Pollinator Habitat Implementation Plan

Monarch Wings Across California – Matt Efrid / Double E Ag

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Contents

Introduction

This comprehensive Habitat Implementation Plan, developed by Pollinator Partnership (P2), is a timeline and roadmap for installing pollinator habitat at Double E Farms, Fresno, California. This plan covers site preparation, plant material installation, establishment assessment, and ongoing maintenance. The goal is to create an all-inclusive plan to execute long-term pollinator habitat at this facility site.

This habitat project involves the installation of pollinator habitat near almond orchards. Habitat containing a wide range of plant species is critical in supporting a diverse population of pollinators. Flowers of herbaceous plants blooming early in the season provide resources for honey bees (*Apis mellifera)* pollinating crops like almonds. This bloom during the late winter/spring time period is also critical for native bees, like the yellow-faced bumble bee (*Bombus vosnesenskii*). When bumble bees emerge from the ground in February and March, they immediately require pollen and nectar resources in order to build a colony and rear workers. Woody plants, often used in hedgerows, are excellent at providing nutrition for pollinators in the summer and fall when resources are increasingly scarce. A well designed habitat project will increase the amount of nutrition throughout the year which supports the vitality and health of pollinators. For example, bees have lower pathogens loads and increased rates of winter survival when they have access to adequate forage late into the season.

Offering diverse sources of pollen and nectar to pollinators is just one role that habitat plays. Successful habitat also provides places in which bees, butterflies, and other beneficial insects can seek shelter, build domiciles, and complete their life cycle. This habitat project includes milkweed plants which are necessary for the Western monarch butterfly (*Danaus plexippus)* to repopulate itself. Milkweeds are the only food source for the larval stage of the monarch. Adult monarchs will use other, non-milkweed plants for a source of carbohydrates/nectar in the same way bees do. Areas between the plants of undisturbed ground allow ground nesting bees to burrow and hibernate. Dead branches, or the hollow stems of plants are where cavity nesting bees like carpenter bees (*Ceratina spp.*) and mason bees (*Osmia spp.*) provision and rear the next generation. Beneficial insects like green lacewings (*Chrysoperla rufilabris*), California lady beetles (*Coccinella californica*), and the navel orangeworm wasp (*Goniozus legneri*) that control common pests found in California agriculture will also utilize this habitat. Enhancing the landscape by restoring and creating habitat plays a crucial role in supporting increased biodiversity, feeding bees, and helping producers control pests.

Preferred and Recommended Timeline (see appendix)

Site Preparation

Effective invasive plant management on sites dominated by well-established non-native annual grasses requires the integration of site preparation actions into a multi-year treatment program. It should be noted that ongoing management to prevent non-native and invasive species from re-establishing on the site will be required throughout the lifetime of the project, with emphasis placed on the first four (4) years after implementation. Once the installed habitat reaches maturity, management actions will be greatly reduced as the desired vegetation will act as a cultural and biological control against invasive plant species re-establishment.

In California, a fall seeding is considered the best time to establish a diverse native plant community that is attractive to monarch butterflies, bees, and other pollinating species, since many of these native plant species benefit from establishing a root system before the hot and dry summer season.

Proper site and seedbed preparation is a crucial step often overlooked but is vital to the success of establishing pollinator habitat, and commonly requires multiple seasons of planning and implementation. These guidelines will walk you through site preparation, seeding and planting, and long-term maintenance techniques to address management across the project's lifetime.

Fallow and idle field sites dominated by cool season non-native annual grasses are often subject to pressures from an accumulated seedbed from previous years. A seedbank is the natural store of seeds that remain viable for growth within the top layers of soil. As a result, proper site preparation is key to removing both existing vegetation and preventing further infestation from undesired seeds awaiting germination. Idle field sites will require a series of scheduled treatments over several seasons to control and prevent the non-desirable vegetation from persisting through the existing seedbank. The control of invasive species is an imperative aspect of all habitat installation plans, including those that are considered 'novel ecosystems' within working lands as well as for the restoration of native ecosystems. Invasive species removal is also key to reducing excess vegetation fuels, which are considered to be a potential hazard under the threat of wildfires, and supports overall wildlife habitat enhancement goals.

Herbicide applications, or other forms of weed control ideally will be conducted, in the spring and again in the fall for two consecutive years. However, if a full two years of preparation isn't possible, successful habitat can still be achieved by focusing efforts on controlling weeds during the spring, summer, and fall leading up to planting. This method targets both the undesirable cool and warm-season vegetation that competes with desirable native species especially during establishment. Targeting both cool and warm season grasses will most effectively address undesirable species that will emerge from persistent perennial rootstock, and those that will emerge from the seedbank. Dormant seed will not be affected by foliar herbicide treatments that are applied to live plant foliage, as foliar herbicides are only effective on plants once they have broken dormancy and have begun to sprout. Some weed seeds can remain viable in the soil for decades. Activities that disturb the soil, like discing, bring dormant seeds to the soil surface and can worsen weed problems. Using a harrow that only works up a few inches of soil is preferable to discing. A combination of foliar and pre-emergent herbicides can then be employed to address both living and dormant vegetation. It is critical that herbicide contractors be fully aware of the revegetation timeline and that pre- emergent herbicides are carefully selected in accordance with the scheduled seeding events.

Guidelines for ongoing management are also included within this document to help ensure that Double E Farms can meet their goals of establishing and maintaining vital pollinator habitat within a productive green-energy working-lands environment.

The appropriate site preparation activities at Double E Farms include integrated applications of prescribed herbicide(s) in conjunction with mowing and the removal of thatch (dead leaves, stems, and grasses) to prepare the site for seeding and ensure good seed to soil contact.

Year 1

Reduction of Existing Vegetation (February - May 2023)

Site preparation activities at Double E Farms include integrated applications of prescribed herbicide(s) in conjunction with mowing and the removal of thatch (dead leaves, stems, and grasses) to prepare the site for seeding and ensure good seed to soil contact. Site prep begins with the reduction of existing dead vegetation by mowing throughout the site. When mowing, reduce standing vegetation to 2" – 4" with the cut material bagged during the mowing process. It is essential to bag and remove all cut materials to help prevent unwanted seed from being further distributed during this process as well as to remove plant debris so that herbicide treatment can be as successful as possible (to allow direct contact with remaining plant stems/blades). If large amounts of plant matter persist on the ground, it may be necessary to remove the plant residue by raking.

Herbicide Application (February - May 2023)

The above mowing treatment must be followed with an herbicide application approximately 2 to 4 weeks later or once 2" to 3" of new growth has appeared. The use of a foliar broad-spectrum herbicide is recommended. A pre-emergent under the guidance of a local applicator should also be considered. Extra care should be taken when treating wetland or riparian areas to ensure application are safe and not detrimental to aquatic species.

Repeated Mowing/Herbicide Application (May-September 2023)

(If needed based upon response rate from first treatment)

The site will need to be checked, at minimum, on a monthly basis. The site should be re-treated with herbicide if or when new plant growth occurs. If new growth has occurred and has grown over 5" it should be mowed to 2" to 4" in preparation for additional herbicide treatment(s) to prevent all undesirable vegetation, including weeds and non-native grasses, from re-establishing and/or reaching a mature state. It is essential to remove all cut materials to help prevent unwanted seed from being further distributed during this process as well as to remove plant debris so that herbicide treatment can be as successful as possible (allowing direct contact with remaining plant stems/blades). If large amounts of plant matter persist on the ground, it may be necessary to remove the plant residue by raking.

The mowing treatment must be followed with an herbicide application approximately 2 to 4 weeks later or once 2" to 3" of new growth has appeared. Extra care should be taken when treating wetland or riparian areas to ensure application are safe and not detrimental to aquatic species.

Site Evaluation (Spring through September 2023)

The site will need to be assessed on a regular basis to evaluate the effectiveness of prior treatments as well as to locate and address any resistant species. Additional targeted herbicide treatments may be needed if resistant weedy species are present. If new herbaceous (grass and forb) growth has occurred and has grown over 5" it should be mowed to 2" to 3" in preparation for treatment and to prevent all undesirable vegetation, including weeds and non-native grasses, from re-establishing and/or reaching a mature state. This will help prevent undesirable vegetation from producing seed and re-contaminating the site. If such growth has occurred, a targeted application of foliar broad-spectrum herbicide should be employed in coordination with the mowing.

Habitat Installation

Pollinator Partnership (P2) has developed a preferred species list for inclusion on the site (Appendix 2). P2 will work with local seed and plant material suppliers to determine availability of the species and facilitate the seed/plant order 3 to 6 months ahead of time. Once seed mixes are ordered and complete, P2 will provide further instruction for installation regarding the species to be planted.

Seeding and Hedgerow Planting (October – November 2022)

The timing of seeding/planting activities needs to be determined in accordance with weather conditions and in coordination with the timing of the last herbicide application. For example, if glyphosate is used, two weeks should pass between application and seeding. Seeding in the late fall to early winter months will allow plants to germinate under natural precipitation events and develop strong root systems before the summer heat. The blooming season will begin the following spring, although many perennials will not first bloom until their second year of growth.

Planting Methods

Hedgerow Planting

Rows of native pollinator supportive species deliberately planted adjacent to crops like almonds, mimics the hedgerows that were historically present on the landscape. This habitat is useful for supporting strong colonies of migrating honey bees and native bee populations that are key to successful crop pollination. In addition, habitat like hedgerows support other wildlife like monarch butterflies and songbirds. Plants, in plug form, will be planted in rows at each of the two sites, creating a hedgerow which provides nesting opportunities and resources (pollen/nectar/propolis) for pollinators. The mix of recommended species (see appendix 2) contains plants that have a wide range of sizes when they reach maturity. For the purpose of installing these plants in an efficient and manageable manner, each species is categorized as large or small. The exact order or placement of each species doesn't matter as long as they alternate, small ➔large➔small➔large and so on. Plants should be planted approximately 0.829 feet apart.

Planting should occur as quickly as possible upon delivery. The black containers each plant is in attracts heat and can easily dry up over the course of just one day. If the project installation happens over multiple days, plans should be made to properly stage unused plants so they can be watered until they are planted. Each plant should be carefully extracted from the container to ensure the root ball remains undisturbed. Turning the container over in conjunction with a slight shaking motion is often enough to dislodge most plants. More stubborn plants may need to be finessed out of the container with a trowel or screwdriver.

The size of each hole will be determined by the size of the plant. Each hole should be about twice the size of the plant's root ball. When planting into soil with a high clay content it may be advantageous to amend each hole with lighter soil that will allow for better drainage.

Seeding

Planting methods (drill seed or broadcast) should be determined based upon the site conditions after herbicide treatments, including the potential for seed to soil contact. Planting seed at the appropriate depth is key to achieving a successful outcome. Many native plant species produce very small seed, and it is imperative they are not planted too deep, or they will not grow. However, if seed is left on the soil surface it can germinate and subsequently dry up causing mortality. Seed should not be planted deeper than twice the seed's diameter. For example, if a seed's diameter is ¼'' it should not be planted any deeper than ½''. The seedbed should be evaluated for soil compaction due to heavy equipment use. If the soil has been compacted, breaking up the soil surface will significantly help the planting to establish; this can be accomplished by lightly working up the top 2" to 3" of the soil surface. This can be accomplished by using a harrow or very shallow disc implement.

No-till Native Seed Drill: Using a no-till native seed drill is preferred and highly recommended to increase establishment success, which are equated with the ability to calibrate equipment to accurately plant native seed at the appropriate depths. Traditional seed drills are not equipped for working with tiny seeds. No-till seed drills can be used to plant the seed into remaining dead sod where tillage is not feasible or desirable. This will also prevent erosion and assist in weed control. This method will work best when any remaining vegetation is dry and the majority of dead thatch has been removed by mowing or raking as recommended above. It is imperative that the seed be planted only to a depth not exceeding ¼" as native seed is small and **planting at greater depths will result in a significant decrease in germination.** Preparing the seed mix by incorporating an inert carrier agent such as rice hulls to help distribute the seed evenly is a good idea but not required for success.

Broadcast Seeding: Broadcast seeding may be accomplished utilizing an ATV, small tractor, or by hand. If broadcasting onto bare soil, mix a carrier agent (sand, sawdust, clay-kitty litter), at a 1:1 ratio, with the seed to help distribute the seed evenly. The equipment employed will need to be calibrated according to the size of the seeds. Broadcasting the seed over the area followed by lightly raking, harrowing, or rolling the area with a cultipacker to achieve desired seed-to-soil contact. Dragging a section of chain-link fencing behind the broadcaster while seeding is an excellent method to help plant the seed into the upper most layer of the soil.

Plant Establishment and Assessment

It is important to remain patient with the development of your planting over the first few years, as many native perennial forbs and grasses will not bloom or be highly noticeable on your planting site the first year. For this reason, multiple native annual species are included in the prescribed seed mix which will flower in the first year. The use of annual species will help to hold the space until perennials can fully establish. The annuals are key to preventing weedy pioneer species from re-establishing within the site and will naturally reduce overtime as the stronger perennial plants come to maturity. However, surveying the site for weeds and invasive species on a regular and consistent basis is critical during the first 3 years of revegetation to prevent them from establishing before the desired species have fully matured. As soon as weeds are observed they should be treated with a targeted herbicide application which can be conducted easily with a backpack sprayer or removed by hand.

Proper care and maintenance are a vital part of any pollinator planting. **Management is especially critical during the first 3 years of habitat implementation.** The more attention and resources spent on weed control and proper irrigation while the plants are still young and vulnerable, the better the habitat will be throughout its lifetime. While native plants require less maintenance over time, the installation of any new habitat will require some attention to help it succeed. The following recommendations have been put together to aid in the establishment of your pollinator habitat.

Year 2 to 4

Short Term Management 2024-2025

Irrigation (seed): After the seed mix has germinated, irrigate the seeded area if needed to keep the soil moist for the first 4-6 weeks post germination. It is important to keep the soil moist until the seedlings are about 4-6" tall. After that, the seedlings will survive on natural rains. During excessive dry weather conditions, occasional watering will help. Monitor the vegetation in conjunction with weather forecasts to prevent loss from drought.

Hedgerow Irrigation: The water requirements for all the hedgerow species are low. They will need water during the non-rainy months (May-September) for the first 2 or 3 years. Irrigating about 2 times per month should be fine once they reach maturity. Before then, irrigation should occur as often as needed. **It should be noted the first year is when the risk of plant survival is at its highest, especially the first 6 months. The root ball of all specimens planted in the fall should remain moist until seasonal rains occur.** This is subject to change depending on weather and soil drainage. Slight modifications in the water schedule will have to be made based on monitoring of the plants during establishment. At no point during the year should any of these sites have standing water. Species like California lilac (*Ceanothus spp.*) in particular are susceptible to overwatering. Drought tolerant species will not do well with standing water and if overwatering occurs during the summer, it will likely kill them. It is recommended to water for up to 5-10 hours during each irrigation event depending on rate of emitters. Different soil conditions can affect the necessary duration of each irrigation. If run-off is a concern in soils with high clay content, it is advisable to switch shorter irrigation times. Run the water until the area is saturated but does not run-off. Sandy soils may never appear completely saturated so beware of over-irrigating in these situations. There are a wide range of irrigation types that can be used for hedgerows and other habitat projects. If full coverage of an area is desired, fan-jets or micro-sprinklers should be used. While they do use more water, full coverage systems are ideal for simultaneously irrigating perennials in a hedgerow and seed-sown areas adjacent to the hedgerow. Drip irrigation is very effective for hedgerows because each emitter provides water directly to the root ball. Drip emitters have some limitations because they do not cover large patches of ground, which may be necessary to germinate and grow plants from seed.

Targeted Herbicide Treatments: Spot spraying resistant invasive species is another management action that needs to occur on a regular basis throughout the first three to four years of vegetation establishment and will be required as an ongoing activity as needed for long-term site management.

Monitor: Organize a team of employees or community volunteers and schedule monitoring activities at the site on a monthly basis to identify and prevent weed encroachment. Either hand pull or target spray with an herbicide.

Conservation Maintenance Mowing: In the fall, after the native plants have browned, we recommend an annual mowing of the habitat with the blades 8" from the ground through the first 5 years of establishment. This will support the distribution of native seed throughout the site and will prevent any woody plants from establishing on the site. Over time (~3 years) the perennials will have established as large colonies and will prevent re-infestation from non-native annual grasses.

Year 5 and Beyond

Long Term Maintenance 2026 - Throughout Project Lifetime

Having a maintenance plan in place is strongly advised to monitor for weeds bi-annually, focusing efforts on aggressive and invasive species, to prevent them going to seed and reestablishing. As the native wildflowers and grasses establish, the weed pressure will be reduced, however, some weeding and targeted spraying will be required each year.

Conservation Maintenance Mowing: In the fall, after the native plants have browned, we recommend an annual mowing of the habitat with the blades 8" from the ground through the first 5 years of establishment. This will support the distribution of native seed throughout the site and will prevent any woody plants from establishing on the site. Over time (~3 years) the perennials will have established as large colonies and will prevent re-infestation from non-native annual grasses.

Long-term management activities should be repeated on a yearly basis, but mowing cycles may be extended up to every 3 to 5 years after the 5th year after establishment. Perennial plants will not be hurt by this repetitive mowing as long as the plants are not cut shorter than 8". The repetitive mowing will prevent non-natives and invasive species from maturing and reseeding.

Monitoring and Targeted Weed Treatment: Surveying for weed and invasive species re-establishment should continue throughout the lifetime of the project with emphasis on the first several years. Management activities, including spot mowing or targeted spot herbicide treatment, should be anticipated to keep control over weeds and prevent re-establishment or spread. Rehabilitated habitat takes multiple years to fully establish and mature; the site will look different from year to year as the perennial species form extensive healthy root systems and increase floral production. Be patient as your habitat invests in its below ground growth. Once the roots become well established, the benefits of increased flowering, perennial spread, and the decreased need for weed control will follow.

References

Calflora. www.calflora.org

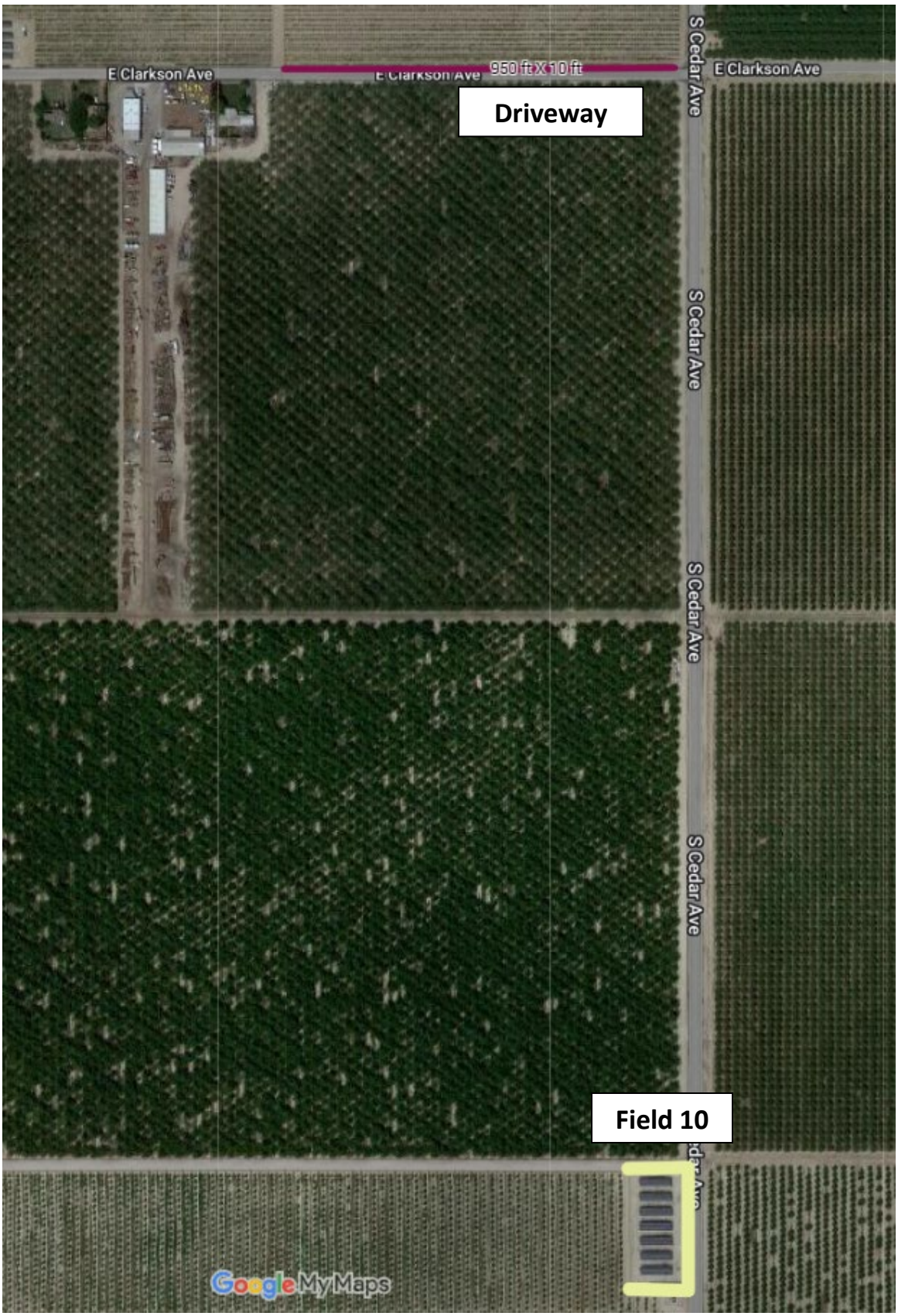
California Native Plant Society, Calscape. www.calscape.org

Cal-IPC. 2015. Best Management Practices for Wildland Stewardship: Protecting Wildlife When Using Herbicides for Invasive Plant Management. Cal-IPC Publication 2015-1. California Invasive Plant Council, Berkeley, CA. Available: www.cal-ipc.org

Vegetation & Biodiversity Management, Report and Work Plan 2017-2018. Contra Costa County Parks.

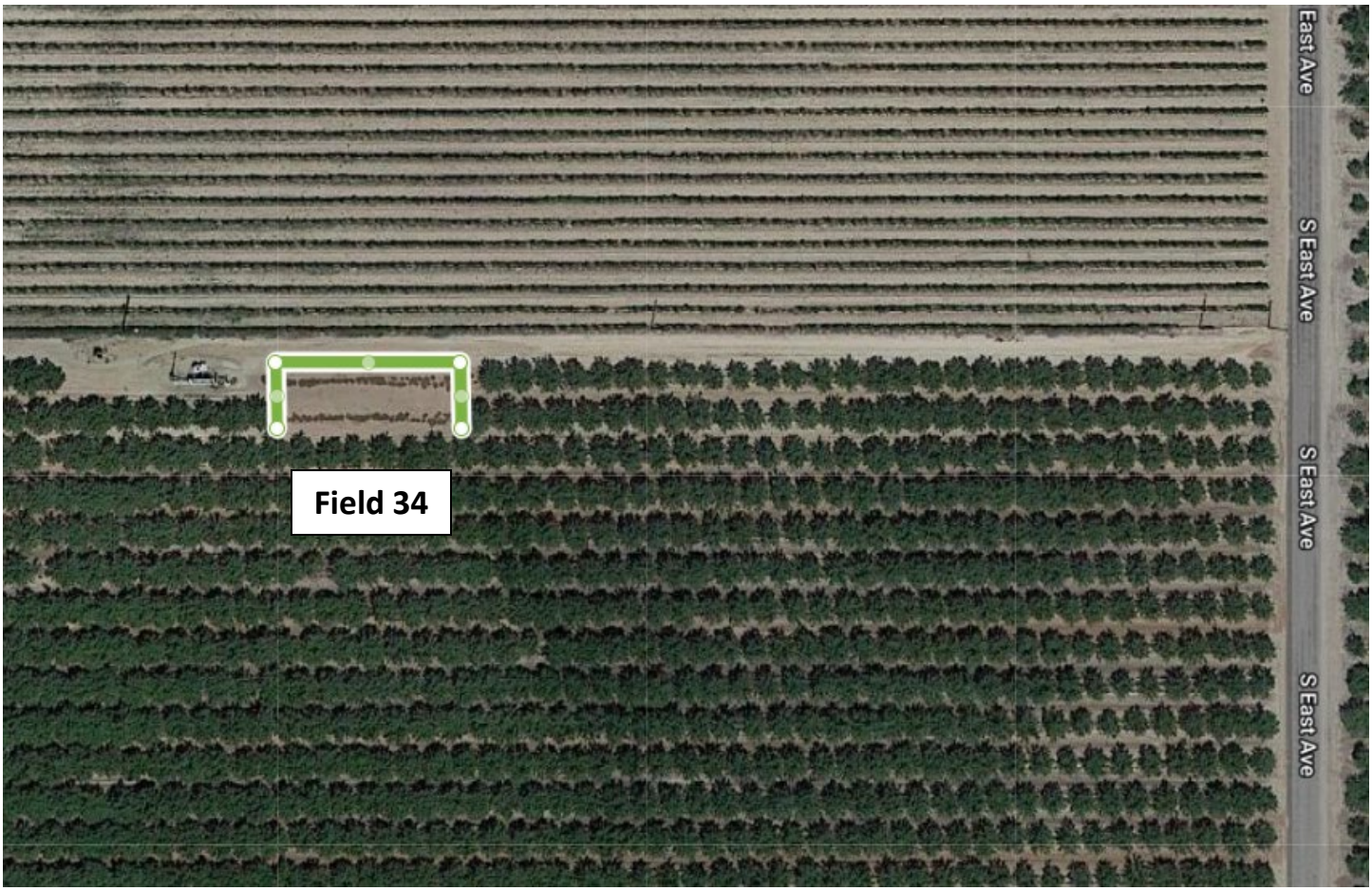
Appendices

Appendix 1: Project Area Map – Driveway & Field 10

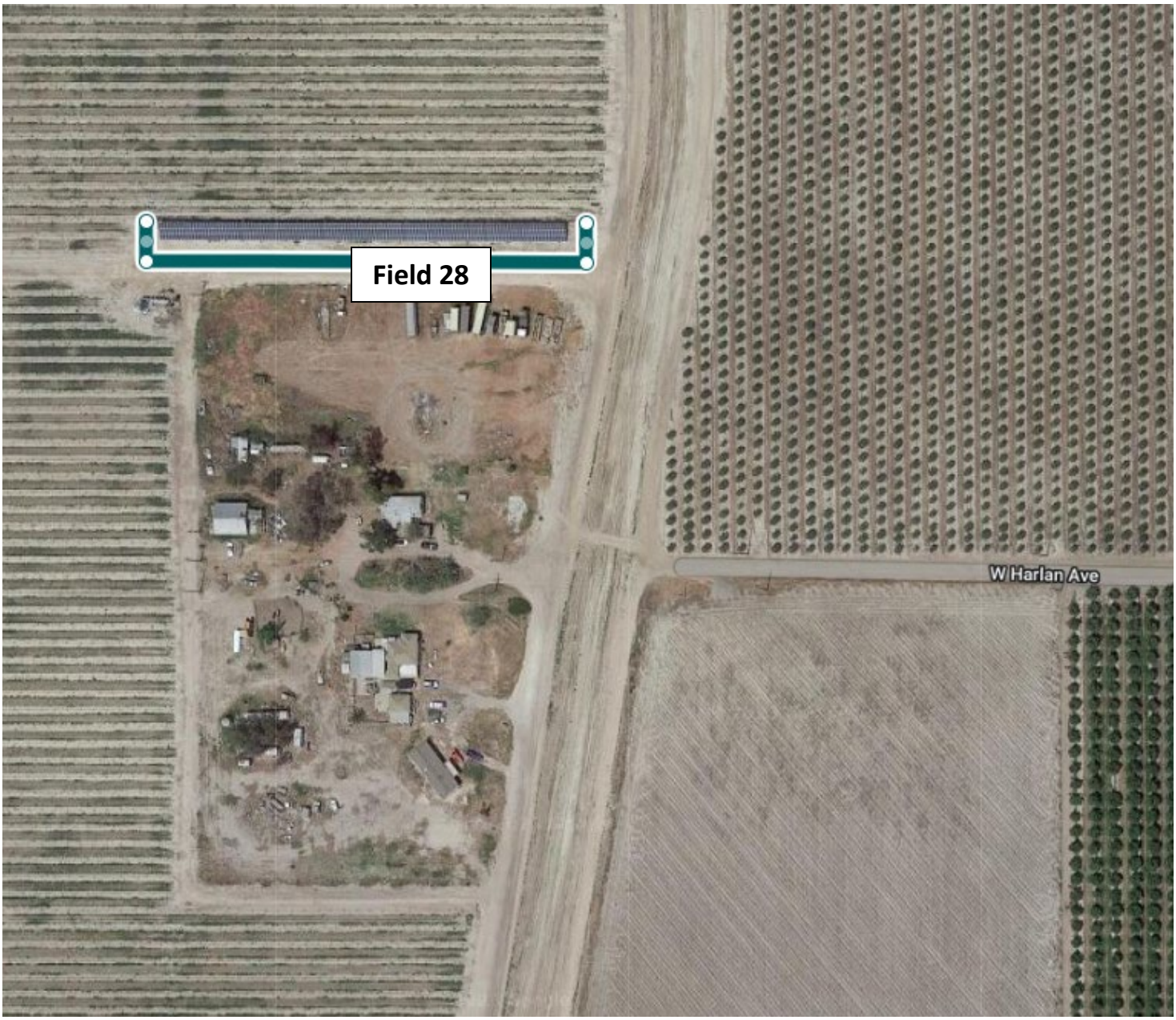


Appendix 1: Project Area Map – Field 12 & Field 13

Appendix 1: Project Area Map – Field 34



Appendix 1: Project Area Map – Field 28



Appendix 1: Project Area Map – Field 35

Appendix 2: Plant Species List

Common Name	Scientific Name	Size	Bloom Period
Narrowleaf Milkweed	*Asclepias fascicularis*	small	June-September
Indian Milkweed	*Asclepias eriocarpa*	small	June-August
Desert Milkweed	*Asclepias subulata*	small	April-October
Common Yarrow	*Achillea millefolium*	small	April-September
Saltmarsh Baccharis	*Baccharis glutinosa*	large	June-October
Fringed Willowherb	*Epilobium ciliatum*	small	March-September
Leafy Daisy	*Erigeron foliosus*	small	May-September
Western Goldenrod	*Euthamia occidentalis*	small	July-November
Evening Primrose	*Oenothera elata*	large	June-September
Alkali Sacaton	*Alkali sacaton*	small	July - August
Orange Bush Monkeyflower	*Diplacus aurantiacus*	large	March-August
California Buckwheat	*Eriogonum fasciculatum*	large	April-September
Coyote Brush	*Baccahris piuluaris*	large	September-January
California Wild Rose	*Rosa californica*	large	May-August
Purple Sage	*Salvia leucophylla*	large	April-July
Black Sage	*Salvia mellifera*	large	March-July

Appendix 2: Seed Species List

Common Name	Scientific Name	Bloom Period
Narrowleaf milkweed	*Asclepias fascicularis*	June-September
Chinese Houses	*Collinsia heterophylla*	February-April
California Poppy	*Eschscholzia californica*	February-September
Gum Plant	*Grindelias camporum*	April-October
Arroyo Lupine	*Lupinus succulentus*	February-May
Five Spot	*Nemophilia maculata*	February-April
Baby Blue Eyes	*Nemophila meniesii*	March-June
California Bluebells	*Phacelia minor*	March-June
Tansy Phacelia	*Phacelia tanacetifolia*	March-May
Goldfields	*Lasthenia californica*	February-June
Globe Gilia	*Gilia capitata*	February-April
Farewell to Spring	*Clarkia amoena*	June-August
Elegant Clarika	*Clarkia unguiculata*	June-September
Golden Lupine	*Lupinus succulentus*	February-May
Common Sunflower	*Helianthus annus*	June-August

Appendix 3: Site Specifications

- Shop Driveway / Hedgerow & seed
  - Total area is 950 ft X 10 ft = 9,525 sq ft.
  - Seeded area is 950 ft X 5 ft = 4,750 sq. ft
  - 950 linear ft. hedgerow planted on north side of Clarkson Ave.
  - 787 plants
  - 14 lbs. seed

- Field 13 Powerline / Hedgerow & seed
  - Total area is 1,300 ft X 20 ft = 26,000 sq ft.
  - Seeded area is 1,300 ft X 20 ft = 26,000 sq. ft
  - 1,300 linear ft. hedgerow North of Elkhorn
  - 1,077 plants
  - 77 lbs. seed

- Field 10 / Hedgerow & seed
  - Total Area is 580 ft X 10 ft. = 5,800 sq ft.
  - 580 linear ft. hedgerow in a U shape around the solar panels
  - Matt will move irrigation farther away from fence
  - No seed
  - 480 plants

- Field 34 / Hedgerows & seed
  - Total Area is 175 ft X 15 ft. = 2,625 sq ft.
  - 175 linear ft. hedgerow in a U shape around the solar panels
  - Matt will move irrigation farther away from fence
  - No seed
  - 144 plants

- Field 12 / Hedgerow & seed
  - Total Area is 380 ft X 10 ft. = 3,800 sq ft.
  - 380 linear ft. hedgerow in a U shape around the solar panels
  - Matt will move irrigation farther away from fence
  - No seed
  - 314 plants

- Field 28 / Hedgerow & seed
  - Total Area is 600 ft X 15 ft. = 9,000 sq ft.
  - 600 linear ft. hedgerow in a U shape around the solar panels
  - Matt will move irrigation farther away from fence
  - No seed
  - 496 plants

- Field 35 / Hedgerow & seed
  - Total Area is 880 ft X 10 ft. = 8,800 sq ft.
  - 880 linear ft. hedgerow
  - Matt will move irrigation farther away from fence
  - No seed
  - 725 plants

4,250 total plant plugs

91 total seed pounds

Appendix 4: Timeline

		YEAR 1 (2023)										YEAR 2 (2024)												YEAR 3 (2025)											
		M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Phase 1	**Site Preparation/Existing Vegetation Removal**																																		
	Mow and/or Remove Vegetation																																		
	Site Wide Broad Spectrum Herbicide Applications																																		
	Grass Selective Herbicide Applications on Seeded Area																																		
	Install Irrigation																																		
Phase 2	**Habitat Installation**																																		
	Install Hedgerow																																		
Phase 3	**Plant Establishment and Assessment**																																		
	Irrigation (if needed)																																		
	Plant Monitoring																																		
	Spot Spray Herbicide																																		

Key:	
	Required
	Execute action if & when needed
	Ongoing