maximum pool depth after heavy rainfall when pools were full. Also, we measured maximum water depth at time of survey for each pool during each annual dipnet survey using a graduated measuring pole.
In 2007, we examined timing of pool drying at all study preserves by measuring pool depths at weekly intervals beginning in mid-March and continuing until pools were dry.

CTS Larval Density Sampling

To determine relative densities of CTS larvae at study pools, we conducted annual standardized timed dipnet surveys (Heyer et al. 1994) from 2002-2019 (n = 18 years) at ALT, ENG, FEM, and HAL. Other preserves were not sampled in all years (BRN and YUB sampled in years 11 and 13, respectively). Surveys were conducted in March, approximately 12 weeks after breeding had first occurred, as indicated by recorded rain events and observed CTS breeding migration dates for that year (Cook et al. 2006; DGC personal observation).

We used dipnets to sample the pools because dense wetland vegetation made other methods (e.g., seining) impractical. All study pools were shallow enough (< 1m) to be waded by surveyors, who swept "D" shaped dipnets along the pool bottom in a standardized fashion to capture CTS larvae. Dipnet surveys were timed, with survey duration depending on pool size. Moderate-sized pools were typically sampled for 30 to 40 cumulative person-minutes. We standardized larval density estimates for each pool by dividing the total number of larvae captured by the number of person-minutes sampled (larvae/min).

We measured the total length of captured CTS larvae and released all larvae after completion of the survey (Figure 4). In spring 2015 and 2016 we conducted dipnet surveys at weekly intervals at pools with high larval abundance to determine larval growth rates (mm/day). Surveys continued until these pools dried or no longer contained larvae.

Population Estimate, Box Plot Enclosure Sampling

To estimate the true density and number of CTS larvae in pools, we intensively sampled 13 breeding pools consisting of 5 at ALT, 3 at ENG, and 5 at HAL during spring 2015. These pools were selected to represent a range of CTS productivity, including the two most productive CTS breeding pools at each preserve. At each of the 13 pools, we sampled a stratified random array of enclosed plots (Heyer et al. 1994). We randomly located transects across pools (Cook and Jennings 2007), selected a random initial plot location on each transect, and then identified sample plot locations at 3 m intervals along the length of each transect. The number of sampled plots varied in proportion to pool size.

The plot enclosure consisted of a 1.0 m^2 plywood box with open bottom and top that was pressed into the pool substrate at each plot location (Figure 5). The top of the box extended above the water level, and we recorded maximum water depth at each plot. We systematically sampled the enclosure in six successive dipnet sweeps. CTS larvae captured in each of the six sweeps were recorded.

Depletion of larval captures by sweep fit a negative exponential function (y = 327.11e-0.58x, r^2 = 0.95) and a projection based on this model suggests that our sampling captures accounted for 97% of larvae present (Cook et al. 2016). We measured the surface area of each pool on the day of box enclosure sampling. From surface area and box plot depth measurements, the volume of each pool was estimated. We then estimated the true number of CTS larvae in each pool from the measured density of CTS larvae (larvae/m^3) and proportion of the pool volume sampled.

Definitions

We classified each study pool as a “breeding pool” if CTS larvae were detected at least once during the 18 years of dipnet sampling, and “non-breeding” if larvae were never found. We designated a pool as “active” in a given year if larvae were detected in the pool. We surveyed all constructed pools from the beginning of our study or, for those constructed during our study, from the year after construction. We defined a pool’s colonization time as the number of years between construction and the first year in which we detected CTS larvae. We assumed that breeding CTS adults were first present in 2002 at the ALT Pool 1, which was stocked with larvae in 1996 (see Results).

Field studies and animal care were conducted under the auspices of permits from CDFW (SCP-514), USFWS (TE816187), and University of Washington Institutional Animal Care and Use Committee Protocol (4143-01).

RESULTS

Habitats and CTS Occurrence at ALT

Prior to preservation and the creation of vernal pools, ALT was partially under cultivation, including orchard and vineyard, based on a review of aerial imagery from 1942 and from 1993 to present. All of the pools at ALT are constructed, with the exception for 4 pools along a natural swale (Figure 3, Table 2). Most pools were constructed in uplands, but a small number appear to be impounded natural swales. Some of the constructed pools are located where orchards and vineyards once occurred. Historically, the lands surrounding ALT were rural residential, orchard, vineyard, and rangeland.

Among the 56 pools at ALT (Table 2; Figure 3), the 4 natural pools have depths that range from 25 to 50 cm and have not been utilized for CTS breeding. The 52 constructed pools were built in phases from the 1980s to 2010 (Table 2). The two largest and deepest pools, Pools 1 and 2, have depths of 70 and 95 cm, respectively (Figure 6). These two pools were constructed circa 1988 and appear to be the oldest pools at ALT. They, along with pool 1.5, are atypical at ALT in that they were created by constructing small earth berms (impoundments) across a natural meandering shallow swale-like drainage. Pool 1.5 is connected to Pool 1 and is isolated once water levels recede in spring. These swale-constructed pools have both irregular shorelines and bottoms that gradually slope to a deep part of the pool. The remaining 49 constructed pools were excavated in uplands, have well-defined shorelines, and flat bottoms (Figure 7).

The CTS population at ALT apparently originated with the introduction of approximately 15 larvae in 1996 at Pool 1 (Charlie Patterson personal communication). Bill Cox (California Department of Fish and Game, unpublished data) conducted dipnet surveys on March 29, 1996 and he captured two CTS larvae, presumably two of those introduced earlier in the year. He conducted dipnet surveys at the pool on April 1, 1998 (30 min) and April 7, 1999 (15 min) and detected no CTS larvae. We have found larvae in Pool 1 every year since the start of our sampling in 2002. Given that first breeding in CTS probably occurs at approximately age 4-5 years (Trenham et al. 2000), larvae from the 1996 stocking probably first returned to breed in Pool 1 in 2000 or 2001.

During winter 2004, 65 CTS adults (28 females, 37 males) were released into ALT Pool 1 (Bill Cox, unpublished data). These were salvaged CTS from the current location of Lowes Hardware Store in west Cotati, approximately 16.4 km southeast of ALT. No additional translocations of CTS to ALT are known to have occurred, and the closest known CTS population is 4 km south of ALT. Thus, we assume that CTS at ALT are derived from the 1996 and 2004 translocations.

Habitat Characteristics and Hydrology of Breeding and Non-breeding Pools

We evaluated the hydrologic characteristics of vernal pool at preserves across the Santa Rosa Plain, including ALT, to determine the value of pools for CTS breeding. Over the course of our

18-year study, we detected CTS larvae in 58 of the 116 vernal pools sampled at 6 preserves (Table 1).

The use of pools by CTS for breeding is strongly influenced by the pool's hydroperiod, which in part, is related to depth and surface area that determine volume. Breeding pools (pools where CTS larvae were detected in at least one year) are significantly larger in area, deeper, and dry later in spring compared to pools where breeding never occurred (Table 3). Water depths at breeding pools averaged 38.8 cm (range = 22 – 95 cm) while non-breeding pools averaged 23.7 cm (range = 12 – 50 cm).

The average difference in hydroperiod between breeding and non-breeding pools was 15 days, suggesting that whether or not a pool can support breeding CTS may depend on relatively minor differences in pool hydrology. Natural and constructed CTS breeding pools did not differ significantly with respect to these physical characteristics (Cook et al. 2016).

Similar patterns for pool depth and hydroperiod were found at ALT (Table 3). Breeding pools were significantly deeper ($\bar{X}$ = 37.2 cm, range = 19 – 50) than non-breeding pools ($\bar{X}$ = 22.8 cm, 12 – 40). Also, they had longer hydroperiods; breeding pools held water until at least mid-April, while non-breeding pools were mainly dry by March 23 (Figure 8).

The deepest pool (Pool 2) had the latest dry date (June 15). Unlike the pattern at other preserves, pool surface area at ALT did not differ significantly between breeding and non-breeding pools (Table 3). This may be due to the shallow, flat-bottomed design of many constructed pools (which form a higher proportion of pools at ALT than at other preserves) making pool area a less important determinant of hydroperiod.

Patterns of Pool Colonization

During the 18 years of this study, 18 previously unoccupied pools at ALT were colonized (i.e., newly used as CTS breeding sites; Figure 9). Pool 1 was initially stocked in 1996 and we detected CTS larvae in this pool in the first year of our study in 2002. The first pools colonized following the occupation of Pool 1 were Pools 2 and 16 in 2005. These pools are three of the four deepest pools at ALT (Figure 8). The number of pools colonized each year was variable (range = 0 – 5). In 2011, the year of the greatest number of colonizations, 4 of the 5 newly colonized pools were constructed during the previous year. The fifth pool was constructed in 1988. The most recent colonization at ALT was in 2019 when larvae were found in Pool 22, which was constructed in 1999. In addition, CTS eggs were found in Pool 51 on January 25, 2019 (Michael Fawcett, unpublished data) that increases the total number of pools with CTS detections to 20 pools.

Generally, deeper pools were colonized earlier than shallower pools (Figure 8). An exception is the relatively deep natural Pool 54, which is still unoccupied. Assuming a minimum pool depth for CTS breeding of 19 cm, there are 27 unoccupied pools at ALT that could be used for CTS breeding. Seven of these are deeper than 30 cm and are likely more favorable for successful reproduction and larval survival (Cook et al. 2016).

Pool Activity and Abundance of Larvae

Deeper CTS breeding pools at ALT tend to have a higher frequency of pool activity and higher average larval density than shallower pools (Figure 10). Pool 1, the second deepest pool at ALT, had the highest density of larvae during the study period and is the only pool among all of our study pools across all preserves where CTS breeding has occurred in all 18 years of the study (100% activity). Also, Pool 2, the deepest pool at ALT, had a high frequency of activity: active in 72% of years over the entire study period and 87% since it was first colonized in 2005.

Adult CTS may forgo breeding during years of low winter rainfall or drought, with consequent impacts on the abundance of larvae in the spring (Cook et al. 2016). The relationship between winter rainfall and larval abundance was observed in some years at the ALT pools (Figure 11). Larval densities were low relative to other years in 2012, 2013, and 2018, when there was winter drought, and densities increased in the wet years of 2017 and 2019. However, in 2014 and 2015 larval abundance did not vary as expected with rainfall. These anomalies may result from the many other factors that influence CTS breeding, including the pattern of winter rainfall, which could affect adult breeding behavior, or annual variation in the size of the adult breeding cohorts. In summary, while CTS larval abundance tends to be positively correlated with winter rainfall, other factors are also important.

In spring 2015, we estimated the absolute abundance of CTS larvae at 13 pools located on three preserves (Figure 12). The population at ALT Pool 2 was 4,438 larvae, more than all of the other sampled pools combined, and nearly 30 times the number at the ALT pool with the next most larvae (Pool 1 with 151 larvae). ALT Pools 3, 4, and 337 had negligible numbers of larvae. The second greatest larval abundance across all study preserves was at ENG Pool 8 with an estimated 1,112 larvae. The weather in the region during 2015 and for the preceding three years was characterized by severe drought. Given that drought likely suppressed CTS breeding across the Santa Rosa Plain and reduced the survival of larvae in many shallow pools from early pool drying, the reproductive output and survival to metamorphosis of larvae (see Figure 13) at ALT Pool 2 is exceptional and underscores the high value of this breeding pool. More generally, it indicates the value of particularly favorable breeding habitats, which can be responsible for a large proportion of a preserve's reproductive output. Also, it suggests the value of maintaining a range of habitats, as habitat quality is likely to be condition-dependent. As such, deeper pools may be more productive in dry years and shallower pools may be more productive in years with cooler temperatures that could slow development or in locations where non-native fish invasion is a threat (Cook et al. 2005).

Larval Growth Rates, Survival, and Metamorphosis

During spring 2015 and 2016, we measured CTS larval sizes at ALT Pools 1 and 2 at regular intervals to investigate growth rates and metamorphosis potential. Surveys began in early to mid-March and continued weekly until pools were dry or larvae were no longer detected. CTS metamorphosis must occur before a pool dries, and larvae must attain a minimum size before metamorphosis is possible. Typically, a total length of at least 100 mm is required, although larvae as small as 80 mm can sometimes metamorphose, but with lower fitness (Cook, personal observation; Brad Shaffer personal communication). Rainfall during the spring larval development period in 2015 was 34% of average (drought), and in 2016 was 130% of average (wet). The difference in weather between the two years resulted in a mean pool dry date that was 30 days later in 2016 than in 2015.

Larval size and growth patterns changed over the spring development season and varied between pools and years (Figures 13 and 14). Larval length was also variable within samples. Larval total lengths ranged from 38-125 mm in 2015 and 25-139 mm in 2016. Larvae grew during March at an average rate of about 1 mm/day. This rapid growth occurred when larval sizes where less than 80-110 mm. After this rapid growth period the average size of larvae plateaued and abundance declined (see Figures 13B and 14A). This suggests that the larger larvae successfully metamorphosed and migrated from the pool before it dried.

The weather conditions in 2015 and 2016 affected the reproductive output of ALT Pools 1 and 2 in those years. During the 2015 drought, Pool 1 had very low abundance of larvae and none attained a size greater than 100 mm (Figure 13A), suggesting there was no metamorphosis or recruitment. In contrast, larvae were very abundant at Pool 1 in 2016 and many reached metamorphic size (Figure 13B). At Pool 2, larvae were abundant in both 2015 and 2016. During the 2015 drought, larval size at Pool 2 reached the metamorphic plateau in early April, while in the wet 2016 this plateau was reached a month later in early May (Figure 14). Also, in 2016 there appeared to be a second larval cohort of smaller individuals that may never have reached metamorphic size. This cohort was likely from a late-season breeding event triggered by the wet weather in late winter. At Pool 2 larval abundance, growth, and metamorphosis were similar during dry and wet years suggesting the large pool size and longer hydroperiod provided resilience to the adverse effects of drought. Pool 1 provided less resilience to drought but was a very favorable breeding site under wet conditions.

Preserve Productivity and Viability

CTS larval abundance was characterized by extreme annual variability at the four preserves we sampled continuously from 2002-2019. As estimated by an index of larval abundance (see Figure 15), larval abundance at ENG, FEM, and HAL showed no trend or marginal decline over the study period (Figure 15), suggesting a possible decline in those populations.

In contrast, CTS productivity at ALT increased significantly over the period, as indicated by larval abundance (Figure 16) and number of pools that were active (1 in 2002 to 16 in 2019). ALT has also been the site of more consistent CTS breeding activity over the period, as at least one pool has been active in every year of our study, while all other preserves have had years of no breeding activity. We attribute the increase in CTS larval production at ALT to the highly productive Pools 1 and 2 and the continuous colonization of constructed pools.

DISCUSSION

The CTS population at ALT has grown substantially since its establishment in 1996. Since 2002, CTS have spread across the preserve and have colonized at least 18 pools, in addition to the pool where the species was originally translocated. The breeding pools at ALT have been more productive, with greater larval abundance and more frequent breeding activity, than those at the other preserves we have studied. ALT still has several unoccupied pools with appropriate characteristics (size, depth, hydroperiod) for CTS breeding that may be colonized in the future. The CTS population at ALT will likely continue to expand and colonize suitable unoccupied pools.

Resilience to Drought

The ALT population of CTS has shown resilience through several years of severe drought. We detected CTS larvae at ALT even in the years of lowest seasonal rainfall. For example, during the severe drought in winter 2018, ALT produced larvae that reached metamorphic size. In comparison, we observed complete reproductive failure at other preserves in 2018. Pools at ENG and HAL had no CTS larvae, and while small numbers of larvae were present at HAL, they likely failed to reach metamorphic size.

Viability of the CTS Population at ALT

The ALT population of CTS has continued to expand since its introduction in 1996. In contrast, CTS at ENG, FEM, and HAL preserves appear to be in decline. This is surprising because each of these preserves had very productive populations of CTS during the early years of the study when the ALT population was becoming established (Figure 15). HAL is the largest preserve and contains 17 natural CTS breeding pools, a number similar to ALT's 19 or 20 breeding pools (M. Fawcett, unpublished data). Nonetheless, HAL may not be capable of maintaining a viable CTS population.

One difference between the preserves is that the breeding pools at HAL are mostly very shallow, while ALT has two large and deep pools that are consistently productive. As mentioned above, it is anticipated that the ALT population will continue to increase by colonizing suitable pools. As such, the ultimate population size at ALT may depend on other limiting factors, including adequate terrestrial habitat and connectivity to nearby habitats.

CTS Recovery on the Santa Rosa Plain

Recovery of CTS on the Santa Rosa Plain will require restoration and creation of terrestrial and breeding habitats (USFWS 2005 and 2016) to compensate for the loss of native habitats. Constructed pools have been shown to be suitable for CTS breeding, and in some cases appear to be more productive than natural breeding pools, if designed with appropriate hydrological specifications (Cook et al. 2016).

Of the 116 vernal pools we have studied on the Santa Rosa Plain for nearly two decades, ALT Pools 1 and 2 are the most productive CTS breeding pools, as indicated by larval abundance. Pool 1 is the only pool that was active annually for 18 years without interruption, despite conditions of extreme drought. During the 2015 drought, Pool 2 produced four times the number of CTS larvae than high-value breeding pools at ENG and HAL. Given their high value for CTS reproduction, the physical characteristics of ALT Pools 1 and 2 should be used as models when designing breeding pools for CTS conservation and recovery on the Santa Rosa Plain.

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Table 1: CTS study sites consisting of 6 preserves containing 116 pools. Pool types are vernal pools that are natural, constructed, or altered hydrology. CTS breeding pools are where CTS larvae were detected at least once during 2002-2019.

Characteristic	Preserve						
	ALT	BRN	ENG	FEM	HAL	SCE	YUB
Preserve Area (ha)	18.2	5.3	16.2	32.0	70.4	9.3	4.9
Pool Type							
Constructed	52	0	6	0	7	0	6
Altered	0	0	2	2	0	0	0
Natural	4	1	4	0	27	5	0
Total	56	1	12	2	34	5	6
Construction Period	circa 1988-2010	na	1999	circa 1940	2007	na	1999-00
CTS Breeding							
Constructed	19		5				5
Altered			1	2			
Natural		1	4		17	4	
Total	19 (20[1])	1	10	2	17	4	5

[1] CTS eggs were found in ALT Pool 51 on January 25, 2019 (Michael Fawcett, unpublished data), although no CTS larvae were detected by Dave Cook during spring 2019 dipnet surveys.

Table 2: Pool characteristics at ALT study area. The locations of pools are shown on Figure 3. Pool types are natural wetlands and constructed pools created by impounding a swale or excavated in uplands. CTS breeding is based on larval detections during spring dipnet surveys.

Pool #	Pool Type	CTS Breeding	First Year of Breeding	Construction Year	Maximum Depth (cm)
1	Impounded swale	yes	2000	circa 1988	70
1.5	Impounded swale	yes	no data	circa 1988	34
2	Impounded swale	yes	2005	1989	95
3	Excavated	yes	2008	1989	36
4	Excavated	yes	2006	1989	37
5	Excavated	no		1989	20
6	Excavated	yes	2017	1989	30
7	Excavated	no		1989	27
8	Excavated	no		1992	40
9	Excavated	no		1992	27
10	Excavated	no		1992	12
12	Excavated	no		1989	15
13	Excavated	yes	2006	1999	46
14	Excavated	no		1999	19
15	Excavated	no		1999	21
16	Excavated	yes	2005	1999	50
17	Excavated	no		1999	32
18	Excavated	no		1999	22

Table 2: Pool characteristics at ALT study area. The locations of pools are shown on Figure 3. Pool types are natural wetlands and constructed pools created by impounding a swale or excavated in uplands. CTS breeding is based on larval detections during spring dipnet surveys.

Pool #	Pool Type	CTS Breeding	First Year of Breeding	Construction Year	Maximum Depth (cm)
19	Excavated	no		1999	23
20	Excavated	no		1999	16
21	Excavated	no		1999	23
22/45	Excavated	yes	2019	1999	30
23/44	Excavated	yes	2014	1999	35
24	Excavated	no		1999	13
25	Excavated	yes	2014	1988	22
26	Excavated	no		1992	20
27	Excavated	yes	2010	1992	33
28	Excavated	no		1992	29
29	Excavated	no		1992	22
30	Natural	no			25
30.5	Excavated	no		1989	19
31	Excavated	no		1992	14
32	Excavated	yes	2011	1988	35
33	Excavated	yes	2008	1988	30
34	Excavated[2]	no		1988	20
35	Excavated	no		1992	18
36	Excavated	no		1992	24
37	Excavated	no		1988	12

Table 2: Pool characteristics at ALT study area. The locations of pools are shown on Figure 3. Pool types are natural wetlands and constructed pools created by impounding a swale or excavated in uplands. CTS breeding is based on larval detections during spring dipnet surveys.

Pool #	Pool Type	CTS Breeding	First Year of Breeding	Construction Year	Maximum Depth (cm)
38	Excavated	no		1988	12
39	Excavated	no		1992	21
40	Excavated	no		1992	30
41	Excavated	no		1988	33
42	Excavated	no		1992	18
43	Excavated	no		1989	17
50	Excavated	no		pre-1993	24
51	Excavated	no[1]		pre-1993	25
52	Excavated	no		pre-1993	15
53	Natural	no			36
54	Natural	no			50
55	Natural	no			30
337	Excavated	yes	2014	2010	28
351	Excavated	yes	2011	2010	25
361	Excavated	yes	2011	2010	27
363	Excavated	no		2010	20
363B	Excavated	yes	2011	2010	24
365	Excavated	yes	2011	2010	19

[1]CTS eggs were found in ALT Pool 51 on January 25, 2019 (Michael Fawcett, unpublished data), although no CTS larvae were detected by Dave Cook during spring 2019 dipnet surveys.

[2]Pool 34 may have been constructed from a remnant swale (Ted Winfield, personal communication).

Table 3: Physical characteristics of 114 study pools, Santa Rosa Plain. Pools are located on ALT, BMN, ENG, HAL, SCE, and YUB preserves. The two pools at FEM were excluded due to their highly altered condition. CTS larvae were found at least once in Breeding Pools and no larvae in Non-Breeding Pools. Pool surface area and depth are based on maximum hydration. Pool dry dates are from 2007. Some data not available for all pools. *Significant at $\alpha = 0.05$.

	Breeding Pools			Non-Breeding Pools			Statistic		
	X	SD	*n*	*X*	SD	*n*	*t* test	df	*p*
Pools at All Preserves									
Area (m^2)	1155	1083	52	670	499	26	6.7	78	<0.001*
Depth (cm)	38.8	14.5	53	23.7	7.6	56	2.71	76	0.008*
Dry Date	11-Apr	16.9	47	27-Mar	6.2	41	5.87	60	<0.001*
Pools at ALT									
Area (m^2)	993	1086	18	682	575	37	1.04	27	0.307
Depth (cm)	37.2	18.1	19	22.8	8.2	14	-9156	20	<0.001*
Dry Date	15-Apr	24.8	13	26-Mar	4.9	30	2.94	12	0.012*

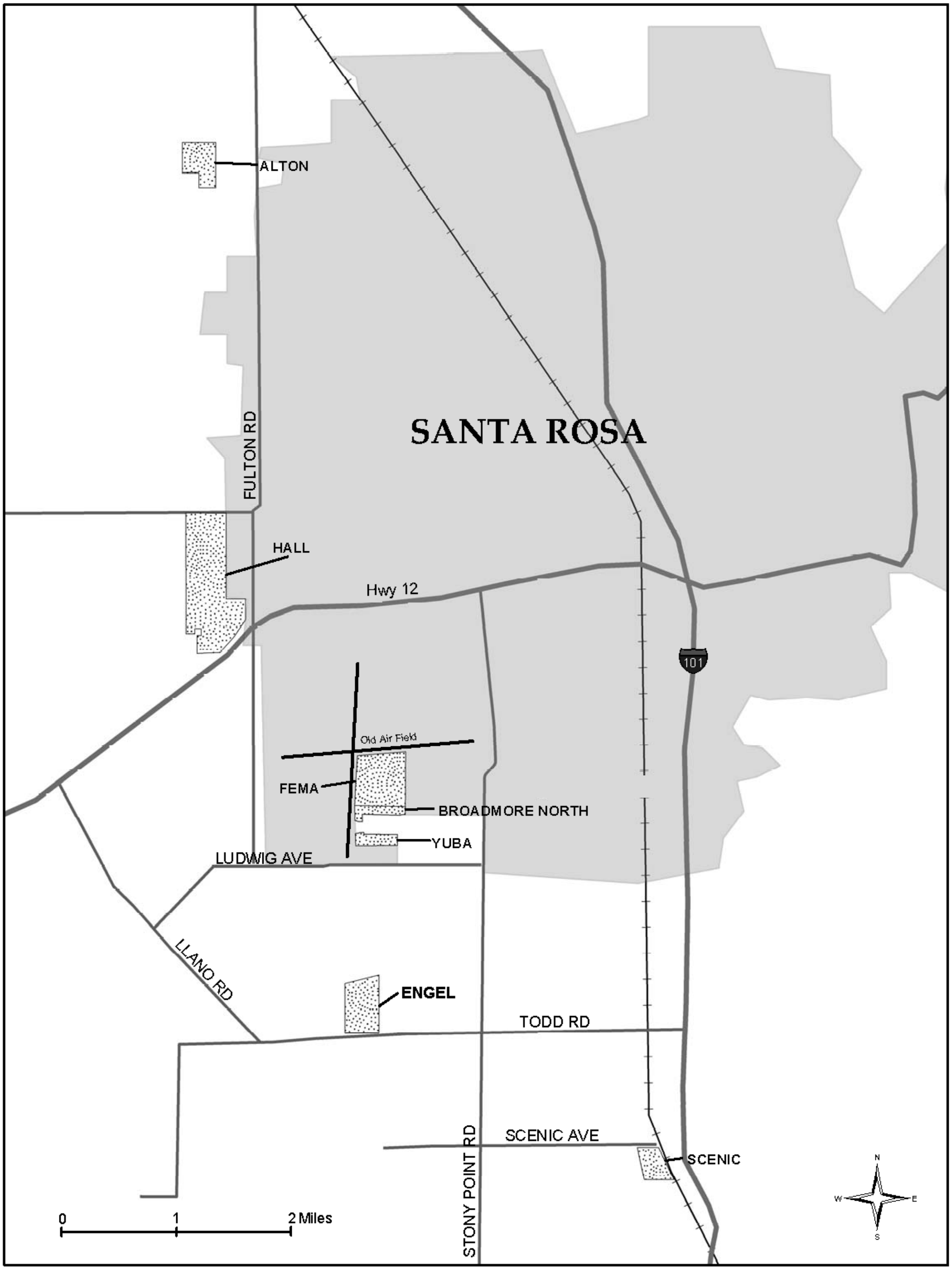


Figure 1: Location of study preserves on the Santa Rosa Plain, Sonoma County.

Figure 2: Alton protected lands complex, Sonoma County.

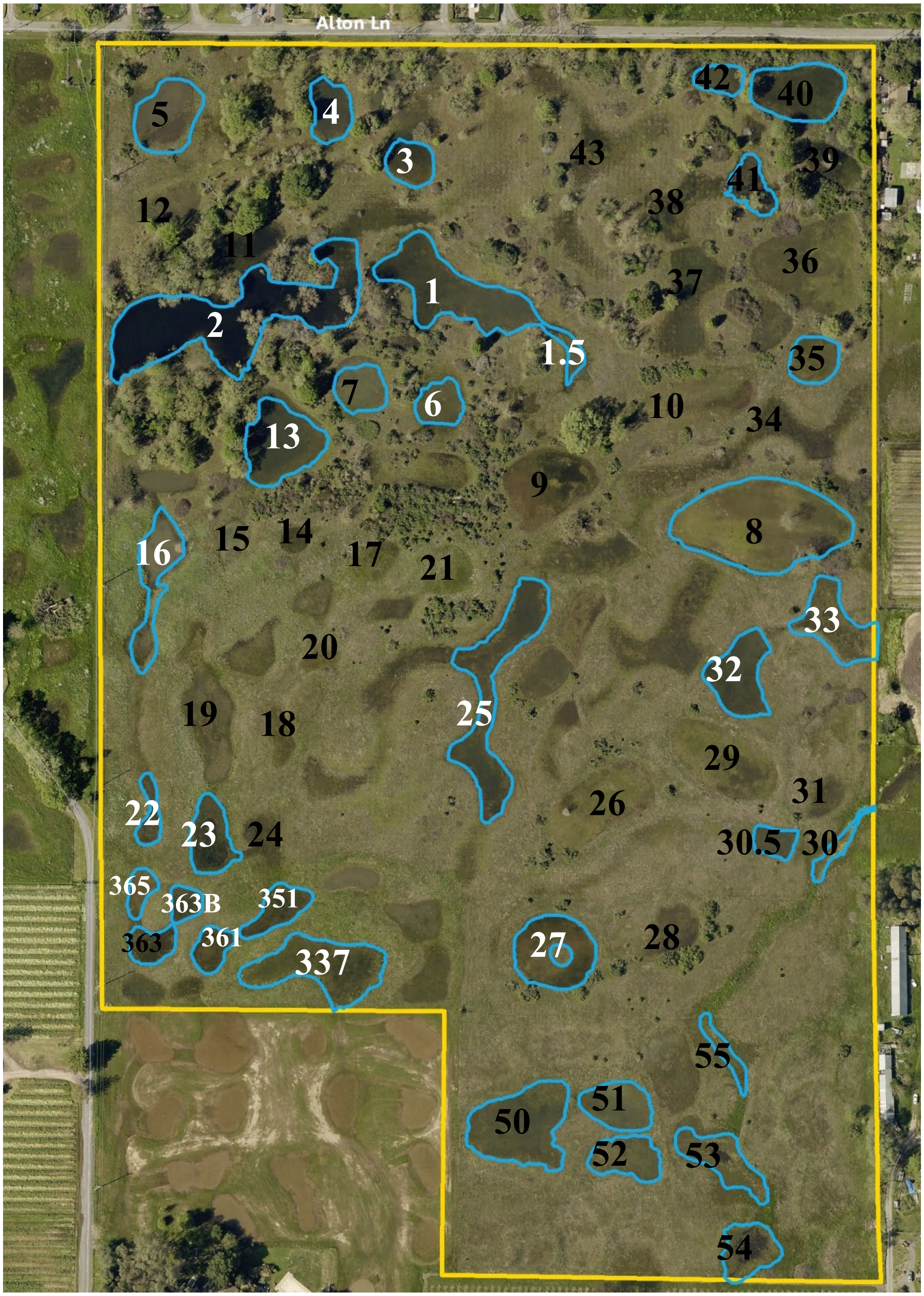


Figure 3: ALT study area consisting of Alton Lane Mitigation Site and southern portion of Alton North Conservation Bank. Pool numbers – CTS breeding (white), non-breeding (black). Pools with no border have short hydroperiods and not regularly sampled. CTS eggs were found in ALT Pool 51 on January 25, 2019 (Michael Fawcett, unpublished data), although no CTS larvae were detected by Dave Cook during spring 2019 dipnet surveys.

Figure 4: CTS larvae captured during timed dipnet surveys.

Figure 5: Box Plot enclosure sampling used to estimate the true population of CTS larvae in selected pools in spring 2015.

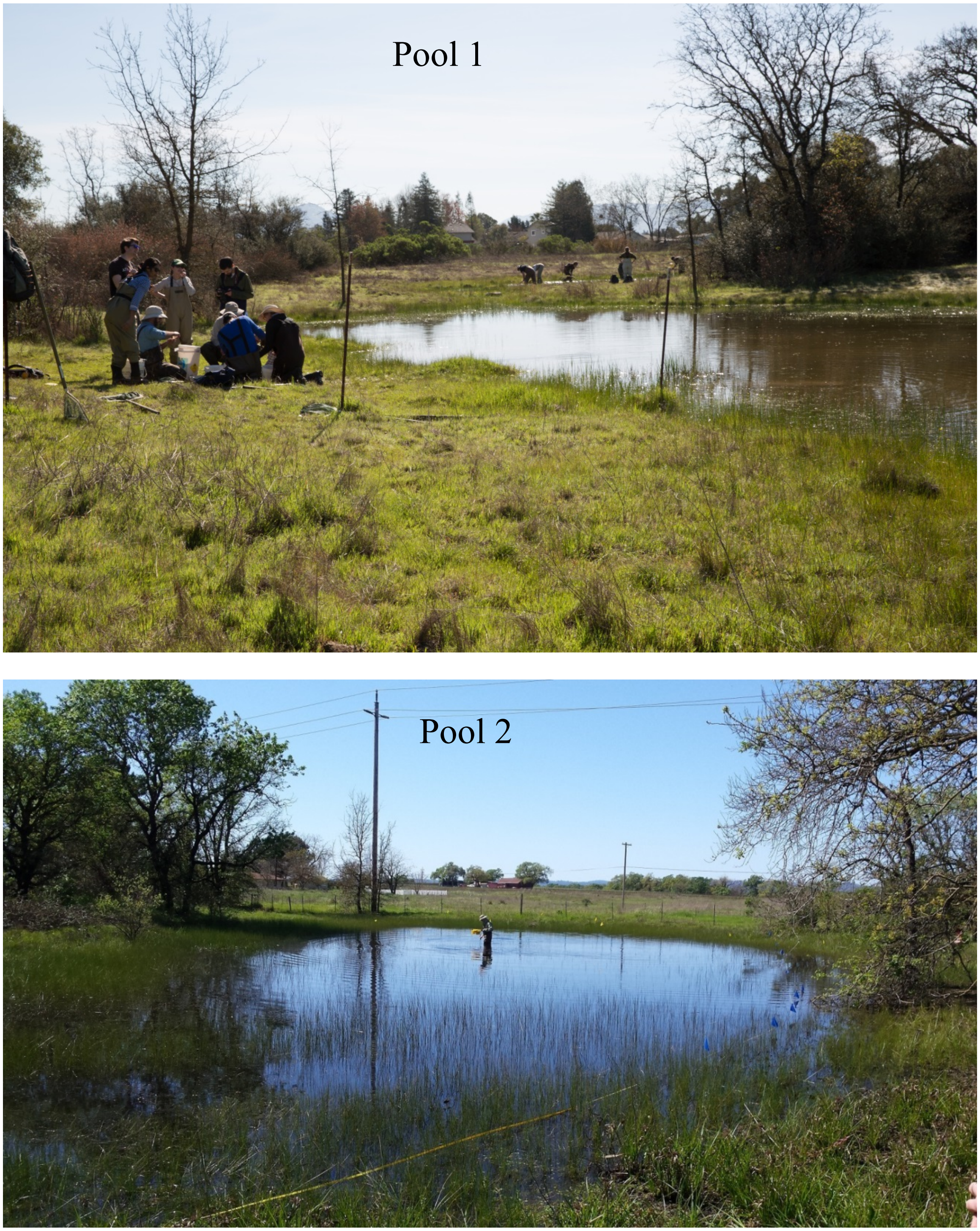


Figure 6: ALT constructed Pools 1 and 2. These pools were constructed by impounding a shallow swale. They are the largest and deepest pools and most productive for CTS at ALT.

Figure 7: CTS breeding Pool 4 at ALT. This pool was constructed in uplands in 1989 and was colonized in 2006.

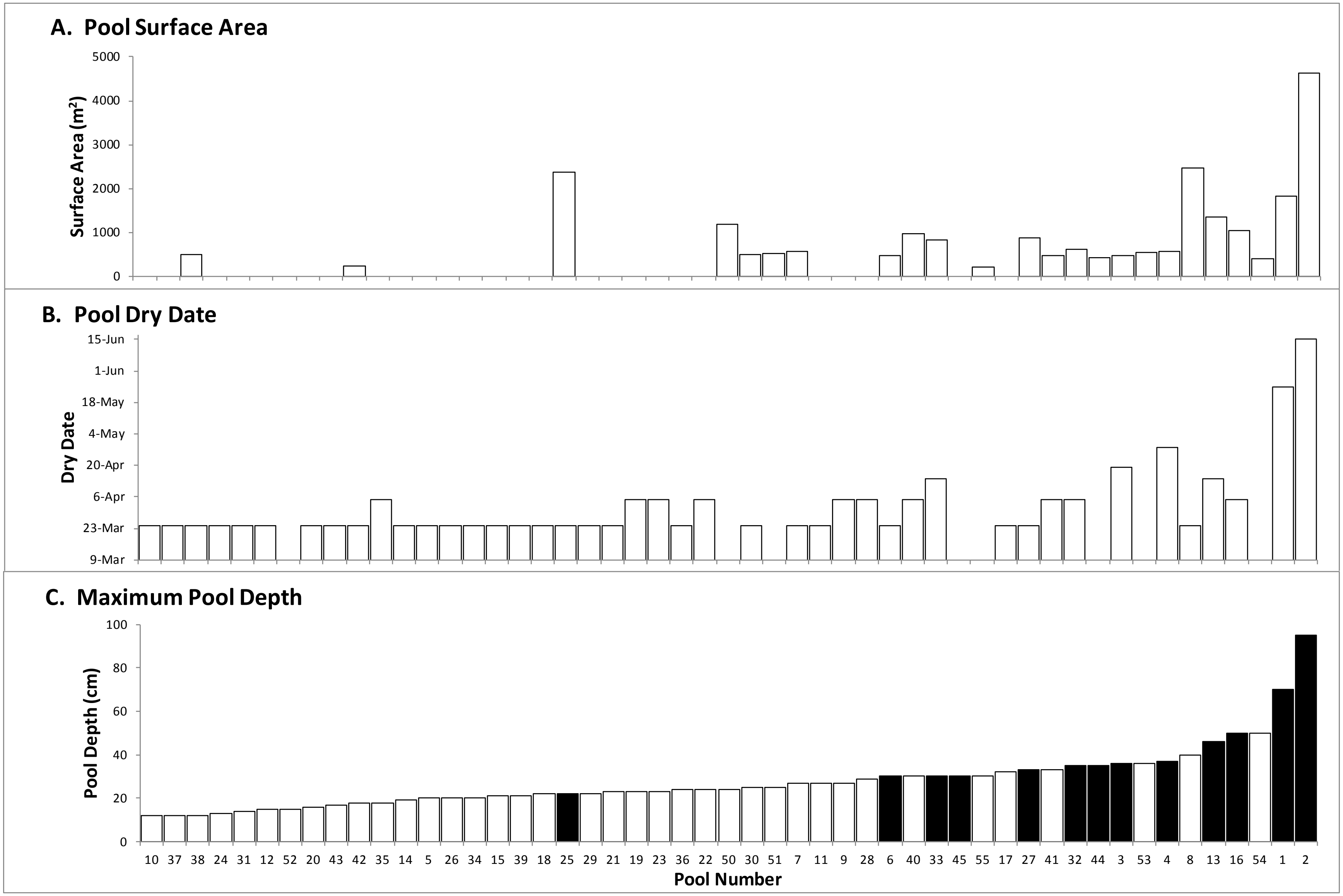


Figure 8: Physical characteristics of pools at ALT. Pools are in order of shallowest to deepest. Panel A - pool surface area when full. Panel B - pool dry date in 2007. No value for an individual pool in panels A and B indicates no survey conducted. Panel C - maximum pool depth, black bars indicate used for CTS breeding. Pools constructed after 2007 not shown. Pool 1.5 included as Pool 1. CTS eggs were found in ALT Pool 51 on January 25, 2019 (Michael Fawcett, unpublished data), although no CTS larvae were detected by Dave Cook during spring 2019 dipnet surveys.

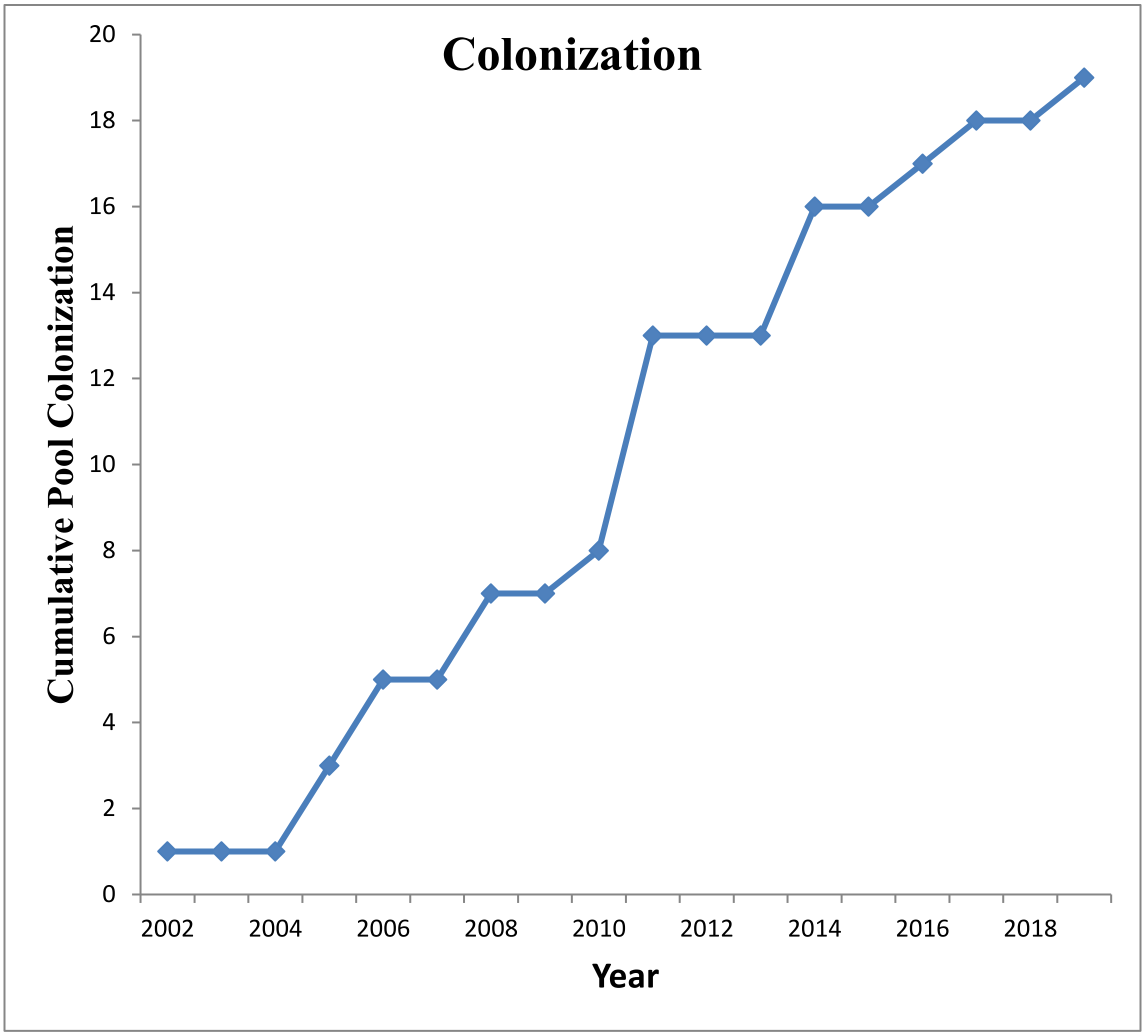


Figure 9: Cumulative colonization of pools by CTS at ALT from 2002 to 2019. CTS were initially stocked in one pool at ALT in 1996. CTS detections are based on spring dipnet surveys for larvae.

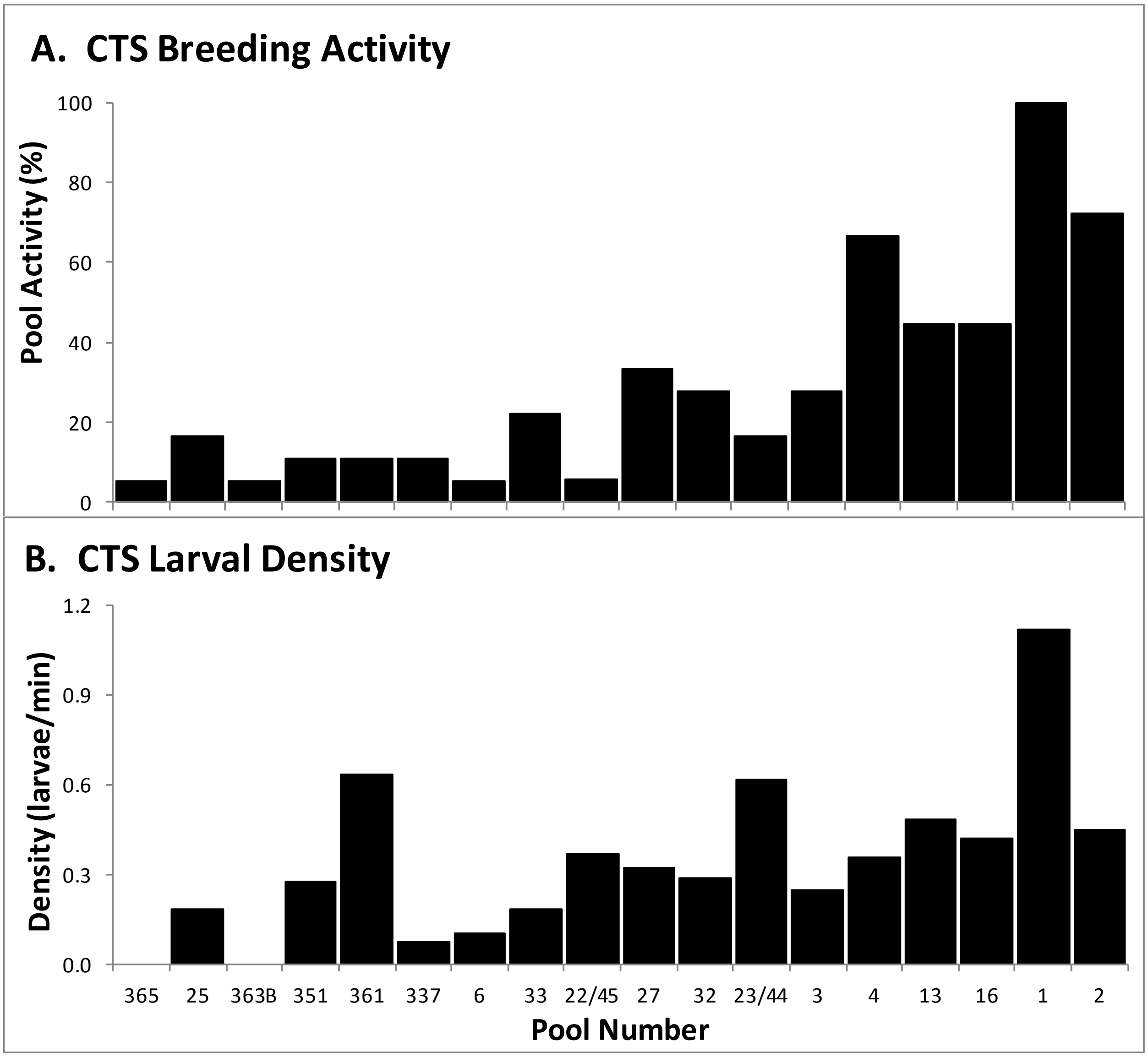


Figure 10: Larval CTS activity and density at ALT breeding pools, 2002-2019. Pools are in order of shallowest to deepest. Panel A - frequency of annual breeding pool activity. Panel B - average larval density of breeding pools from timed dipnet surveys during 18 years of study.

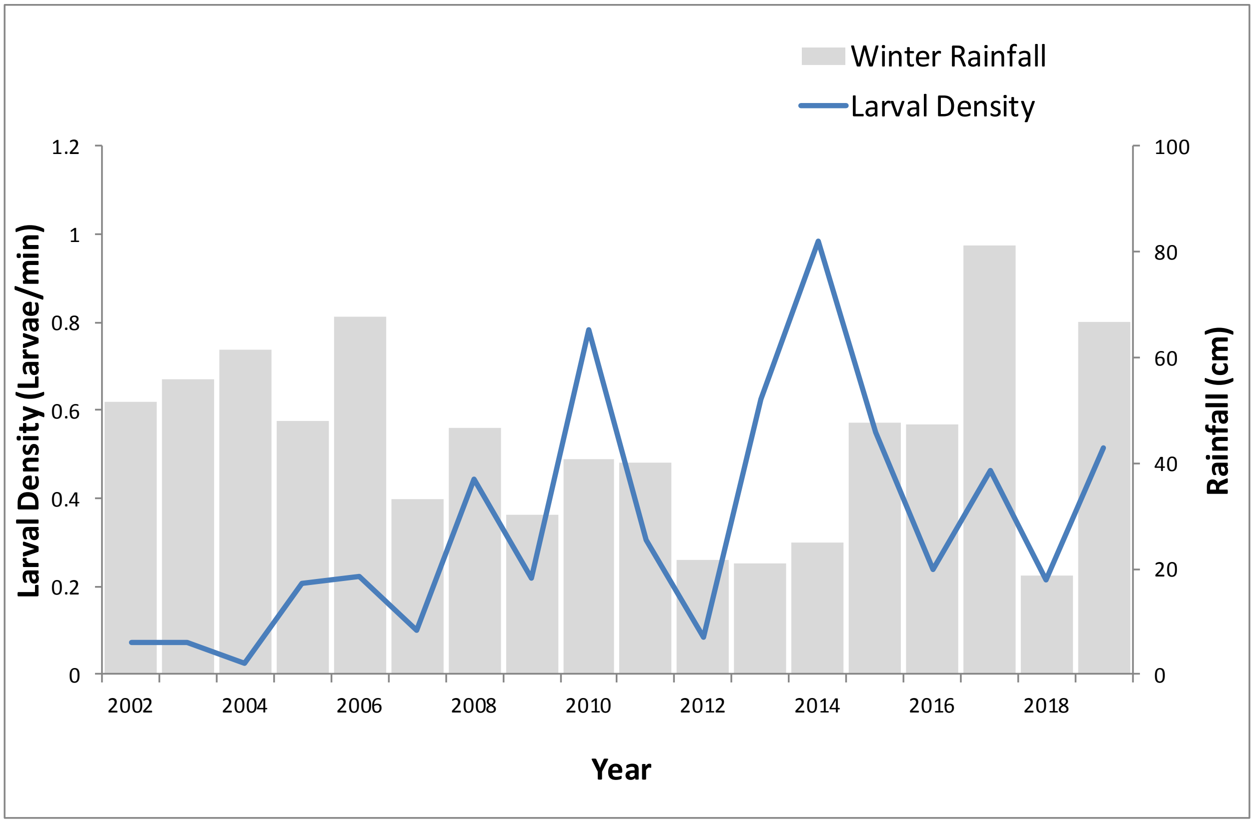


Figure 11: CTS larval density at ALT and winter rainfall, 2002-2019. Larval densities at breeding pools are combined for each year. Larval densities are from timed dipnet surveys. Winter rainfall includes December-February, which is the main CTS breeding period.

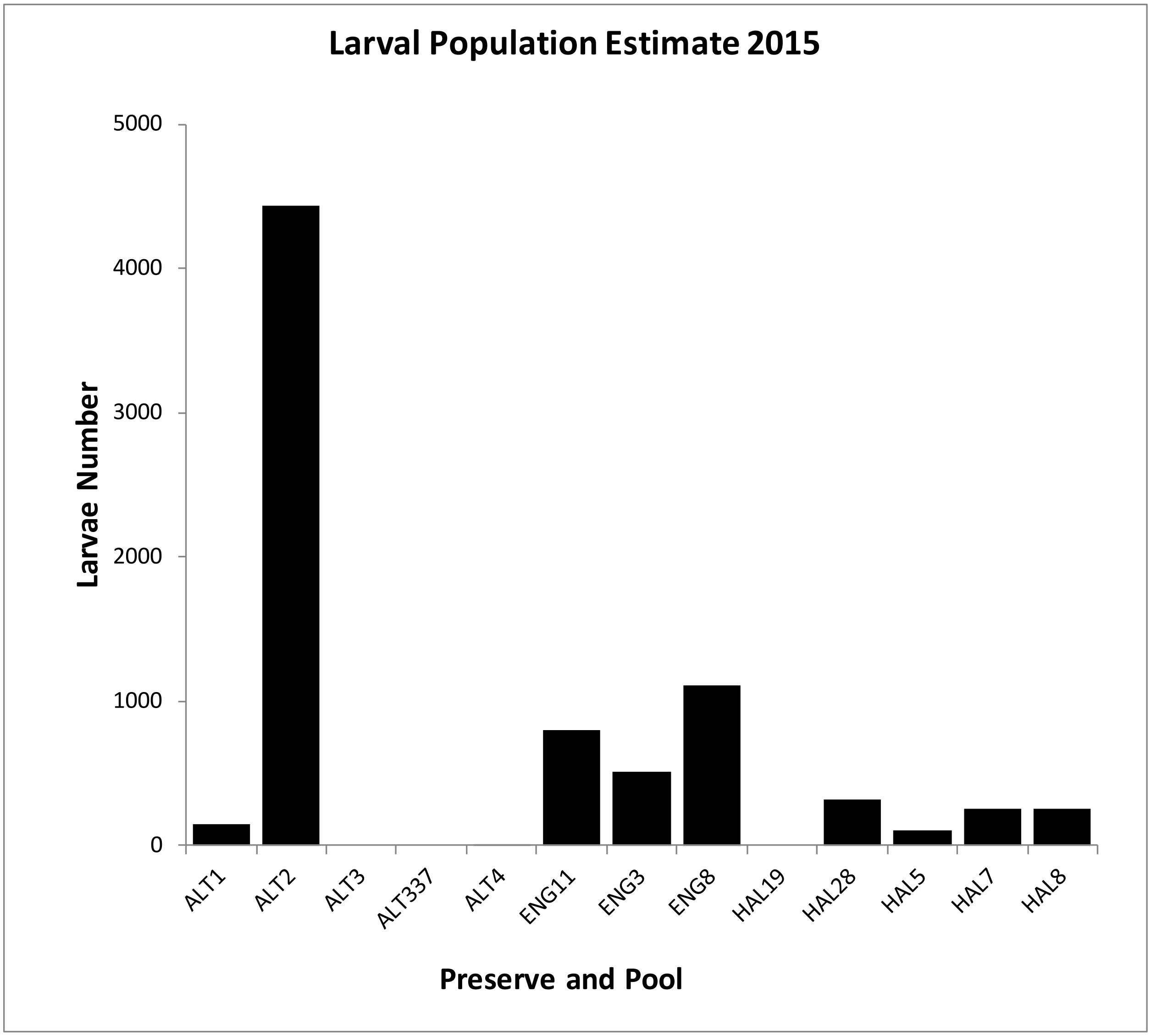


Figure 12: CTS larval population estimates at ALT, ENG, and HAL preserves, 2015. Estimates are from box plot enclosure sampling. The two most long-term productive pools at each of the preserves are ALT1, ALT2, ENG11, ENG8, HAL28, and HAL8.

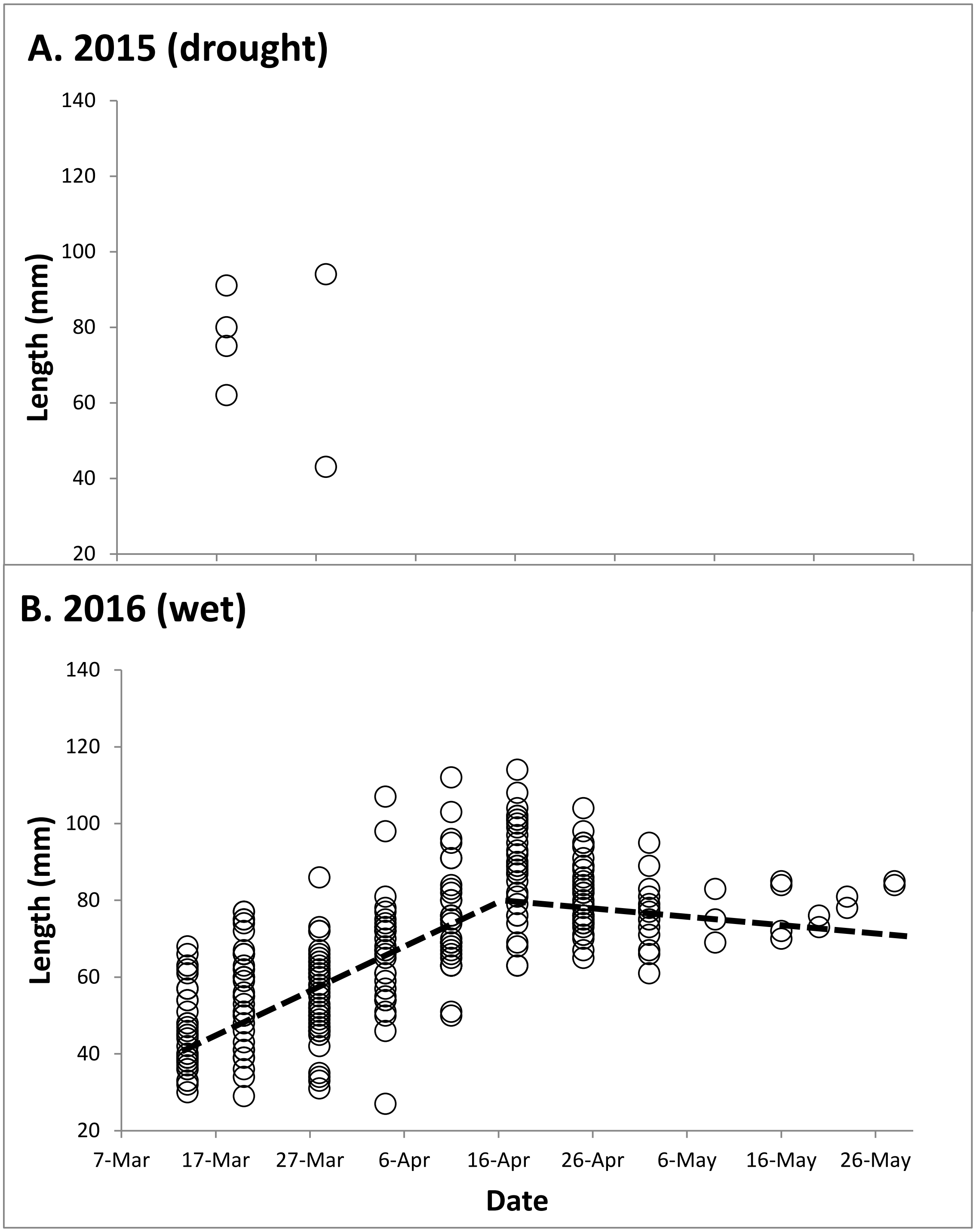


Figure 13: CTS larval sizes at ALT Pool 1 during spring 2015 and 2016. Dashed lines show rapid growth of larvae early in the season followed no change or a decrease in size suggesting metamorphosis.

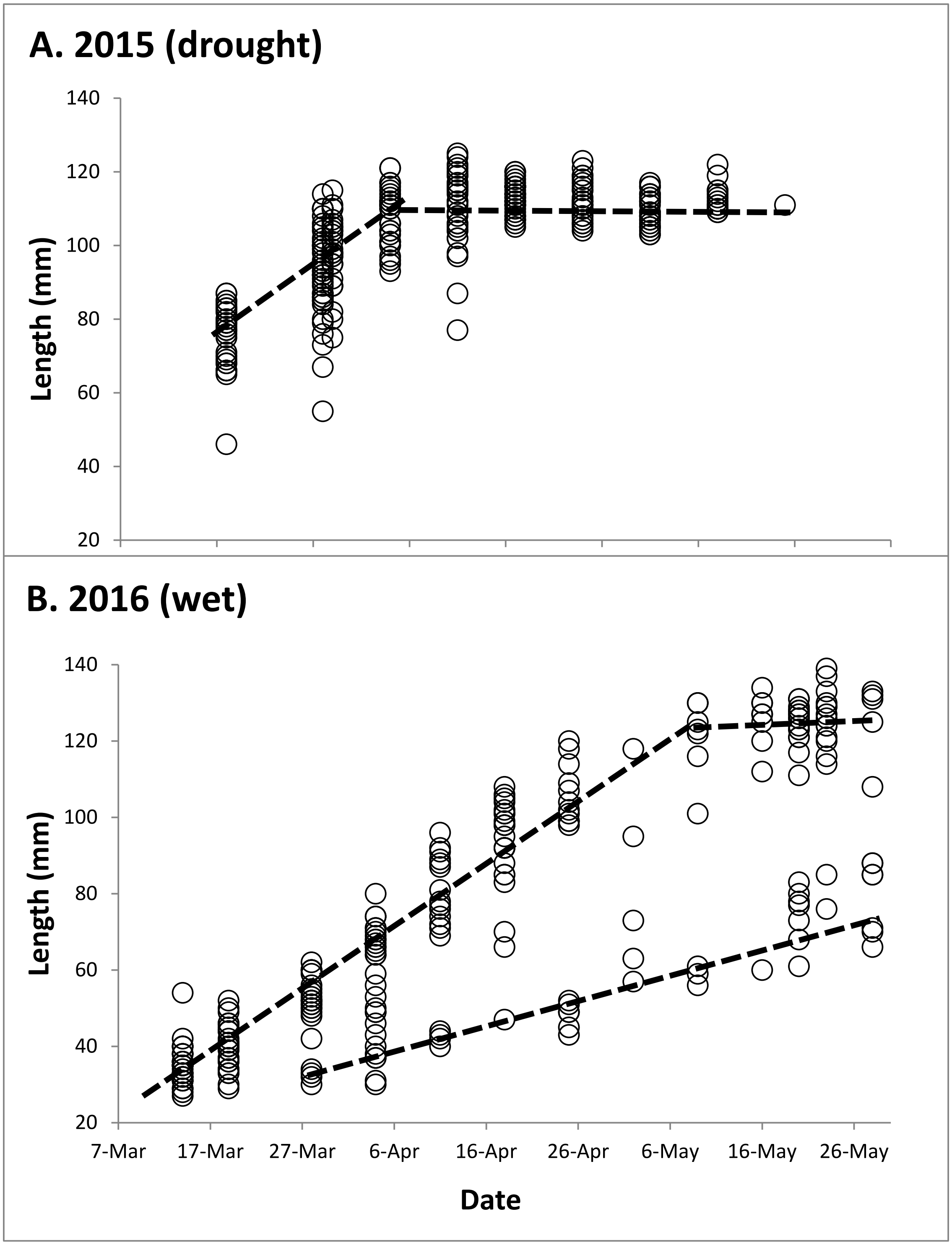


Figure 14: CTS larval sizes at ALT Pool 2 during spring 2015 and 2016. Dashed lines show rapid growth of larvae early in the season followed no change in size suggesting metamorphosis. In 2016, a smaller cohort of larvae with a slower growth rate may not have reached minimum size to metamorphose.

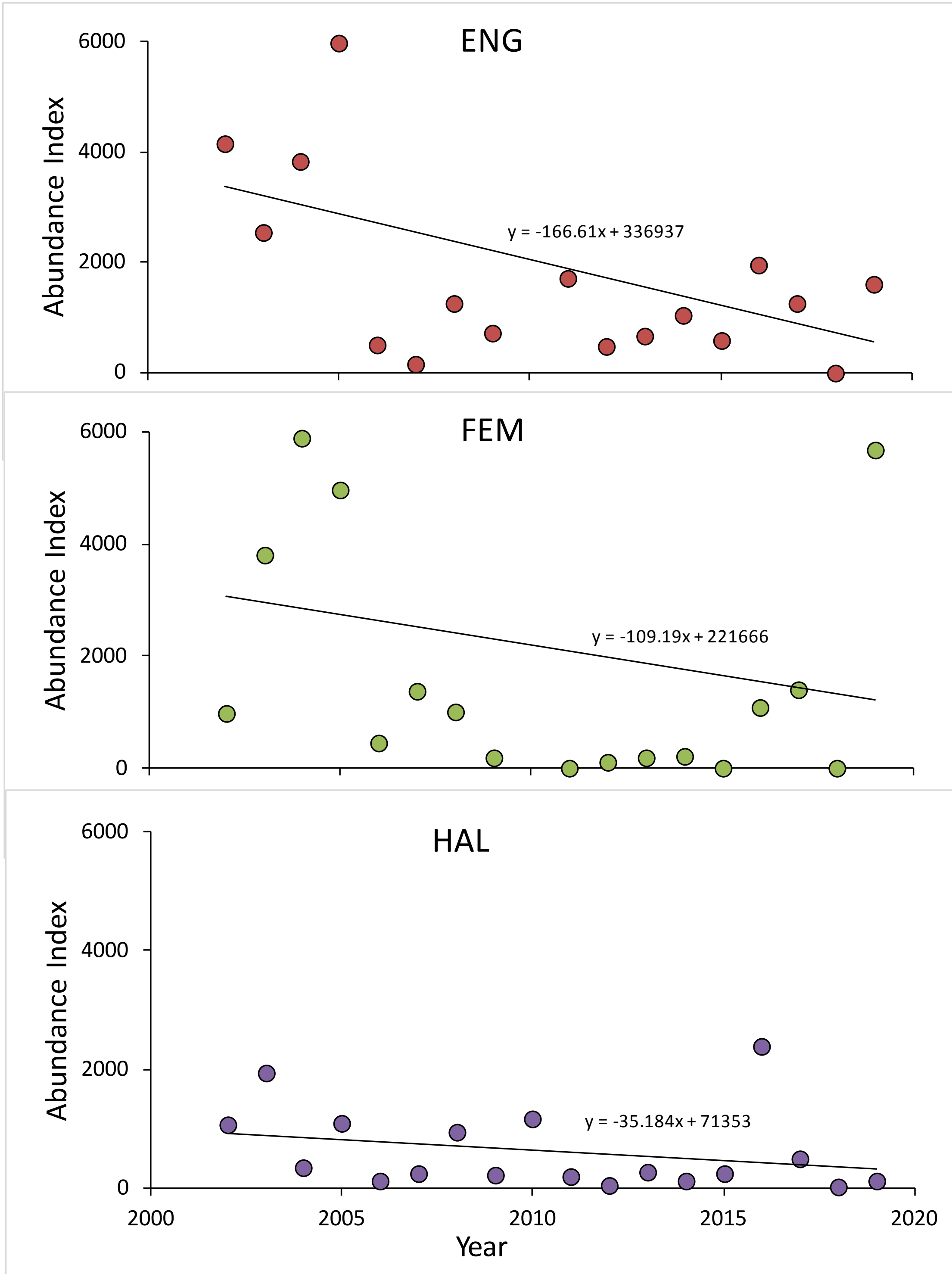


Figure 15: CTS larval abundance index at ENG, FEM, and HAL from 2002 to 2019. Abundance index = larval density (larvae/min) x pool volume (maximum surface area x ½ pool depth). The linear regression at all three preserves indicate a non-significant long-term decline in CTS productivity (ENG: $F_{1,17} = 3.91$, $r^2 = 0.197$, $p = 0.065$; FEM: $F_{1,17} = 0.62$, $r^2 = 0.0.03$, $p = 0.443$; HAL: $F_{1,17} = 1.30$, $r^2 = 0.0.07$, $p = 0.271$).

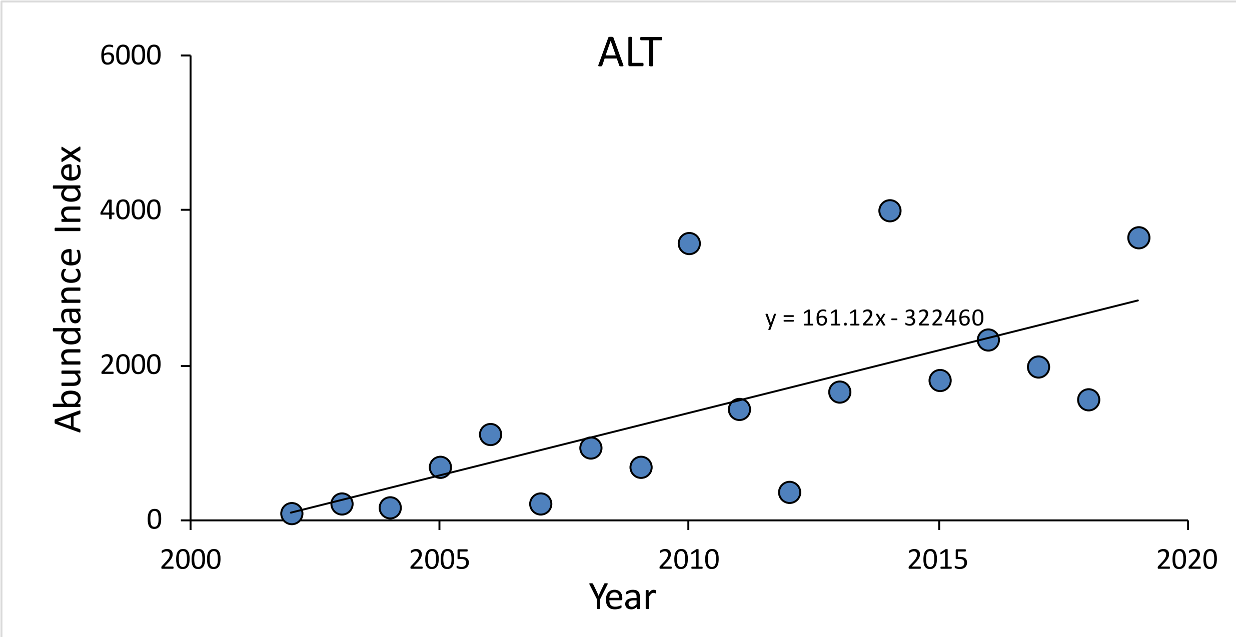
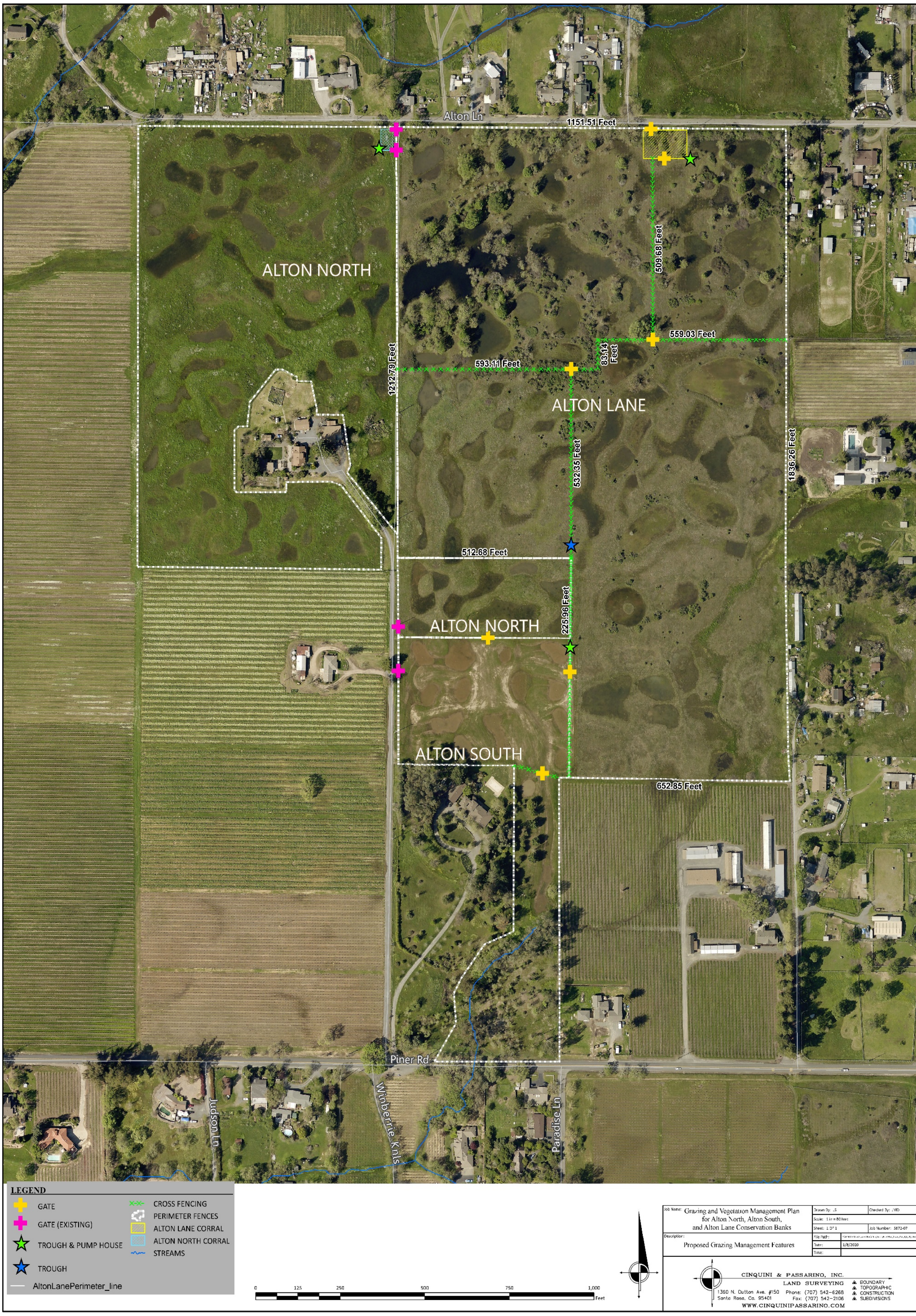


Figure 16: CTS larval abundance index at ALT from 2002 to 2019. Abundance index = larval density (larvae/min) x pool volume (maximum surface area x ½ pool depth). The linear regression indicates a long-term increase in CTS productivity ($F_{1,17}$ = 14.49, r^2= 0.475, p = 0.002).

APPENDIX B. FENCING DIAGRAM FOR ALCB SHOWING FENCING THAT WILL BE REPLACED UNDER THIS LONG-TERM PLAN.


Alton Ln
1151.51 Feet
ALTON NORTH
509.68 Feet
559.03 Feet
593.11 Feet
83.14 Feet
1212.79 Feet
ALTON LANE
532.35 Feet
1836.26 Feet
512.68 Feet
ALTON NORTH
225.96 Feet
ALTON SOUTH
652.85 Feet
Piner Rd
Judson Ln
Winberrie Knls
Paradise Ln
LEGEND
GATE
GATE (EXISTING)
TROUGH & PUMP HOUSE
TROUGH
AltonLanePerimeter_line
CROSS FENCING
PERIMETER FENCES
ALTON LANE CORRAL
ALTON NORTH CORRAL
STREAMS
0
125
250
500
750
1,000
Feet
Job Name: Grazing and Vegetation Management Plan for Alton North, Alton South, and Alton Lane Conservation Banks
Drawn By: JS
Checked By: JMD
Scale: 1 in = 80 feet
Sheet: 1 OF 1
Job Number: 5872-07
Description: Proposed Grazing Management Features
File Path:
Date: 1/8/2020
Time:
CINQUINI & PASSARINO, INC.
LAND SURVEYING
1360 N. Dutton Ave. #150
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TOPOGRAPHIC
CONSTRUCTION
SUBDIVISIONS
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APPENDIX C. MANAGEMENT ENDOWMENT FOR ALTON LANE CONSERVATION BANK

General Bank Management and Monitoring Activities	Unit	Cost/Unit	No. of Units	Total Cost	Life (yrs)	ANNUAL COST
SUPER ELEMENT 1 - BIOLOGICAL RESOURCES						
Element 1-1: Listed Species Surveys						
Task 1-1-1: Planning and Coordination-Monitoring Activities	hr.	$ 100	4	$ 400	2	$ 200
Task 1-1-2: CTS Monitoring-Egg Surveys	hr.	$ 160	11	$ 1,760	2	$ 880
Task 1-1-3: CTS Monitoring-Larval Surveys	hr.	$ 160	30	$ 4,800	2	$ 2,400
Task 1-1-3: CTS Monitoring-Supplies (decontamination supplies)	total	$ 50	1	$ 50	2	$ 25
Task 1-1-4: Monitor CTS Breeding Pool Condition	hr.	$ 70	16	$ 1,120	1	$ 1,120
Task 1-1-5: Late Season CTS Surveys	hr.	$ 160	30	$ 4,800	4	$ 1,200
Task 1-1-6: CTS Monitoring Data Reduction/Management	hr.	$ 160	40	$ 6,400	2	$ 3,200
Task 1-1-7: Listed Plant Surveys-Burke's Goldfields	hr.	$ 90	8	$ 720	1	$ 720
Task 1-1-7: Listed Plant Surveys-Supplies	total	$ 150	2	$ 300	2	$ 150
Task 1-1-7: Listed Plant Surveys-Sonoma Sunshine	hr.	$ 90	8	$ 720	1	$ 720
Task 1-1-8: Listed Plant Surveys-Data Reduction/Management	hr.	$ 90	8	$ 720	1	$ 720
Subtotal: Listed Species Surveys						$ 11,335
Element 1-2: Invasive Species (Habitat Management)						
Task 1-2-1: Planning and Coordination	hr.	$ 100	8	$ 800	1	$ 800
Task 1-2-2: Survey and Map Invasive Species	hr.	$ 70	8	$ 560	1	$ 560
Task 1-2-3: Develop/Prioritize Treatment Options	hr.	$ 100	4	$ 400	1	$ 400
Task 1-2-4: Invasive Weed Control-Manual Removal	hr.	$ 70	16	$ 1,120	3	$ 373
Task 1-2-4: Invasive Species Eradication-Herbicide Application	hr.	$ 70	24	$ 1,680	1	$ 1,680
Task 1-2-4: Expenses (ATV Rental/Repair; Mileage)	total	$ 500	1	$ 500	1	$ 500
Task 1-2-4: Herbicides and Related Chemicals	total	$ 500	1	$ 500	1	$ 500
Subtotal: Invasive Species (Habitat Management)						$ 4,813
Element 1-3: Vegetation Management						
Task 1-3-1: Planning and Coordination	hr.	$ 100	8	$ 800	1	$ 800
Task 1-3-2: Develop and Administer Grazing Lease	hr.	$ 100	4	$ 400	1	$ 400
Task 1-3-3: Administer Professional Advisor Contracts (CRM)	hr.	$ 150	4	$ 600	1	$ 600
Task 1-3-4: Implement Grazing Plan	hr.	$ 100	16	$ 1,600	1	$ 1,600
Task 1-3-5: RDM Monitoring	hr.	$ 70	8	$ 560	1	$ 560
Task 1-3-5: Expenses (ATV rental/repair; mileage)	total	$ 500	1	$ 500	1	$ 500
Task 1-3-6: Evaluate Results of RDM	hr.	$ 100	4	$ 400	1	$ 400
Task 1-3-6: Consult with Certified Rangeland Manager	hr.	$ 150	8	$ 1,200	5	$ 240
Task 1-3-7: Mowing (Fire Control)	hr	$ 130	12	$ 1,560	5	$ 312
Subtotal: Vegetation Management						$ 5,412

SUPER ELEMENT 2 - SCIENTIFIC RESEARCH AND SITE SECURITY						
Task 2-1-1: Administer Agreements for Research	hr.	$ 100	4	$ 400	5	$ 80
Task 2-2-1: Trash Monitoring and Removal	hr.	$ 70	8	$ 560	1	$ 560
Task 2-2-1: Expenses (ATV rental/repair; mileage)	total	$ 150	4	$ 600	1	$ 600
Task 2-2-2: Identify Damages Resulting from Trespass	hr.	$ 70	4	$ 280	1	$ 280
Task 2-2-3: Planning and Coordination/Administration of Repair	hr.	$ 70	2	$ 140	1	$ 140
Task 2-2-4: Repair Trespass Damage	hr.	$ 70	4	$ 280	1	$ 280
Task 2-2-4: Expenses (ATV rental/repair; mileage)	total	$ 150	4	$ 600	1	$ 600
Subtotal: Scientific Research and Site Security						$ 2,540
SUPER ELEMENT 3 - INFRASTRUCTURE AND FACILITIES						
Task 3-1-1: Coordinate Repair with Grazer during Grazing Season	hr.	$ 70	4	$ 280	1	$ 280
Task 3-1-2: Repair Fences and Gates during Non-grazing Season	hr.	$ 70	8	$ 560	1	$ 560
Task 3-1-2: Supplies (fencing, gate repair, locks and chains)	total	$ 120	1	$ 120	1	$ 120
Task 3-1-3: Maintain/Repair Water Infrastructure (pump, water pipes)	hr.	$ 300	2	$ 600	1	$ 600
Task 3-1-3: Expenses (supplies, ATV rental/repair; mileage)	total	$ 500	1	$ 500	1	$ 500
Task 3-1-4: Replace Existing Perimeter Fencing every 30 Years	lf.	$ 9.00	3641	$ 32,769	30	$ 1,092
Task 3-1-4: Replace Existing Internal Fencing every 30 Years	lf.	$ 9.00	2277	$ 20,493	30	$ 683
Task 3-1-4: Adjustment for Common Fencing between ANCB and ALCB	lf.	$ 3.00	1952	$ 5,856	30	$ 195
Task 3-1-4: Replace Existing Corner/Tension Posts every 30 Years	corner	$ 200	12	$ 2,400	30	$ 80
Task 3-1-4: Remove Existing Fencing	lf.	$ 2	5918	$ 11,836	30	$ 395
Task 3-1-4: Replace Existing Gates every 20 Years	gate	$ 800	14	$ 11,200	20	$ 560
Task 3-1-4: Replace Water Pump/Solar Panels every 15 Years	total	$ 15,500	1	$ 15,500	15	$ 1,033
Task 3-1-4: Replace Pump House every 20 Years	total	$ 3,000	1	$ 3,000	20	$ 150
Task 3-1-4: Replace Water Troughs every 20 years	total	$ 2,640	1	$ 2,640	20	$ 132
Task 3-1-5: Fee for Groundwater Use	total	$ 500	1	$ 500	1	$ 500
Element 3-2: Other Bank Site Infrastructure						
Task 3-2-1: Monitor Condition of Other Infrastructure	hr.	$ 70	8	$ 560	1	$ 560
Task 3-2-2: Replace Signs as Necessary	hr.	$ 70	4	$ 280	1	$ 280
Task 3-2-2: Supplies (Signs)	signs	$ 650	2	$ 1,300	10	$ 130
Task 3-2-3: Repair/Replace Measuring Devices and Temporary Structures	hr.	$ 70	2	$ 140	1	$ 140
Task 3-2-3: Supplies (staff guages)	total	$ 200	1	$ 200	1	$ 200
Subtotal: Infrastructure and Facilities						$ 8,190

SUPER ELEMENT 4 - REPORTING AND ADMINISTRATION									
Element 4-1: Annual Report									
Task 4-1-1: Prepare Annual Report	hr.	$	100	18	$	1,800	1	$	1,800
Task 4-1-2: Submit Annual Report to Approving Agencie by December 15th	hr.	$	100	4	$	400	1	$	400
Element 4-2: Administration									
Task 4-2-1: Project Management	hr.	$	100	24	$	2,400	1	$	2,400
Task 4-2-2: Prepare/Administer Contracts for Infrastructure Repair	hr.	$	100	8	$	800	1	$	800
Task 4-2-3: Office Space, Insurance and Related Administrative Costs	total	$	500	1	$	500	1	$	500
Subtotal: Reporting and Administration								$	5,900
Total								$	38,191
Contingency (20%)								$	7,638
Annual Total Costs								$	45,829
Annual Capitalization Rate									3.50%
TOTAL ENDOWMENT								$	1,309,399