

Cache Creek Watershed Weed Management Plan

A Strategy for Invasive Plant Management in the Watershed



Cache Creek Watershed Forum

Yolo County Resource Conservation District

Funding Provided by:

Water Resources Association of Yolo County



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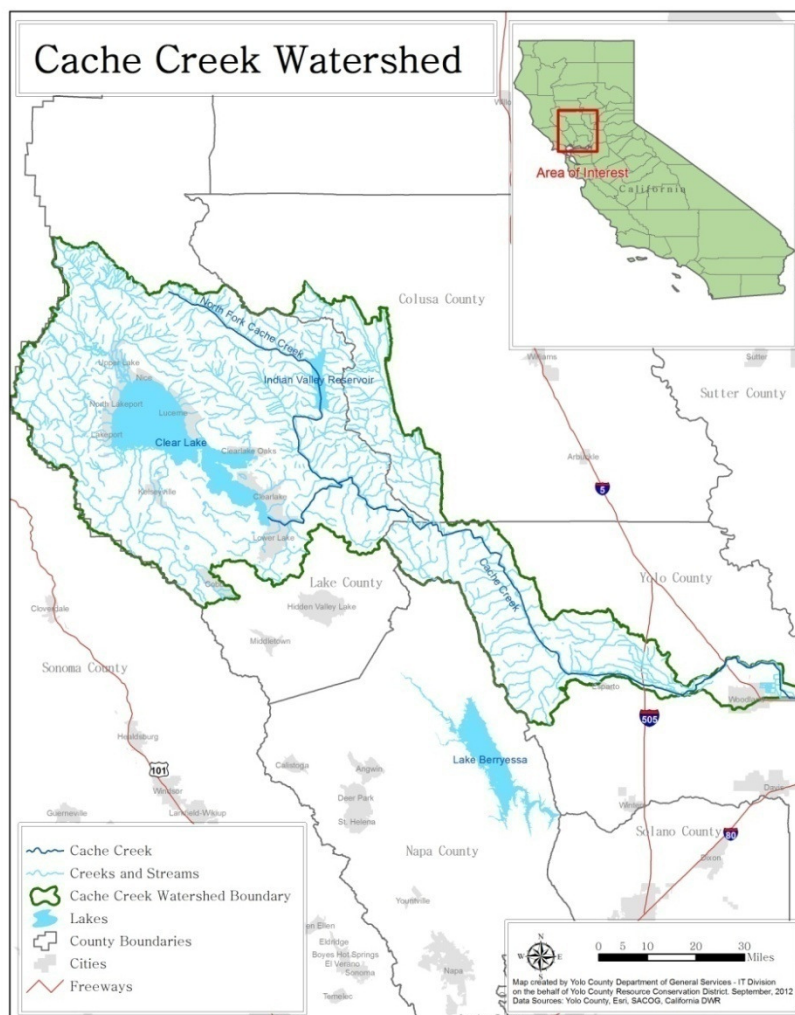
California Invasive Plant Council/Calflora, CalWeedMapper

All photos provided by Yolo County Resource Conservation District Staff

Executive Summary

The Cache Creek Watershed (Figure 1) is rich with cultural, natural, and agricultural diversity. It allows its residents a plentiful range of recreational opportunities as well as being a beautiful place to live. From the Mendocino National Forest, through Clear Lake, Bear Valley, and from the Blue Ridge, the waters of Cache Creek flow through Lake County, the Western edge of Colusa County and down through the heart of Yolo County before meeting with the Yolo Bypass and, ultimately, the Sacramento River. The watershed is in parts wild and scenic, is a wealth of agricultural productivity, and yet provides the backdrop for the residents of several large towns and cities. One major issue which threatens all aspects of the health of the watershed is the presence and prevalence of invasive plants. Over the years leading up to this plan's development, there has been a sustained effort by a large and diverse group of individuals, organizations, and government agencies to control many of the species that threaten the natural and cultural values of the watershed. This plan is a result of that effort and the collation of the years of experience gained by the members of the Cache Creek Watershed Forum (CCWF) in battling the weeds in the watershed. It is also an opportunity to present a strategy, and set goals and objectives for coordinated weed management on the watershed scale.

Figure 1: Map of the Cache Creek Watershed



In developing the plan, the first step was to define the goals for weed management in the watershed. By developing a clear set of goals which meet the needs of the various stakeholders and those most affected by the presence of noxious weeds any future actions will have significance. Those goals were defined as:

Goal 1: Protect water quality and quantity

Goal 2: Protect California Rangelands

Goal 3: Protect agricultural lands

Goal 4: Enhance native biodiversity

Goal 5: Enhance recreation activities

The partners involved in developing this plan also provided input used for the development of the invasive species prioritization components. From this, the following objectives were deemed essential components that should be considered in invasive species management. This plan outlines systematic strategies for identification, monitoring, control, and eradication of invasive species that have either not yet been positively identified as occurring within the watershed but pose a real threat due to their proximity and likely invasiveness, or species that do currently exist within the watershed and require some level of management:

Early Detection

Eradication

Localized Containment

Long-term Program (maintenance, monitoring etc)

Outreach and Education

The next step in developing this plan was to first of all decide upon a method for species prioritization, and then to use that system to define the species and rank them in terms of priority for management. For the purposes of this large scale weed management plan and in such a diverse and varied landscape, it was necessary to adopt an approach which allowed the greatest amount of accuracy while being both extensive and efficient. By utilizing Cal-IPC's Invasive Plant Inventory and newly developed [CalWeedMapper](#) tool to identify and classify invasive species threats, along with calling upon the expert opinions of land managers we were able to quickly confirm potential and existing targets for inclusion in the priority species list. This plan is a result of a collaboration of individuals, non-profit, state, federal, and local government agencies. This management plan delivers a set of goals and objectives for weed management, outlines a system for species prioritization which allows for continual review, and provides general recommendations on how to control and prevent the spread of invasive species and noxious weeds. The funding for the development of this plan was provided by the Water resources Association of Yolo County.

1. Introduction

1.1. Context of Weed Management

The invasion of non-native plant species has become one of the biggest threats to the natural resources of countries the world over. Plants become invasive by accidental or deliberate introduction to areas void of their natural controls, such as predators or environmental barriers, and by outcompeting native vegetation through their ability to thrive on minimal resources. Without natural predators or limiting environmental factors, these plants are adapted for fast reproduction, and for survival under the harshest of conditions. Their ability to spread quickly and cover large tracts of land threatens the biodiversity of wildlands areas by altering ecosystem processes as well as decreasing the productivity of agricultural lands. If left unchecked, invasive species can impact both our economic livelihood and our biological heritage. It is therefore important that communities carry-out positive actions to prevent, control, or reverse the spread of noxious weeds.



Giant Reed (*Arundo Donax*) thicket.

1.2. Development of the Cache Creek Weed Management Plan

Due to the increasing awareness regarding the destructive nature of invasive plant species on our local ecosystems, The Cache Creek Watershed Forum and partners believed it was vital to address this issue within the watershed. The Cache Creek Watershed Weed Management Plan evaluates the existence of invasive species and noxious weed populations identified in the watershed, problems caused by these species, potential for future invasion, and strategies to address this issue.

The objectives of the Plan include:

- Inventory and map existing invasive species and control efforts
- Develop a consensus on priority species, strategies and actions between land managers and agencies
- Develop a coordinated identification, monitoring, and reporting system
- Assess environmental compliance issues and permitting needs
- Identify funding needs for eradication, control and long-term maintenance efforts

The details of these objectives are discussed throughout the sections of this document.

1.2.1. Cache Creek Watershed Forum

The Cache Creek Watershed Forum is "A forum of all stakeholders committed to sustain, protect and enhance the natural, cultural, and economic vitality of the Cache Creek watershed through interest-based collaborative planning and stewardship". The overall goal of this Forum is the protection and restoration of the watershed ecosystem. The three main components of this goal are; Ecosystem Improvement, Vegetation Management, and Education. The Forum participants work cooperatively under a Memorandum of Understanding (MOU) on active restoration and vegetation management projects, provide comment on natural resource issues within the watershed, and also participate at various outreach events throughout Yolo, Colusa, and Lake Counties.

1.2.2. Relevance

For years, invasive species have been recognized as a natural resource concern in the Cache Creek Watershed. Federal, state, and local governments, and local stakeholder entities have acknowledged that invasive plant species pose severe threats to wildlife habitat, increase property damage from flooding, deplete and degrade water quantity and quality, reduce the productivity of agricultural lands, and lead to more erosion problems in an area already prone to flooding and erosion.

While the Yolo Resource Conservation District (RCD), the Cache Creek Conservancy and other local entities have worked to bring these species under control along segments of Cache Creek, we have been lacking an overall strategy to ensure the long-term success of our individual efforts.



Ravenna Grass (*saccharum ravennae*)

In the Master List of Integrated Actions for the Yolo County Integrated Regional Water Management Plan (IRWMP) under Integrated Actions, the first listing is "Cache Creek Exotic and Invasive Species Removal Project, status ongoing", documenting that this type of action is an IRWMP priority and that significant work needs to continue into the future.

This plan is consistent with the goals and objectives of watershed and vegetation management plans in all three counties in the Cache Creek Watershed, as listed in Appendix A.

1.3. Benefits of Weed Management in the Watershed

The Cache Creek Watershed hosts a wealth of wildlife and native habitat throughout the publicly and privately managed farm and wildlands that make up its diverse open space areas. While impressive bands of native riparian and upland habitat remain throughout this 723,500 acre region, the habitat is significantly impacted by dense stands of invasive plants, such as; Tamarisk (*Tamarix parviflora*), Yellow Starthistle (*Centaurea solstitialis*), Perennial Pepperweed (*Lepidium latifolium*), Ravenna grass (*Saccharum ravennae*), and Arundo (*Arundo donax*). In

some places, these stands completely displace native wildlife-friendly vegetation, exacerbate flooding and streambank erosion by constricting and deflecting flow along the creek, decrease the available forage for livestock on rangelands, and otherwise decrease the economic and ecological value of the watershed's natural resources as a whole.

By controlling or eradicating populations of invasive plants, we are attempting to lessen the impacts those species are having on the ecosystems or natural resources of the target area. For example, once an area of riparian habitat is cleared of a particular invasive species, such as Tamarisk, and a suitable array of native vegetation is installed in its place, the benefits to native wildlife species are somewhat gradual but nonetheless significant. Although Tamarisk is thought to provide adequate cover and nesting habitat for some wildlife species, once established the native habitat provides far greater diversity of cover, nesting, and foraging opportunity supporting a much wider array of species. By replacing the tamarisk infestation with native species we are also lessening the impacts of flood events and erosion by allowing a more natural pattern of stream channel dynamics. Tamarisk is only one example of a species currently thriving within the watershed that is having a detrimental impact on the health and vitality of the region's natural resources and ecosystems. By employing tactics to remove or control invasive species, we are reversing that negative trend and encouraging an ecologically positive, healthy, and self-supporting watershed system.

The control of invasive species and noxious weeds also benefits livestock and crop production. In agricultural landscapes, invasive plants and noxious weeds out-compete crops for soil and water resources, reduce crop and forage quality, and poison livestock species. Non-native plants have a detrimental impact on pollinators and pollination by disrupting the structure and function of ecosystems. In the Cache Creek Watershed, the continued health of rangeland ecosystems is of high importance to local agriculture. The vegetation found in the rangelands of Yolo, Colusa, and Lake Counties provides valuable forage for winter and spring livestock grazing. Current threats to those rangelands include; yellow starthistle, medusahead, barb goatgrass, and woolly distaff thistle. These species have been shown to quickly spread throughout vast areas of rangeland, displacing more valuable forage species by creating dense monocultures of species of little forage value or palatability. This is but one example of how invasive species impact the agricultural productivity of the watershed. Other species create problems and decrease the production value of row cropping, hay and alfalfa production and fruit and nut orchards throughout the watershed.

1.4. Approach to Weed Management

Considerable effort and funding has been directed towards managing some of the more well-documented infestations throughout much of the watershed. However, without a continued and coordinated management strategy, these existing infestations threaten the viability of past and ongoing control efforts by serving as a nursery of seeds, stems and rhizomes to reinfest sites further down the watershed. This management plan represents an opportunity to not only enhance the viability of existing work and protect the resources of the Cache Creek Watershed, but to fully coordinate upstream and downstream vegetation management work as a unified watershed effort, which is ultimately the most logical and likely successful approach.

2. Description of the Watershed

2.1. Location and Boundaries

A watershed is an area of land that drains water and sediment to an outlet at some point along a stream channel. A watershed is in effect a large drainage basin. Watersheds occur at multiple scales, from small streams that may drain only an acre to large, complex river systems that drain thousands of square miles. The smaller drainages are often referred to as sub-watersheds. Several sub-watersheds combine to form a larger watershed. Watershed boundaries are drawn along the ridgelines or highpoints be they mountains or subtle rises in flat lands that surround the waterway of interest.

The Cache Creek Watershed is located in Lake, Yolo, and Colusa Counties in the Coast Ranges of Northern California. Cache Creek drains approximately 1,300 square miles and trends (from upstream to downstream) in a southeast direction. The major tributaries to Cache Creek are Clear Lake, North Fork Cache Creek, and Bear Creek. Numerous minor tributaries join Cache Creek as it flows to the Cache Creek Settling Basin with its outlet to the Yolo Bypass of the Sacramento River.

The mainstem of Cache Creek flows from the outlet of Clear Lake and is controlled by the Cache Creek Dam. The lake traps virtually all from the upstream tributary watersheds. The



Mainstem Cache Creek at Dead Man's Rock

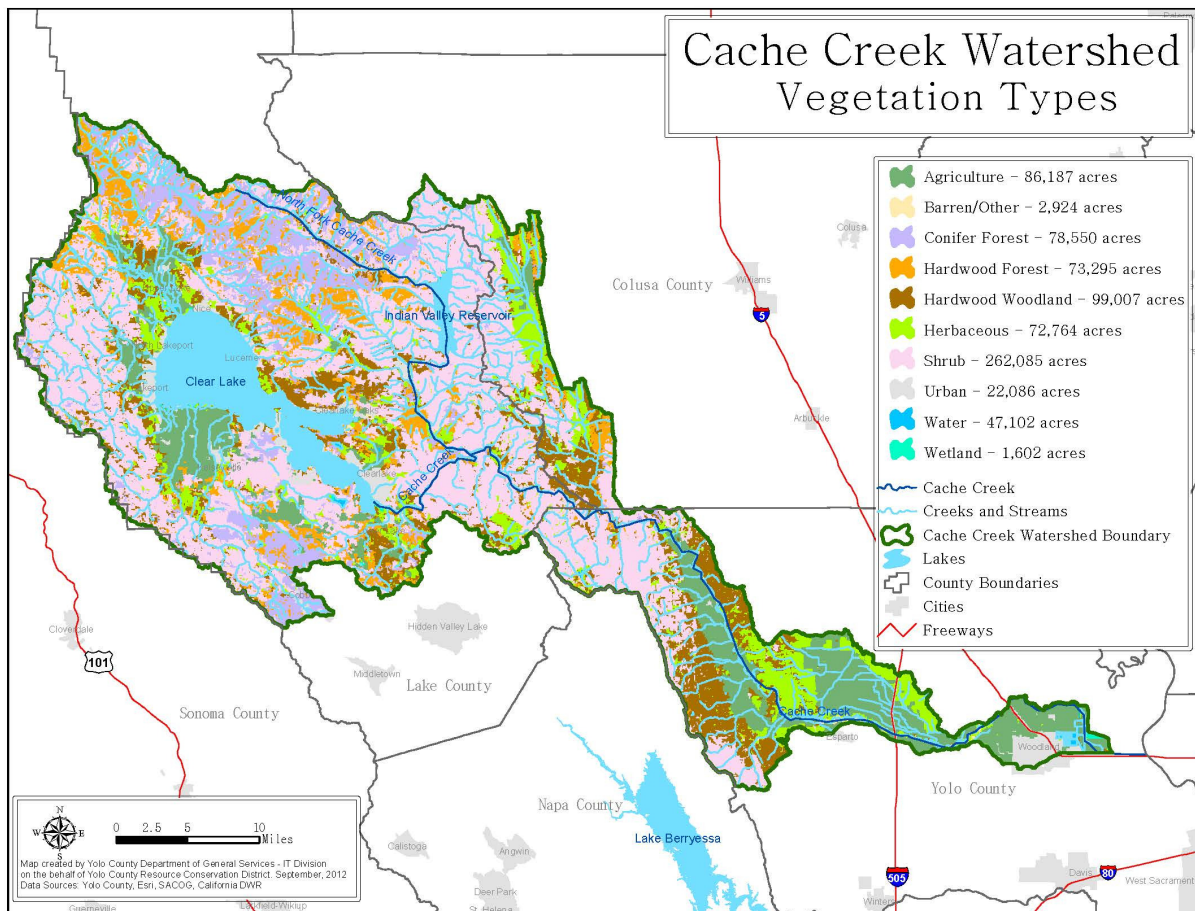
North Fork Cache Creek begins in an alluvial valley surrounded by the hills much lower in elevation than those surrounding Clear Lake. Sediment produced by this area is trapped in the Indian Valley Reservoir. Bear Creek is similar to the North Fork in that it also flows through a long alluvial valley in its upper reach before flowing approximately 12 miles through steep canyons to its confluence with the combined North Fork and mainstem of Cache Creek. The combined Cache Creek sub-watersheds flow into the Capay Valley reach in northwestern Yolo County, approximately 7 miles downstream of the confluence of bear and Cache Creeks. Below Capay valley, the Cache Creek channel flows into the wide alluvial fan area of the Sacramento Valley, in which deposition of sediment was historically the dominant process. The creek's terminus is the Cache Creek Settling Basin, designed to capture sediment and enhance ground water recharge, before ultimately releasing water into the Yolo Bypass of the Sacramento River.

2.2. Resource Base

2.2.1. Hydrology

Prior to the construction and operation of the Cache Creek Dam in 1914 at the Clear Lake outlet channel and the Indian Valley Reservoir in 1975 on the North Fork Cache Creek, the stream functioned as a seasonal stream which often naturally ran dry during the summer and fall and experienced heavy flows in the winter and spring. Flows ranged from 0 to over 40,000 cfs. About 85 percent of the annual precipitation occurs from November to March. Normal annual precipitation varies from a maximum of more than 60 inches in the upper portion of the watershed to a minimum of about 17 inches near the Cache Creek Settling Basin and averages about 32 inches over the entire watershed. A high percentage of the rainfall that occurs in the mountainous areas of the watershed results in direct runoff due to the nature of the soils and the steepness of the topography. Annual runoff in the drainage basin fluctuates over a wide range.

Figure 2: Cache Creek watershed Vegetation Types



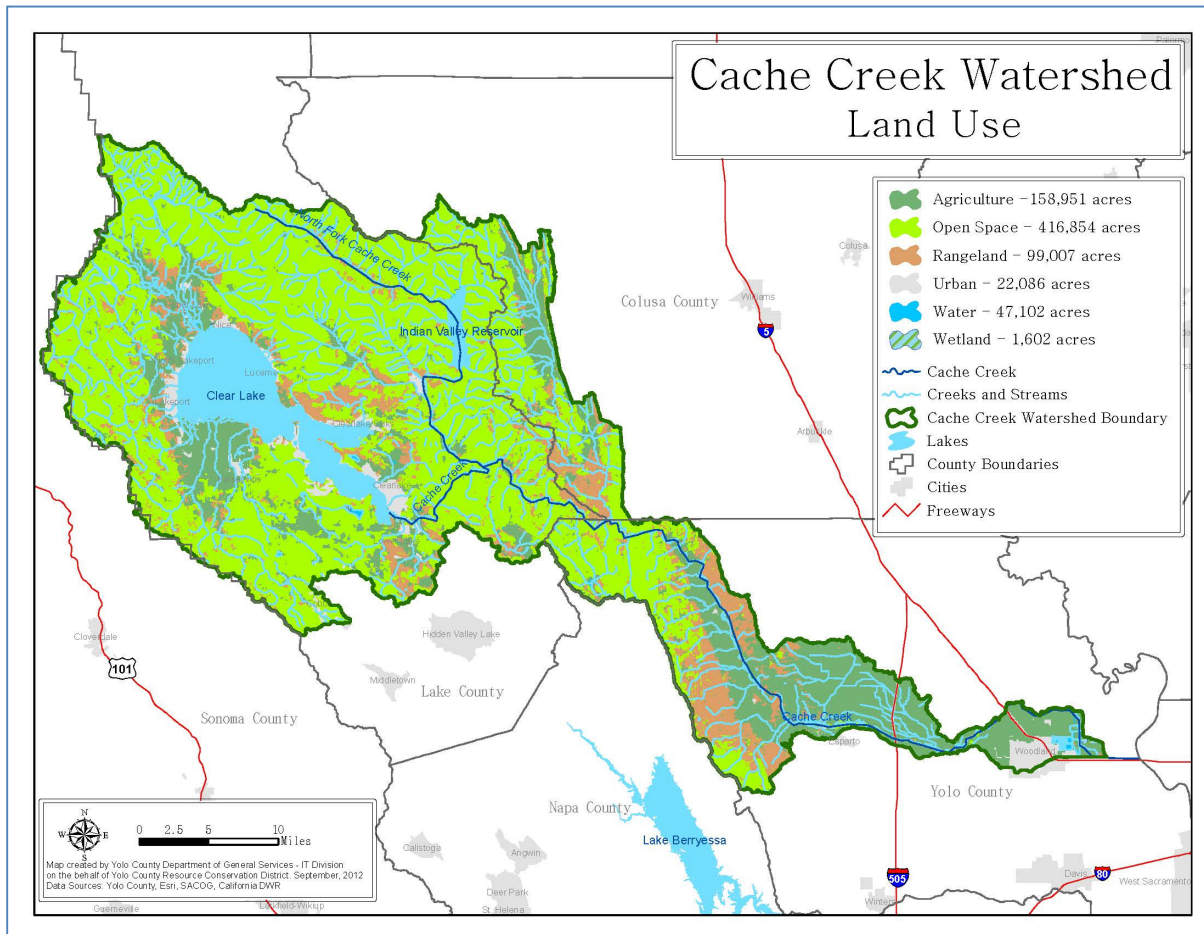
Throughout the recorded hydrologic history of Cache Creek, many floods have occurred, most notably in 1958, 1983, 1986, and 1997. Floods in the Cache Creek Basin are principally caused by runoff of high-intensity rainstorms during winter and spring. Since stream reaches are short and channel gradients steep, peak flood flows usually pass completely through the basin within 24-hour periods.

2.2.2. Vegetation

The Cache Creek Watershed supports a diverse assortment of vegetation types and plant communities. The California Native Plant Society (CNPS) and California Department of Fish and Game (DFG) have developed the most comprehensive protocol for vegetation type classification.

In general terms, there are six major vegetation communities in the Cache Creek Watershed, not including agricultural croplands. These are conifer forest, hardwood forest, herbaceous cover, shrub/scrubland, wetlands, and hardwood woodland/rangeland (Figure 2). Historic and environmental conditions such as elevation, precipitation, soil characteristics, and fire have shaped the spatial distribution of those vegetation communities throughout the watershed. Shrubland is the most prevalent of vegetation types and is composed of a variety of dense shrubs. Riparian areas, although not listed here, are naturally rich in species diversity and provide a wealth of benefits to the health of the watershed. They are often the communities most threatened by invasive species, and as can be seen along vast stretches of the Cache Creek channel, can relatively quickly become overrun by monocultures of invasive species.

Figure 3: Land Use in the Cache Creek Watershed



2.2.3. Fauna

The Cache Creek Watershed is home to a number of wildlife species which are associated with the varied types of habitat available for food, cover, and nesting. Avian species found in the watershed include house finch, scrub jay, acorn woodpecker, tree swallow, bank swallow, common flicker, California quail, California towhee, Wild turkey, American goldfinch, and Stellar's jay, among many others. The Cache Creek Watershed is also lucky to be home to a large number of bald eagles along with several other more common raptors including, Golden eagles, Osprey, Red-tailed, Swainson's, and red-shouldered hawks, kestrels, great horned, Barn, Burrowing, and pygmy owls. Species dependant on a healthy riparian and aquatic system include Osprey, Great blue heron, Great egret, Green heron, Bittern, Spotted sandpiper and the charismatic belted kingfisher.

The watershed also provides habitat for a vast array of reptile and amphibian species, including various federally and state listed species of concern. California tiger salamander, giant garter snake, foothill yellow-legged frog, and western spadefoot can all be found within the watershed.

Mammalian species found in the Cache Creek Watershed include, Blacktail deer, Wild pig, Black bear, Jackrabbit, California ground squirrel, California vole, Opossum, Western grey squirrel, and Muskrat. Mammalian predators in the area include Mountain lion, Coyote, Gray fox, Bobcat, Badger, Raccoon, Beaver, River otter, and striped skunk.

2.3. Land Use

Land use in the Cache Creek watershed varies significantly from the urban centers of Davis, Woodland, and Clear Lake, to the fertile agriculture lands of the Capay Valley, and the vast wild and scenic stretches of the Cache Creek Natural Area. The majority (56%) of the watershed is taken up with what is classed as 'Open Space' (Figure 3), which includes the Cache Creek Natural Area, areas of the Mendocino National Forest, Parklands, and other privately owned and public open space. 21.5% of the watershed is classed as being currently in 'Agriculture' and 13.25% in 'Rangeland'. The remainder of the land use is classified as either 'Open Water', 'Urban', or 'Wetland'.



Spraying priority species Woolly Distaff thistle (*Carthamus lanatus*) in rangeland setting.

3. Weeds in the Watershed

3.1. Weed inventory criteria and data collection methods

There are several options available to land managers to help them determine which species to prioritize for management in California. These options include the California Department of Food and Agriculture's (CDFA) Noxious Weed Rating system, the California Invasive Plant Council's (Cal-IPC) Invasive Plant Inventory, focusing only on urgent problems on a site by site basis, or relying exclusively on the input of local experts and vegetation management professionals. All of these options have their merits and serve vegetation managers well in a variety of settings. However, for the purposes of this large scale weed management plan and in such a diverse and varied landscape, it was necessary to adopt an approach which allowed the greatest amount of accuracy while being both extensive and efficient. By utilizing Cal-IPC's Invasive Plant Inventory and newly developed [CalWeedMapper](#) tool to identify and classify invasive species threats, along with calling upon the expert opinions of land managers we were able to quickly confirm potential and existing targets for inclusion in the priority species list.

The following is an excerpt from <http://calweedmapper.calflora.org/about/>:

CalWeedMapper enables natural resource managers, scientists and others to create maps and reports of invasive plant distribution, to identify management opportunities in a county, Weed Management Area (WMA) or region, and to maintain up-to-date species distribution data statewide. CalWeedMapper is integrated with [Calflora](#) and [Consortium of California Herbaria](#) (CCH) databases, so that new occurrence data submitted to either one informs quad data in CalWeedMapper.

The [California Invasive Plant Council](#) (Cal-IPC) interviewed hundreds of natural resource managers around the state to collect a baseline of "expert knowledge" on abundance, spread and management status by USGS 7.5-minute quadrangle ("quad"). Dates and names from these interviews are noted for each quad. This expert knowledge data forms the foundation of the quad mapping tool.

Quads measure approximately 8.5 miles north to south, and in California range from approximately 7.2 miles east to west on the southern border of the state to 6.5 miles east-to-west on the northern border of the state. There is a complete grid of quads over the United States.

Occurrence data from Calflora and CCH is also included, in particular for quads where expert knowledge indicates that a species is not known to occur but where occurrence data documents observations. Verifying quad data for such discrepancies is a key opportunity.

CalWeedMapper identifies management opportunities based on the current distribution of a given plant in an area. If a plant is not known to exist in the region, but is found within a given distance (50 miles) of the region, it is identified as a

surveillance target. If a plant exists only in single, isolated quads in the region, it is identified as an eradication opportunity. Finally, if a plant is present in the region at levels higher than this, it is identified as a containment opportunity.

To show where a given plant is most likely to spread, CalWeedMapper also maps suitable range based on climate. This modeling uses: Maxent modeling software; occurrence data documenting where the plant currently grows in California; and climate data for California. Projections of future suitable range use: the A2 climate change scenario developed by the International Panel on Climate Change and downscaled data for California from the Canadian Centre for Climate Modeling. Ongoing efforts are aimed at including data from outside California, which will increase the accuracy of suitable range maps for species not widely distributed in California currently.

Data shown on CalWeedMapper, while very useful, should not be considered to be 100% accurate. Quad data, while having the great benefit of drawing on the extensive experience of individual local resource managers, is inexact. Occurrence data, though of higher precision, may not always be correct, either, since species may be misidentified or locations not captured correctly. Data of either type can become outdated if not maintained. Range modeling is predictive, providing an estimate of the probability that a plant will find conditions in a given area suitable for growth.

For more detailed information on methods contact mapping@cal-ipc.org.

The CalWeedMapper tool has the ability to categorize, map, and approximately quantify species' extent and management level, and its capability for real-time data management allows land managers and others working in the watershed to quickly and efficiently view and revise weed management strategies and assess management opportunities. This provides an ideal opportunity for ongoing review and revision as species change through positive management actions or infestation progression providing the watershed with a powerful tool that takes the goals and priorities set within this document and allows them to be coordinated with shifts in species composition, management action, and infestation extent.

Along with natural resource manager input through personal involvement in the data gathering aspect of the CalWeedMapper tool development, another critical component of the process involves the addition of actual field data in the form of GPS points and field mapping. As mentioned above, when possible this data can be uploaded to either the Calflora or CCH databases and then transferred to CalWeedMapper as points on a map with attached collection information. Having this valuable data on-hand allows for easy verification of individual species accounts and for greater accurateness of species prevalence, trend, and management activities.

3.2. Inventory of weed species present in the watershed

CalWeedMapper is able to produce a list of species present in pre-determined geographical or political areas. Users are able to choose their area of interest as the County, Weed management Area, or Watershed level. The tool then provides a regional “Management Opportunity Report” for the chosen area. These reports provide a starting place for establishing priorities and goals at the regional level. The report includes a table of all invasive plants that present opportunities for surveillance, eradication, or containment in the region selected. The table summarizes each plant’s distribution and suitability in the region. Plant species are organized by their statewide rating in [Cal-IPC’s Inventory](#), but impacts can vary by region.

Attached is the regional Management Opportunities Report for the Cache Creek Watershed (Appendix B). The report is included as an attachment and not within the body of the report as it is a real-time report and therefore is constantly changing as new species are discovered, populations are eradicated or reduced, or species spread to new areas and that data is updated by natural resource managers or other interested stakeholders.

The most recent version of the Invasive Species Management Opportunities Report for the Cache Creek Watershed can be found at: <http://calweedmapper.calflora.org/maps/>

3.3. Priority species list

The Management Opportunities Report provides a comprehensive overview of species composition, extent, trend, potential for spread, and current levels of management. To enable land managers to make strategic decisions for planning and implementing invasive species management actions at the watershed level, it is necessary to develop a consensus on priority species and to outline specific goals for those species. By having such systems in place, weed management efforts are more coordinated and thus, success is more likely.

As part of the process of developing this weed management plan, members of the Cache Creek Watershed Forum (CCWF) participated in several working group meetings whereby priority species were identified and goals were set for the management of those species at the watershed level. Drawing upon the expert knowledge and experience of the CCWF partners, populations of species identified in the Management Opportunities Report were assessed and ranked in order of their level of threat and manageability. Priority species were chosen in each of three categories; Eradication targets, Containment targets, and Surveillance targets.

- **Eradication targets.** The goal is to work together to eradicate all populations of these species found within the region within three years. The opportunity for eradication of these species results from a small number of isolated infestations. To be considered an eradicable population, the species must only appear in one quad surrounded by at least two concentric bands of quads showing an absence in the Management Opportunities Report.
- **Containment targets.** Containment relates to limiting the spread of existing infestations, eradication on a site-specific basis, and working collaboratively to ensure the reduction of the species within the watershed overall. The opportunity for containment of certain

species is included in the Management Opportunities Report by larger groups of infested quads within the watershed.

- **Surveillance targets.** These species are currently not found within the Cache Creek Watershed but are found within neighboring areas and show a high potential for spread. Including a list of surveillance targets provides an opportunity to practice Early Detection and Rapid Response (EDRR) which limits the potential for future large-scale infestation.

The Cache Creek Watershed Weed Management Priority List is attached as Appendix C.

4. Management Goals and Objectives

The CCWF partners involved in this project provided input used for the development of the invasive species prioritization components. The following goals and objectives were deemed essential for consideration in invasive species management in the Cache Creek Watershed.

4.1. Land Management Goals

Goal 1: Protect water quality and quantity

Cache Creek is a major tributary to the Sacramento River and the San Francisco Bay Delta. Invasive species found within the watershed, in riparian zones, rangelands and woodland ecosystems, have been shown to have a negative impact on water quality and quantity. By managing these invasive plant species, land managers will be protecting the water resources from the effects of soil erosion, flooding, and decreasing water availability within the Cache Creek watershed and consequently the larger Sacramento and Bay Delta Watersheds.

Goal 2: Protect California Rangelands

California's annual rangelands offer a variety of essential ecosystem services along with providing valuable habitat for a wealth of plant and animal species. Weed control in rangeland systems can lead to increases in native plant species, forage quality for livestock, wildlife populations, plant diversity, and soil water availability. Protecting rangeland systems from the effects of invasive weed species can also decrease allergens, restore normal fire regimes in an area, and can also help prevent the degradation of rivers and streams.

Goal 3: Protect agricultural lands

The Cache Creek Watershed is home to some significant agricultural areas including the aforementioned rangelands, vegetable, hay, and grain croplands, orchards and vineyards. This agricultural base is an important facet of the region's economy. Minimizing the impacts of invasive plant species on the region's agriculture ensures

both the environmental and economic health of the agriculture community as well as protecting the wildlands and waterways from possible invasion by agricultural weeds.

Goal 4: Enhance native biodiversity

The reestablishment of native plant populations will be a beneficial outcome of invasive species management and control. As invasive plants are controlled and replaced by native plants, communities can be restored to a natural state providing numerous benefits for wildlife, aesthetics, agriculture, and recreation. A healthy and diverse community of native plants provides a variety of food and cover for resident wildlife unlike the dense monocultures that are often created by invasive species. Native plants are better adapted to the environment (climate, geology and soil characteristics, pests and diseases, etc.) of their native range, thus are better suited to rejuvenate an area back to a more natural ecology. Native plant regeneration as a result of controlling detrimental invaders can highlight regionally native species, resulting in a more pleasing landscape.

Goal 5: Enhance recreation activities

Invasive species are detrimental to the pursuit of the range of recreation activities available to both residents and visitors to the watershed in a variety of ways. Many plants become invasive because of the large amount of seeds that they produce, and the seeds can spread easily in the fur of pets or fishing and boating equipment. By educating visitors and recreation users such as boaters, pet owners and hikers to the importance of vigilance in the possibility of seed transportation, the spread of invasive species seed is minimized. Preventing the spread of invasive species will also enhance the beauty of natural areas for nature enthusiasts by allowing native plant regeneration and subsequent wildlife attraction. Accessibility to recreational areas is also often greatly affected by the presence and extent of invasive species providing another opportunity for management.

4.2. Weed Management Objectives

The partners involved in this project provided input used for the development of the invasive species prioritization components. From this, the following objectives were deemed essential components that should be considered in invasive species management. This plan outlines systematic strategies for identification, monitoring, control, and eradication of invasive species that have either not yet been positively identified as occurring within the watershed but pose a real threat due to their proximity and likely invasiveness, or species that do currently exist within the watershed and require some level of management. By setting these objectives in the Cache Creek Watershed, the threat of invasive species in the Sacramento River and San Francisco Bay Delta is also reduced.

- 4.1.1 **Early Detection:** To prevent invasion and spread of new weed species in the watershed, a framework and target list for potential threats has been developed. The Priority Species Target List contains species identified as Surveillance

Targets. Surveillance targets are those that have not yet been identified within the Cache Creek watershed but are currently invading adjacent areas or areas close enough to pose a threat.

- 4.1.2 **Eradication:** The objective for eradication target species is to successfully eradicate them from the watershed within a three-year time period from the time of positive identification.
- 4.1.3 **Localized Containment:** The objectives for Containment target species are set on a site-specific basis within the context of individual land management priorities.
- 4.1.4 **Outreach and Education:** To implement workshops focused primarily on watershed weeds and their management, and acquire greater support and educate more land managers, members of the public, and those in the agriculture sector on the importance of weed management, species of concern, and what they can do to help protect their land and the watershed in general. This objective also involves outreach focused on specific priority species within each of above objectives and enhancing the ability for early detection and rapid response.
- 4.1.5 **Long-term Program (maintenance, monitoring etc):** All species included in the Watershed Weed Management Priorities Lists will be continually monitored for and land managers within the watershed are encouraged to educate themselves and the public on these species and provide input to the CalWeedMapper site if new infestations are observed or populations are brought under management or are eradicated. The List will be subject to annual review by members of the Cache Creek Watershed Forum and the public.

5. Weed Management Actions

5.1. Prevention

The first action in weed control is prevention. By preventing a species from infesting an area, the often high cost of implementing eradication measures is avoided. This plan addresses prevention in three ways; surveillance, education, and minimizing human seed dispersal. Before a species has an opportunity to spread into and infest an area, efforts to prevent that new infestation should begin. In order to locate and identify possible new species, monitoring should be ongoing and extensive throughout the watershed and also in neighboring areas. Not only should areas be monitored in search of new populations, but locations where problem species existed and were treated should also be monitored to prevent future recurrences.

To aid in the prevention of new infestations, the inclusion of a list of surveillance target species ensures land managers, members of the public, and landowners alike are able to learn and identify species that currently pose a threat to the watershed but are not yet found within its

borders. Utilizing CalWeedMapper, species were identified that exist in USGS quads adjacent to the watershed. To manage the threat to the watershed that these species pose, the members of the CCWF will develop a system for monitoring the level of threat from each species through the combined use of CalWeedMapper and on-ground field surveys. By developing a system for continued and adaptive monitoring, the CCWF partners will be far better equipped to assess the threat levels from each of those species, prevent their introduction to the watershed, and react with rapid targeted control actions if they do become a problem.

5.2. Weed Control Options for Priority Species

Actions involved in managing priority species include: planning, mapping and maintaining data on the current extent of eradication targets; updating and maintaining the CalWeedMapper database for revising/adapting management opportunities and tracking infestation spread; coordinating treatment activities on target species (eradication and containment); holding annual meetings of the Cache Creek Watershed Forum to discuss new or potential infestations and the status of ongoing eradication or other management efforts; carrying out treatment of eradication and/or containment target species; holding public outreach events. All of these actions are necessary for a successful program of weed management on any scale but are particularly important for such a large scale. Without coordinated collaboration, good planning, monitoring, education, and strategic implementation, any species control measures are rendered ineffective. By defining goals, prioritizing actions, and working in a strategic and organized manner there is set in motion a system for the successful long term management of invasive species for the benefit of the watershed. The following is a brief discussion of each action;

Planning -To enable an effective series of control actions within the watershed, planning is necessary to assess, and strategize for best approaches to enact control measures. Planning may involve the review of maps and species extent data, deciding upon the most appropriate control method for the individual species and site concerned, logistical considerations, scheduling, and partner coordination, among many other steps.

Mapping –The first of the on-ground activities enables decisions based around firm data of species population extents and potential for spread and confirms size and level of management required for species populations within the watershed. Without this knowledge, there is no possibility for a strategic and methodical approach to treatment activities. It is a baseline action, without which future activities cannot be appropriately planned or implemented. It also provides solid data with which land managers can measure and evaluate the success of all future actions. As control actions are carried out, it is also necessary to update mapping data.

Mapping may be carried out on an annual, bi-annual basis or as funding allows. Infestations can be mapped using hand-held GPS devices and the data can therefore be easily compared with that from initial surveys. Challenges to this approach may include the remote locations of some infestations, annual climate variability acting against the consistency of species prevalence, and also the sheer size of the watershed may provide challenges relating to the ability to cover such a

vast landscape which, with the support and participation from the various watershed partner organizations and the general public, should be able to overcome.

Updating and maintaining the CalWeedMapper database – Following the on-ground mapping of a species, area, or site, land managers can upload their data to the CalWeedMapper dataset, which allows others working in the watershed and throughout the State the opportunity to access, review, and revise as necessary. Maintaining data in a central location allows for smaller, site, or project-specific actions and datasets to become included in a much larger context which has the added benefit of giving each individual action a relevance and traceability on the watershed scale. It also allows for the wider and more secure availability of data into the future. The physical part of this action is relatively straightforward, requiring little in the way of GIS or GPS knowledge and various members of the CCWF are available to provide guidance or to maintain the datasets for partners, landowners, or members of the public not able to do so. This task also involves the annual review of the three categories of priority species by the members of the CCWF and other interested parties. On an annual basis, the CCWF will meet specifically to address the Weed Management Plan, its successes, and shortcomings, and will discuss any developments in weed species prioritizations as management actions are carried out.

Coordinating – An important part of a large-scale weed management project such as in the Cache Creek Watershed is coordination. Building and utilizing partnerships is a key component to carrying out successful landscape-scale conservation projects. Partnerships and coordination allow for the utilization of a greater, more diverse and often more qualified skills and knowledge base. By coordinating with the various members of the CCWF, this plan allows for input and action from partners throughout the watershed and beyond. This plan was built around the needs identified by partners with specific skills, or with knowledge of particular species or locations, and as it moves from development to implementation, their continued involvement is critical to the success of the stated objectives.

Weed Treatment – Weed control methods include mechanical removal, chemical applications cultural practices, grazing, prescribed burning, biological control, revegetation with native species, and integrating various combinations of these methods. At times, each invasive species will respond differently to the diverse types of treatment methods and a single type of treatment may not be adequate for a site with multiple invasive species, especially if they are intermingled with desirable plants. The four management techniques described below are often used on an integrated basis to enhance the effectiveness of the treatments. In order to sufficiently control the invasive plants, the best possible combination of treatments, dosages, and timing of applications must be determined through continual research and experimentation – also known as Adaptive management.

The term Adaptive management refers to a plan or set of actions that integrates research and conservation efforts. Through the principles of adaptive management,

project leaders are encouraged to apply different actions based on the monitoring results of site-specific areas. The documentation gained from previous successes or failures in conservation projects provides information which will improve future management practices. Investigating earlier projects conducted within an organization, region, or by other groups, is a vital component of adaptive management. Through personal experience, data collection enables a project group to discover and learn the methods which are most effective for their specific conservation practice or site. Therefore, it is recommended that all actions are implemented with this theory in consideration, i.e. not all recommended actions will work for each species or site conditions which necessitates land managers being aware of the need for adapting their particular strategy and for consulting with local experts and other land managers prior to starting work.

It is also important when determining which techniques will be used for treatment to consider issues such as; the existence of desirable species in the area, proximity to water supply and hazards, proximity to agricultural areas, growth stage of the plant in question, density of the population, disturbed areas, threatened or endangered species presence, land accessibility, permitting, and financial and labor resources.

In general, four treatment techniques include:

- Chemical Treatment

Chemical treatments involve pesticides that can be applied to plants with or without special certification. A primary goal of any chemical invasive plant management program is promoting selectivity of one species over another. It is often the case that the invasive species or noxious weeds that are the targets of control co-occur with desirable native species. Chemical treatments can offer such selectivity with the use of proper application techniques, timing, and chemical choice. Although many herbicides are available as over-the-counter purchases and can be applied by members of the public it is highly recommended that land managers contact a qualified Pest Control Advisor (PCA), County Agricultural Commissioner, or UC Cooperative Extension Specialist. Many herbicides, however are labeled for restricted use and as such can only be applied by qualified individuals, thus large scale projects in parks, golf courses, waterways, forests, roadsides, cemeteries and many other situations as well as the traditional agricultural crops, must be carried out following the pesticide recommendation of a PCA and under the supervision of qualified persons.



Spraying a large infestation of tamarisk (*Tamarix parviflora*).

- Cultural Methods

Cultural methods for weed control include the use of fire and livestock grazing. When conditions allow they are both viable options for the control of a diverse range of species. Grazing can help reduce seed production of target species, but timing and growth stage of the plant are critical. Repeated grazing just prior to flowering can be very effective at reducing seed production in annual plants and in depleting



Sheep targeting yellow starthistle.

underground storage carbohydrates of perennial plants. Certain species are able to regrow and flower successfully, if at a lower branching pattern, therefore repeated grazing may be required to minimize the risk of seed production. In practice, there are various considerations to take into account when planning a targeted grazing much of which can be answered by consulting and contracting with an experienced grazer. Some issues that arise when utilizing the services of a

contract grazer include; predators, fencing, neighboring land uses, and accessibility for stock delivery to the site among others. Although it can provide some logistical challenges, grazing is proven to be a successful tool in managing certain populations of weeds.

Fire has been used successfully to control species of annual grasses, perennial plants and others. It is most successfully utilized as a tool in annual rangeland settings to reduce buildup of thatch and deplete the seedbank of species such as medusahead and yellow starthistle. As with most control methods, timing and appropriate planning are critical to the success of using fire as a management tool. Consulting with the local fire or air quality control district prior to scheduling a burn is often necessary to ensure proper precautions and regulations are met.

- Mechanical Methods

Mechanical treatments include hand pulling, weed wrenching, lopping, cutting, mowing, and excavating and all can be effective tools in weed management. Combining mechanical and chemical methods of control may increase effectiveness and reduce overall control duration. However, it is important to understand the growth habits of the particular species targeted for mechanical control, as this method may proliferate certain species, such as tamarisk. The mowing of alien invaders can be part of a valuable control strategy for heavy infestations when used in conjunction with chemical treatments to control root masses. Other mechanical methods, such as hand pulling and digging out roots are also useful for the control of certain species in selected settings. However, the size of the infestations can make these control options extremely labor and time intensive.

- Biological Control



Tamarisk leaf beetle (*Diorhabda elongate*) was released in the Watershed to control tamarisk.

Biological control is the introduction and release of insects, mites, or pathogens to provide permanent control of the existing invasive plant. Due to the potentially harmful effects of the non-indigenous species used as biological control, it is protocol that before the introduction of a formidable biological control to a new ecosystem, both the control and host are studied thoroughly to ensure the selected candidate control agent has little or no chance to thrive on other desirable native or agricultural crops. The cost is often high because these control methods require

extensive study and are not yet as widespread as more conventional management techniques. In addition, the application of biological control agents can be time and labor intensive.

5.3. Permitting and Weed Control Law

Implementation of some of the methods described in this plan will require the compliance with certain federal, state, and local regulations and for land managers to obtain the relevant permits prior to commencing on-the-ground work. A permit is an authorization, license, or equivalent control document issued by a federal, state or local government or agency to implement the requirements of a regulation or law. Therefore, a permit is an agreement between the issuing agency and the applicant whereby the applicant agrees to follow the applicable codes and laws governing a project or type of land use. By issuing and keeping track of permits, local, state and federal agencies can set minimum standards for activities that ideally will protect California's environment now and in the future. The permit process was developed to provide for orderly development, ensure compliance with applicable regulations, and minimize future adverse impact on a wetland or riparian area (i.e. streamside), clearing vegetation, disturbing ground, or conducting work near a sensitive area requires permits from numerous agencies.

Permit applicants may be individuals, watershed groups, special districts (such as RCD's), or local, state, or federal agencies. Permitting agencies require different forms to be filled out for different types of applicants. Because the permitting process can be complicated and time consuming and there are often fees associated with permit applications, it is recommended that individuals work with their local watershed group, RCD, or NRCS office to combine restoration projects and permit applications into a larger effort. Below is a brief summary of the permits applicable to restoration projects undertaken by individuals and watershed groups. A checklist of possible required permits is attached as Appendix D

Local Agencies:

City/County Planning Department: Many City or County planning departments have local ordinances pertaining to streams and wetlands, and depending on the nature of the project several other permits/exceptions/approvals may be required as well.

Local Irrigation, Water or Flood Control District: Irrigation, Water or Flood Control Districts are empowered to protect water resources within their jurisdiction which may require a permit for certain projects.

State Agencies:

California Environmental Quality Review: The local or state government with the most jurisdictional responsibility for your project must review it under their requirements of the **California Environmental Quality Act (CEQA)**. The main purpose of CEQA review is to identify and prevent potentially significant environmental impacts from proposed projects.

California Department of Fish and Game (DFG): The DFG requires a **Streambed Alteration Agreement (1602 Permit)** for any work that occurs in, on, over or under a waterway, from the bed of a stream to the top of the bank, any work that will divert or obstruct the natural flow of water, change the bed, channel, or bank of any stream, or use any material from the streambed. This permit is also required when removing exotic vegetation from a riparian area.

State Water Resources Control Board (SWRCB): The SWRCB Division of Water Rights requires a **Water Rights Permit** when there is intention to take water from a stream for storage or for direct use on non-riparian land.

California Regional Water Quality Control Boards (RWQCB): The RWQCB for the region requires a **Federal Clean Water Act (CWA) Section 401 Water Quality Certification** for every federal permit or license for any activity which may result in a discharge into any waters in the United States. Activities include flood control channelization, channel clearing, and placement of fill. Federal CWA Section 401 requires that every applicant for a U.S. Army Corps of Engineers CWA Section 401 permit or Rivers and Harbors Act Section 10 permit must request state certification from the RWQCB that the proposed activity will not violate State and Federal water quality standards.

Federal Agencies:

National Environmental Policy Act (NEPA): NEPA's basic policy is to assure that all branches of the federal government give proper consideration to the environment prior to undertaking any major federal action that significantly affects the environment. In order to reach an informed decision, NEPA requires a prescribed process, including public involvement, scientific analysis and potential mitigations. NEPA compliance is mandated when the Natural Resource Conservation Service (NRCS) provides financial assistance.

6. Restoration of Treated Sites

Without some level of restoration or follow-up, invasive plants that have been controlled or removed from an area have a chance to take hold once more. Even if an eradicated species does not reoccur there plenty of other invasive species in the seed bank, on the perimeter of the site, on the wind, or in the creek just waiting for their opportunity to take hold. This has been

seen all too much following the removal of tamarisk throughout much of the watershed and the rapid colonization by perennial pepperweed, leading to a new problem and a new set of challenges and costs.

6.1. Benefits of Restoration

Well planned restoration in conjunction with and following control activities can increase the long-term success rate of a project and ensure that diverse native plant communities thrive once more. The primary reason that restoration is an important part of invasive plant control is that the successful growth of a variety of native plants can provide the competition needed to keep invasive plants under control. Much as undisturbed areas are less vulnerable to invasion, properly restored areas are not as likely to be reinvaded. As the successful enhancement of native biodiversity is included as one of the major outcomes for weed management in the Cache Creek Watershed, it is therefore of paramount importance that the reintroduction or enrichment of previously stressed or non-existent native populations is a considered outcome of any weed control action. There are two main options for restoration following weed control or eradication; passive and active. What follows is a brief outline of these concepts.

6.2. Passive Restoration

Restoration does not always have to involve planting. In some cases, the existing seed bank and remnant vegetation can provide enough natural regeneration to compete with lingering invasive plants. However, the seeds of other invasive species can exist underground as well. In addition, some early successional (first colonizer) desirables may come back initially, only leading way to more persistent invasive plants later once the competition from them is diminished. Therefore, if relying on natural seed bank restoration, monitoring is key to ensuring long term success.

To determine whether natural restoration is likely to be successful, it is important to survey the perimeter of the invasive plant stand scheduled for control. Recording the species that are found provides insight into the species that will most likely recolonize the controlled areas. It is also valuable to note any other invasive species present, as well as the approximate percentage of desirable natives vs. invasive species. In a best case scenario, managers look at the species present throughout the growing season to determine composition throughout the spring, summer and early autumn. This information helps to predict which native species may be able to provide competition for the targeted invasive plant based on their timelines for emergence and establishment.

6.3. Active Revegetation Strategies

If available resources allow, active restoration provides the best chance for long-term success, if carried out with informed care. Each active planting strategy originates from knowledge about plant characteristics, ecology, species interactions, and communities.

Understanding when and how plants emerge and develop can aid in producing an early competitive advantage for the appropriately selected native plants. Emerging plants can out-compete other young species through crowding, shading and allelopathy (toxic chemical release).



Active revegetation project following control of a tamarisk monoculture.

Also, in order to meet the goals of long term ecosystem sustainability, an understanding of succession is critical. Succession is how a plant community develops and changes over time - over a season - and throughout the years. Selecting a group of species that span both the seasonal calendar of establishment and maturity, along with those that span the years, will increase success of restoration efforts. For example, a restoration plan for a riparian area may call for the shading effects of trees to keep light-loving invasive plants from re-establishing, ideally a mixture of low-growing shrubs, or willows and overstory plants such as oaks and cottonwoods.

Much stress is placed on making plant selections based on soil composition, moisture and sunlight level. However, other factors come into play when the goal is long-term establishment of native plant communities. Symbiotic relationships exist among plants of a particular type of plant community, therefore, community types should be researched and restoration should strive to restore the types appropriate to an area.

Before planting, be sure that any threat from chemical herbicide use is gone or is assured to be selective in nature. If you plan to treat invasive populations for another year, determine the threat to new plants prior to any investment. Planting may need to wait until chemical application is finished or at least limited to small spot-treated areas. Once planted, the community needs to be monitored for continued health and for any threats to the new establishment, especially at first. However, monitoring should continue so that other problems such as wildlife browse damage and invasive plant encroachment do not threaten your investment. Some weeding around planted species may be necessary to reduce undesirable competition, especially in the first few years of establishment.

Above is an overview of restoration strategies and issues. At the time of implementation, more specific information and assistance can be found through a variety of people, literature and organizational resources. See Appendix E for a listing of organizations and agencies that can assist your restoration project.

7. Monitoring and the Future

7.1. Importance of Vigilance and Monitoring

Although previously discussed, vigilance and monitoring for new or re-invading species is critical to the long term success of any weed management plan. Monitoring for new or re-invading species is aided in the Cache Creek Watershed through the development of the Surveillance Species list of priority species. Developed by utilizing Cal-IPC's CalWeedMapper tool and local expert knowledge, the list of surveillance species offers an opportunity to quickly act upon any threat to the watershed by invading species on the list. However, the Surveillance Target list is in no way comprehensive and efforts should be taken by land managers to educate themselves and remain vigilant to the threat of infestation by species not yet included within the priority species lists or shifts in species habits or locations.

7.2. Data Management and Review Process

This Weed Management Plan is designed to provide land managers, members of the public, and agency staff working within the Cache Creek Watershed a clear strategy for invasive species management. To enable this strategy to meet the challenges and document the successes of weed management activities, it requires a fluid set of priorities. These priorities are maintained as a separate document (see appendix B) to allow for that flexibility. An annual review of priority species, control opportunities and management actions will be carried out by the members of the Cache Creek Watershed Forum, members of the public and other interested parties. The review will allow for changes in priority species extent following management activities or population growth, and adjustments in threat level and infestation potential. The review will also allow an opportunity for members to present some of their successes and discuss the overall progress of weed management in the watershed and set priorities for the next year.

Weed management remains a labor and time-intensive, yet minimally funded segment of resource conservation management. Therefore, land managers are often stretched to find adequate resources for even the most essential of weed management activities let alone for carrying out in-depth field mapping, data management, and analysis. It is encouraging that more and more land managers are utilizing GPS and GIS technologies to map and plan weed management activities as part of everyday procedures. When mapping is built in to regular schedules of weed management, it becomes easier to maintain up-to-date weed population data. However, this information is often site; species; and project-specific providing minimal support to larger scale weed management efforts such as on the watershed scale. With the development of the CalWeedMapper Tool, land managers across California now have the opportunity to add their own data to a much larger pool of information upon which decisions can be based on the landscape, or political scale.

In the context of the Cache Creek Watershed, the members of the CCWF have already added a significant amount of data to the CalWeedMapper Database, upon which many of the priorities outlined in this document are based. Although not always possible, in the interests of watershed resource management it is recommended that land managers utilizing GPS/GIS technology in their management programs employ the CalWeedMapper tool to share their mapping data. By employing CalWeedMapper as the go-to software for background and project planning benefits the overall weed management efforts by supporting and confirming the input of local expertise and filling in the gaps of other users datasets, which ultimately enables greater levels of analysis and planning on the watershed scale.

If land managers wish to make use of the CalWeedMapper tool but are unsure of how to get started, the California Invasive Plant Council, CalFlora, or local RCD staff can provide guidance, upload data or carry out training on how users can access and analyze the data.

8. Education and Outreach

8.1. Public Meetings and Workshops

The importance of outreach to conservation, and weed management in particular, is very high. By educating land managers and the general public we are effectively doubling the ability to quickly identify problems and increasing the capacity for effective control, which ultimately reduces the resources required for effective long-term management. The CCWF plans to hold one outreach event each year which will focus directly on weeds in the Cache Creek Watershed, highlighting ongoing work, species present, control options, and provide details of Surveillance species to enhance our ability to prevent new and potentially costly infestations. There will also be aspects of weed management included in the Yolo County Resource Conservation District and Cache Creek Conservancy annual riparian restoration workshop series which focus alternately on weed control and habitat enhancement strategies, practices, and projects.

All education and outreach information is made available to the public by way of: articles in local newspapers, public service announcements, the Yolo County Resource Conservation District website, Social media, and mailings sent out directly to landowners. These avenues have helped to increase awareness and continue to highlight the value of the invasive plant control activities.

8.2. Weed Management Resources

The following is a list of several online resources for landowners and members of the public to find information regarding general weed control principals, species specific control techniques, and local weed control professionals:

UC Davis Integrated Pest Control Program - http://www.ipm.ucdavis.edu/PMG/weeds_intro.html
UC Davis Weed Research and Information Center - <http://wric.ucdavis.edu/>
UC Agriculture and Natural Resources - <http://ucanr.org/>
UC Weed Science Blog - <http://ucanr.org/blogs/UCDWeedScience/>
Calflora Database - <http://www.calflora.org/>
USDA Plants Database - <http://plants.usda.gov/java/>
NRCS California eVegGuide - <http://www.calflora.org/nrcs/index.html>
CalWeedMapper - <http://calweedmapper.calflora.org/>
California Invasive Plant Council - <http://www.cal-ipc.org/>
California Native Plant Society - <http://www.cnps.org/>
Yolo County Resource Conservation District - <http://www.yolorcd.org/>

9. Conclusion

In conclusion, it is hoped that prioritized actions as discussed in this Cache Creek Watershed Weed Management Plan are quickly and effectively implemented. These actions include: significant progress toward eradication or containment of target species in each of those categories and the effective prevention of species listed in that category. Success is dependent on the additional outcome of a higher and more effective level of coordination of weed

management efforts throughout the watershed, a stated goal of this plan. The higher level, long term conservation outcome includes the natural and human-assisted recruitment of native plant species to fill those spaces vacated by invasive plants and a resultant healthier, more functional watershed.

The Cache Creek Watershed Weed Management Plan lists early detection, eradication, and localized containment of target weed species, along with outreach and education, and the implementation of a long-term watershed-wide program of prioritized weed management actions, including monitoring and maintenance actions. The need for a more strategic and coordinated approach required a review of current implementation strategies and clearer definition of these actions as applicable to this watershed.

Maintaining and working with the structure of the Cache Creek Watershed Forum (CCWF), an existing and effective working group will be important to the long-term outcomes and success of these individual prioritized actions. Participating organizations and their representatives have shown a great dedication throughout the development of the weed management plan and for several years prior to its development. This previously demonstrated commitment to weed management and conservation of the natural resources of the watershed portends future commitment to the successful outcomes outlined in this plan. The greatest strength of the CCWF comes from its members and their ability to achieve conservation outcomes, as shown by the recent project successes. By providing a clearly defined and shared set of priorities and goals, weed management activities will be greatly enhanced and our ability to work collectively in achieving the strategic goals as stated in this plan.

The Weed Management Plan calls for surveillance, monitoring, and maintenance of potential, existing, and localized threats from invasive plant species. Although, in prior years, efforts were made to tackle these species, the lack of funding to track, review, and follow-up on work as it was carried out hindered success. This plan describes, as a necessary part of weed management, the follow-up work on species targeted for eradication that are already being treated by CCWF partners; the treatment of new species; and for time spent tracking progress, via GPS and CalWeedMapper, and gives body to the steps required for achieving the goals of effective weed management in the watershed.

In summary, the above outcomes are achievable through the structure this plan will make available to a dedicated and experienced group of organizations working to protect and conserve the natural resources of the watershed, and allow for them to achieve the clearly defined goals and objectives.

10. Appendices

A. Relevant Plans and Strategies

Relevant Plans and Documents

Reviewed	Title	Author
12/8/11	Bear Creek Stewardship Priorities	Colusa RCD
12/8/11	Bear Creek Watershed Assessment	BLM/Colusa RCD
12/13/11	Cache Creek Area Plan <ul style="list-style-type: none"> • Cache Creek Improvement Program • Cache Creek Resource Management Plan • Off-Channel Mining Plan 	Yolo County
12/13/11	Cache Creek Coordinated Resource Management Plan	BLM
1/9/12	Capay Valley Action Plan	Capay Valley Vision
1/9/12	Capay Valley Agriculture Plan	CVV
12/13/11	Capay Valley Atlas	CVV
12/13/11	Capay Valley Watershed Stewardship Plan	RCD & CCWF
12/13/11	Clear Lake Integrated WMP	County of Clear Lake
12/20/11	Forest Management Plan	Mendocino National forest
12/13/11	Integrated Regional Water Management Plan	WRA
12/20/11	Invasive Plant Management for Native Plant Conservation	Thompson et al
12/20/11	Kelsey Creek Watershed Assessment	BVWC
12/20/11	Lake County Weed Management Plan	LCC WMA
12/20/11	Mercury and Erosion Control in the Cache Creek Watershed	CVRQCB
1/3/12	Middle Creek Watershed Assessment	LC DWR
1/3/12	Report of Independent Science Advisors for Yolo County Natural Community Conservation Plan/Habitat Conservation Plan (NCCP/HCP)	The Independent Science Advisors
1/3/2012	Scott's Creek Watershed Assessment	LC DWR
1/3/12	State of the Watershed Report – Cache Creek Sub-watershed	CVRQCB
1/3/12	Stopping the Spread – A strategic framework for controlling invasive species in California	ISCC/CISAC
1/3/12	The Blue Ridge Berryessa Natural Area Conservation Partnership Strategic Plan	Stott Planning Associates
1/3/12	Tuleyome Vision for the Cache Creek Basin	Tuleyome
1/3/12	WMA Strategic Plan	Yolo WMA
1/3/12	Sustainability Initiatives	Yocha Dehe Wintun Nation
1/3/12	Outstanding Environmental Resources and values of the Walker Ridge Public Lands.	California Native Plant Society
1/3/11	A Framework for the Future: Yolo Bypass Management Strategy, August 2001	DWR

B. Cache Creek Watershed Management Opportunities Report

This report summarizes invasive plant management opportunities in Cache Creek River Watershed. Opportunities are determined from maps of each species' current distribution and suitable range. Species are listed by three types of management opportunity:

- **Surveillance** – surveying to detect new infestations
- **Eradication** – complete removal of infestations
- **Containment** – limiting further spread of infestations

Below is a sample of opportunities in Cache Creek River Watershed. This information should be combined with local knowledge to set local priorities (see "Using the Report" at the end of this document.) Click on a plant's name below to view a map of that species.



Opportunities:

These are some opportunities in Cache Creek River Watershed. Tables on proceeding pages of this report contain a complete list of invasive plant management opportunities.

Surveillance:



Photo © Regents of the University of California
Alternanthera philoxeroides
alligator weed



Photo © Regents of the University of California
Delairea odorata
Cape-ivy



Photo © Regents of the University of California
Salvinia molesta
giant salvinia



Photo © Regents of the University of California
Ulex europaeus
gorse



Photo © Regents of the University of California
Acacia dealbata
silver wattle

Eradication:



Photo © Regents of the University of California
Centaurea maculosa
spotted knapweed



Photo © Regents of the University of California
Eichhornia crassipes
water hyacinth

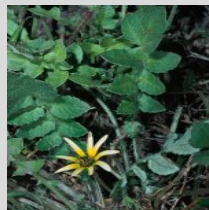


Photo © Regents of the University of California
Arctotheca calendula
fertile capeweed

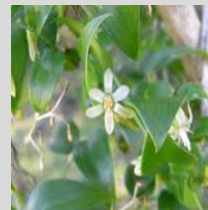


Photo © Regents of the University of California
Asparagus asparagoides
bridal creeper



Photo © Regents of the University of California
Sisymbrium irio
London rocket

Containment:



Photo © Regents of the University of California
Aegilops triuncialis
barb goatgrass



Photo © Regents of the University of California
Arundo donax
giant reed



Photo courtesy of: Cal-IPC
Brassica tournefortii
Saharan mustard, African mustard

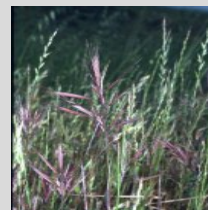


Photo © Regents of the University of California
Bromus madritensis ssp. *rubens*
red brome

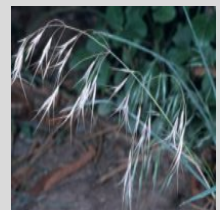


Photo © Regents of the University of California
Bromus tectorum
downy brome, cheatgrass

Surveillance Opportunities

These opportunities entail regular surveys to detect new infestations of species not known to be present in the region. The strategic potential depends on the proximity of nearby infestations and the suitability of the area. The table below includes species occurring within 50 miles of the selected region.

Plant Species:	Suitable Range	
	2010	2050
Grouped by Statewide Cal-IPC Rating		
High (4 species)		
<i>Alternanthera philoxeroides</i> alligator weed	-	-
<i>Delairea odorata</i> Cape-ivy	-	-
<i>Salvinia molesta</i> giant salvinia	-	-
<i>Ulex europaeus</i> gorse	0 %	-
Moderate (15 species)		
<i>Acacia dealbata</i> silver wattle	-	-
<i>Atriplex semibaccata</i> Australian saltbush	-	-
<i>Carduus nutans</i> musk thistle	0 %	-
<i>Cotoneaster franchetii</i> orange cotoneaster	-	-
<i>Cotoneaster lacteus</i> Parney's cotoneaster	-	-
<i>Cotoneaster pannosus</i> silverleaf cotoneaster	-	-
<i>Cupressus macrocarpa</i> Monterey cypress	-	-
<i>Ehrharta erecta</i> erect veldtgrass	-	-
<i>Erechtites minima and E. glomerata</i> Australian fireweed	-	-
<i>Hypericum canariense</i> Canary Island hypericum	-	-
<i>Ilex aquifolium</i> English holly	-	-
<i>Linaria vulgaris</i> yellow toadflax, butter and eggs	53 %	▲▲
<i>Myoporum laetum</i> myoporum	-	-
<i>Salsola soda</i> oppositeleaf Russian thistle	-	-
<i>Sapium sebiferum</i> Chinese tallowtree	-	-
Limited (25 species)		
<i>Acacia melanoxylon</i> black acacia, blackwood acacia	-	-
<i>Bassia hyssopifolia</i> fivehook bassia	-	-
<i>Cakile maritima</i> European sea-rocket	-	-

Surveillance Opportunities, Continued

Plant Species:	Suitable Range	
	2010	2050
Grouped by Statewide Cal-IPC Rating		
<i>Conicosia pugioniformis</i> narrowleaf iceplant	-	-
<i>Cordyline australis</i> giant dracaena	-	-
<i>Cotula coronopifolia</i> brassbuttons	-	-
<i>Crataegus monogyna</i> hawthorn	-	-
<i>Crocsmia x crocosmiiflora</i> montbretia	-	-
<i>Crupina vulgaris</i> common crupina, bearded creeper	-	-
<i>Digitalis purpurea</i> foxglove	-	-
<i>Echium candicans</i> pride-of-Madeira	-	-
<i>Helichrysum petiolare</i> licoriceplant	-	-
<i>Iris pseudacorus</i> yellowflag iris	-	-
<i>Kochia scoparia</i> kochia	-	-
<i>Lobularia maritima</i> sweet alyssum	-	-
<i>Pennisetum clandestinum</i> kikuyu grass	-	-
<i>Phoenix canariensis</i> Canary Island date palm	-	-
<i>Prunus cerasifera</i> cherry plum	-	-
<i>Saponaria officinalis</i> bouncingbet	-	-
<i>Schinus molle</i> Peruvian peppertree	-	-
<i>Schinus terebinthifolius</i> Brazilian peppertree	-	-
<i>Senecio jacobaea</i> tansy ragwort	-	-
<i>Tamarix aphylla</i> athel tamarisk	-	-
<i>Watsonia meriana</i> bulbil watsonia	-	-
<i>Zantedeschia aethiopica</i> calla lily	-	-
Not rated (3 species)		
<i>Buddleja davidii</i> butterflybush	-	-
<i>Lupinus arboreus</i> yellowbush lupine	-	-
<i>Pinus radiata</i> cultivars Monterey pine	-	-

Eradication Opportunities

Eradication entails complete removal of all infestations in the area. These opportunities result from a small number of isolated infestations. The spatial pattern for eradication is one infested quad surrounded by at least two concentric bands of absence quads. The strategic importance of an eradication opportunity can be further assessed based on the degree of isolation as well as the suitability of the surrounding area. Determining the feasibility of eradication requires surveying infestations in the field.

Plant Species:	Current Species Distribution (number of quads out of 38 total)				Suitable Range		
	Infested	Spreading	Managed	Eradicated	2010	Infested	2050
Grouped by Statewide Cal-IPC Rating							
High (2 species)							
<i>Centaurea maculosa</i> spotted knapweed	1	0	0	2	81%	3%	▼
<i>Eichhornia crassipes</i> water hyacinth	1	0	0	0	-	-	-
Moderate (3 species)							
<i>Arctotheca calendula fertile</i> fertile capeweed	1	0	0	0	-	-	-
<i>Asparagus asparagoides</i> bridal creeper	1	0	0	0	-	-	-
<i>Sisymbrium irio</i> London rocket	1	0	0	0	-	-	-
Limited (3 species)							
<i>Cardaria pubescens</i> hairy whitetop	2	0	0	0	-	-	-
<i>Myosotis latifolia</i> common forget-me-not	1	0	0	0	-	-	-
<i>Schismus arabicus and S. barbatus</i> mediterranean grass	1	0	0	0	-	-	-

Containment Opportunities

Containment entails limiting the spread from existing infestations. These opportunities result from larger groups of infested quads. The strategic importance of a containment opportunity can be further assessed based on how distinct the boundaries of the infestation are, how isolated it is, and the suitability of the surrounding area. Determining the feasibility of containment requires surveying infestations in the field.

Plant Species: Grouped by Statewide Cal-IPC Rating	Current Species Distribution (number of quads out of 38 total)				Suitable Range		
	Infested	Spreading	Managed	Eradicated	2010	Infested	2050
High (26 species)							
<i>Aegilops triuncialis</i> barb goatgrass					-	-	-
<i>Arundo donax</i> giant reed					76 %	89 %	▲
<i>Brassica tournefortii</i> Saharan mustard, African mustard					-	-	-
<i>Bromus madritensis ssp. rubens</i> red brome					99 %	46 %	■
<i>Bromus tectorum</i> downy brome, cheatgrass					-	-	-
<i>Centaurea solstitialis</i> yellow starthistle					100 %	100 %	■
<i>Cortaderia jubata</i> jubatagrass					0 %	-	-
<i>Cortaderia selloana</i> pampasgrass					3 %	100 %	▲▲
<i>Cytisus scoparius</i> Scotch broom					58 %	91 %	▲▲
<i>Egeria densa</i> Brazilian egeria					-	-	-
<i>Foeniculum vulgare</i> fennel					-	-	-
<i>Genista monspessulana</i> French broom					58 %	27 %	▲▲
<i>Hedera helix</i> and <i>H. canariensis</i> English ivy, Algerian ivy					-	-	-
<i>Hydrilla verticillata</i> hydrilla					-	-	-
<i>Lepidium latifolium</i> perennial pepperweed					-	-	-
<i>Ludwigia hexapetala</i> and <i>L. peploides</i> Uruguay and creeping water-primrose					-	-	-
<i>Lythrum salicaria</i> purple loosestrife					-	-	-
<i>Myriophyllum aquaticum</i> parrotfeather					-	-	-
<i>Myriophyllum spicatum</i> Eurasian watermilfoil					-	-	-
<i>Onopordum acanthium</i> Scotch thistle					7 %	15 %	▲▲
<i>Rubus armeniacus</i> (= <i>R. discolor</i>) Himalayan blackberry					-	-	-
<i>Sesbania punicea</i> red sesbania, scarlet wisteria					11 %	11 %	▲▲
<i>Spartium junceum</i> Spanish broom					76 %	64 %	▲
<i>Taeniatherum caput-medusae</i> medusahead					-	-	-

Containment Opportunities, Continued

Plant Species:	Current Species Distribution (number of quads out of 38 total)				Suitable Range		
	Infested	Spreading	Managed	Eradicated	2010	Infested	2050
Grouped by Statewide Cal-IPC Rating							
<i>Tamarix parviflora</i> smallflower tamarisk	15	0	9	0	-	-	-
<i>Tamarix ramosissima</i> saltcedar, tamarisk	4	1	3	0	-	-	-
Moderate (51 species)							
<i>Acroptilon repens</i> Russian knapweed	3	1	2	0	68 %	8 %	▲
<i>Ailanthus altissima</i> tree-of-heaven	35	22	0	0	82 %	95 %	▲
<i>Anthoxanthum odoratum</i> sweet vernalgrass	1	0	0	0	-	-	-
<i>Arctotheca calendula infertile</i> sterile capeweed	3	2	0	0	-	-	-
<i>Avena barbata and A. fatua</i> (slender) wild oat	35	0	0	0	-	-	-
<i>Brachypodium distachyon</i> annual false-brome, false brome	6	4	0	0	33 %	27 %	▲▲
<i>Brassica nigra</i> black mustard	29	26	8	0	-	-	-
<i>Bromus diandrus</i> ripgut brome	30	13	0	0	-	-	-
<i>Cardaria chalepensis and C. draba</i> lens-podded white-top, hoary cress	12	4	4	0	81 %	32 %	▼
<i>Carthamus lanatus</i> woolly distaff thistle	3	0	2	1	0 %	-	-
<i>Centaurea calcitrapa</i> purple starthistle	13	5	3	1	-	-	-
<i>Centaurea diffusa</i> diffuse knapweed	1	0	0	2	56 %	3 %	▼
<i>Centaurea melitensis</i> Malta starthistle, tocalote	31	21	0	0	76 %	86 %	■
<i>Chondrilla juncea</i> rush skeletonweed	2	0	2	0	58 %	6 %	▲▲
<i>Cirsium arvense</i> Canada thistle	7	1	1	0	50 %	21 %	▼▼
<i>Cirsium vulgare</i> bull thistle	36	17	0	0	100 %	100 %	▼
<i>Conium maculatum</i> poison-hemlock	32	23	0	0	47 %	89 %	▼
<i>Cynara cardunculus</i> artichoke thistle	6	0	4	2	-	-	-
<i>Cynodon dactylon</i> bermudagrass	29	7	0	0	-	-	-
<i>Cynosurus echinatus</i> hedgehog dogtailgrass	18	0	0	0	-	-	-
<i>Dipsacus fullonum and D. sativus</i> common and Fuller's teasel	31	23	0	0	73 %	86 %	■
<i>Dittrichia graveolens</i> stinkwort	16	14	12	0	0 %	100 %	▲

Containment Opportunities, Continued

Plant Species: Grouped by Statewide Cal-IPC Rating	Current Species Distribution (number of quads out of 38 total)				Suitable Range		
	Infested	Spreading	Managed	Eradicated	2010	Infested	2050
<i>Elaeagnus angustifolia</i> Russian-olive	4	0	0	0	-	-	-
<i>Eucalyptus globulus</i> Tasmanian blue gum	11	0	1	0	-	-	-
<i>Festuca arundinacea</i> tall fescue	7	0	0	0	-	-	-
<i>Ficus carica</i> edible fig	21	0	0	0	-	-	-
<i>Geranium dissectum</i> cutleaf geranium	33	0	0	0	-	-	-
<i>Glyceria declinata</i> waxy manna grass	2	2	0	0	-	-	-
<i>Hirschfeldia incana</i> shortpod mustard, summer mustard	18	0	0	0	-	-	-
<i>Holcus lanatus</i> common velvet grass	11	0	0	0	88 %	31 %	▲
<i>Hordeum marinum</i> Mediterranean barley	20	0	0	0	98 %	56 %	■
<i>Hordeum murinum</i> hare barley	20	0	0	0	97 %	54 %	▼
<i>Hypericum perforatum</i> common St. John's wort, klamathweed	20	0	3	1	-	-	-
<i>Isatis tinctoria</i> dyer's woad	2	0	0	1	58 %	6 %	▼
<i>Leucanthemum vulgare</i> ox-eye daisy	5	0	0	0	4 %	26 %	■
<i>Linaria genistifolia ssp. dalmatica</i> Dalmatian toadflax	2	0	1	3	81 %	9 %	▲
<i>Lolium multiflorum</i> Italian ryegrass	29	4	0	0	85 %	81 %	■
<i>Lythrum hyssopifolium</i> hyssop loosestrife	16	0	0	5	-	-	-
<i>Mentha pulegium</i> pennyroyal	9	0	0	0	-	-	-
<i>Nicotiana glauca</i> tree tobacco	16	0	0	0	1 %	100 %	■
<i>Oxalis pes-caprae</i> Bermuda buttercup, buttercup oxalis	2	0	0	0	-	-	-
<i>Pennisetum setaceum</i> crimson fountain grass	2	2	0	0	-	-	-
<i>Phalaris aquatica</i> harding grass	24	4	0	0	-	-	-
<i>Potamogeton crispus</i> curlyleaf pondweed	4	4	4	0	-	-	-
<i>Rumex acetosella</i> red sorrel, sheep sorrel	24	0	0	0	-	-	-
<i>Saccharum ravennae</i> ravennagrass	12	11	8	0	-	-	-
<i>Torilis arvensis</i> hedgearsley	27	0	0	0	-	-	-

Containment Opportunities, Continued

Plant Species:	Current Species Distribution (number of quads out of 38 total)				Suitable Range		
	Infested	Spreading	Managed	Eradicated	2010	Infested	2050
Grouped by Statewide Cal-IPC Rating							
<i>Trifolium hirtum</i> rose clover	25	0	0	0	-	-	-
<i>Vinca major</i> big periwinkle	18	16	0	0	-	-	-
<i>Vulpia myuros</i> rattail fescue	31	4	0	0	-	-	-
<i>Washingtonia robusta</i> Mexican fan palm	1	1	0	0	-	-	-
Limited (35 species)							
<i>Agrostis avenacea</i> Pacific bentgrass	3	2	0	0	-	-	-
<i>Agrostis stolonifera</i> creeping bentgrass	3	0	0	0	-	-	-
<i>Bellardia trixago</i> bellardia	3	0	0	0	-	-	-
<i>Brassica rapa</i> birdsrape mustard, field mustard	24	22	0	0	-	-	-
<i>Briza maxima</i> big quakinggrass, rattlesnakegrass	11	0	0	0	-	-	-
<i>Bromus hordeaceus</i> soft brome	31	0	0	0	-	-	-
<i>Bromus japonicus</i> Japanese brome, Japanese chess	4	0	0	0	90 %	11 %	▲
<i>Carduus acanthoides</i> plumeless thistle	2	0	0	0	-	-	-
<i>Carduus tenuiflorus</i> and <i>C. pycnocephalus</i> slenderflower and Italian thistle	37	21	21	0	5 %	100 %	▲▲
<i>Dactylis glomerata</i> orchardgrass	29	5	0	0	98 %	81 %	■
<i>Descurainia sophia</i> flixweed, tansy mustard	2	0	0	0	-	-	-
<i>Erodium cicutarium</i> redstem filaree	36	0	0	0	-	-	-
<i>Eucalyptus camaldulensis</i> red gum	6	0	0	0	-	-	-
<i>Euphorbia oblongata</i> oblongspurge	6	0	3	0	-	-	-
<i>Hypochaeris glabra</i> smooth catsear	22	0	0	0	-	-	-
<i>Hypochaeris radicata</i> rough catsear, hairy dandelion	13	0	0	0	-	-	-
<i>Marrubium vulgare</i> white horehound	17	0	0	0	-	-	-
<i>Medicago polymorpha</i> California burclover	33	0	0	0	-	-	-
<i>Olea europaea</i> olive	8	0	0	0	-	-	-
<i>Parentucellia viscosa</i> yellow glandweed, sticky parentucellia	4	2	0	0	-	-	-

Containment Opportunities, Continued

Plant Species:	Current Species Distribution (number of quads out of 38 total)				Suitable Range		
	Infested	Spreading	Managed	Eradicated	2010	Infested	2050
Grouped by Statewide Cal-IPC Rating							
<i>Picris echioides</i> bristly oxtongue	16	1	0	0	-	-	-
<i>Piptatherum miliaceum</i> smilgrass	8	1	0	0	-	-	-
<i>Plantago lanceolata</i> buckhorn plantain, English plantain	27	0	5	0	-	-	-
<i>Poa pratensis</i> Kentucky bluegrass	13	0	0	0	-	-	-
<i>Polypogon monspeliensis</i> rabbitfoot polypogon	26	0	0	0	-	-	-
<i>Pyracantha angustifolia, crenulata, seratus, etc</i> pyracantha, firethorn	12	0	0	0	-	-	-
<i>Ranunculus repens</i> creeping buttercup	1	0	0	0	-	-	-
<i>Raphanus sativus</i> radish	25	0	0	0	-	-	-
<i>Ricinus communis</i> castorbean	1	0	1	0	-	-	-
<i>Robinia pseudoacacia</i> black locust	24	0	0	0	99 %	67 %	■
<i>Rumex crispus</i> curly dock	34	0	0	0	-	-	-
<i>Salsola tragus</i> Russian thistle	12	0	12	0	-	-	-
<i>Silybum marianum</i> blessed milkthistle	27	11	6	0	-	-	-
<i>Sinapis arvensis</i> wild mustard, charlock	3	1	1	0	49 %	9 %	▲▲
<i>Verbascum thapsus</i> common mullein, woolly mullein	22	0	0	0	-	-	-
Not rated (1 species)							
<i>Phragmites australis</i> common reed	12	0	0	0	-	-	-

Legend and Terminology

For each species, statistics are generated from maps. The statistics are divided into two parts: current species distribution and suitable range.

Current Species Distribution

- Infested: Number of quads that are infested with this species (relative to total number of quads in the selected region of interest)
- Spreading: Number of quads where this species is spreading,
- Managed: Number of quads where this species is under management,
- Eradicated: Number of quads where this species has been eradicated,

Suitable Range

- 2010: Percent of the selected region of interest that currently meets the minimum threshold for suitability for the species,
- Infested: Percent of the current suitable range that is infested.
- 2050: Change in suitability between 2010 and 2050, with an arrow representing an increase or decrease of greater than 10%, and a double arrow indicating change of greater than 40%.

- ▲▲ Increase of 40% or more
- ▲ Increase of 10% to 39%
- ▬ No change (less than 10% change either direction)
- ▼ Decrease of 10% to 39%
- ▼▼ Decrease of 40% or more

Using This Report

This report, together with Regional Species Map Reports, summarizes management opportunities for the selected region. This report, together with Regional Species Maps, is designed to inform strategic management decisions at a landscape level. Regional coordinating bodies can use these reports as a starting place for setting priorities and establishing goals. Surveillance priorities can be focused to strengthen early detection. Eradication and containment priorities are based on factors such as how widely a species has spread. This landscape-level view provides a strategic foundation for developing and implementing on-the-ground programs.

Management opportunities are identified in three categories determined by the species' spatial distribution. While each plant species is listed in only one category, multiple management approaches can be appropriate in a given region. Assessing the feasibility of a particular management measure requires additional detailed assessment.

1. Surveillance – Surveillance entails regular surveys to detect new infestations of species not known to be present in a region. The strategic potential depends on the proximity of nearby infestations and the suitability of the area. The table in this report includes species occurring within 50 miles of the selected region.

2. Eradication – Eradication entails complete removal of all infestations in the area. These opportunities result from small, isolated infestations. The spatial pattern for eradication is one infested quad surrounded by at least two concentric bands of absence quads. The strategic importance of an eradication opportunity can be further assessed based on the degree of isolation as well as the suitability of the surrounding area. Determining the feasibility of eradication requires surveying infestations in the field.

3. Containment – Containment entails limiting the spread from existing infestations. These opportunities result from larger groups of infested quads. The strategic importance of a containment opportunity can be further assessed based on how distinct the boundaries of the infestation are, how isolated it is, and the suitability of the surrounding area. Determining the feasibility of containment requires surveying infestations in the field.

For each type of opportunity, plant species are organized by their rating in Cal-IPC's Inventory, which uses a uniform methodology to categorize non-native plants that pose a substantial threat to the state's wildlands. The Cal-IPC rating combines information about ecological impacts, invasive potential and ecological distribution to rate species as High, Moderate or Limited at a statewide level. Regional impacts may differ.

About This Report

This report is generated from an online mapping system developed by the nonprofit California Invasive Plant Council and hosted at Calflora. The site allows the state's network of local experts to maintain updated data on invasive plant distribution statewide. CalWeed Mapper is integrated with the Calflora invasive plant database to reflect new occurrence data submitted to Calflora. Maps and reports generated are snapshots of a dynamic system and should be revisited on a regular basis to ensure that information is current.

In order to cover 200 species over the entire state, the mapping approach used in this work is necessarily coarse. The maps are not sufficient for planning the details of on-the-ground management, which requires information at a much higher resolution. (As you generate such detailed information, please share your data with Calflora.org. More information may be found at CalWeedMapper under Spatial Data.) Cal-IPC interviewed hundreds of natural resource managers around the state to collect a baseline of "expert knowledge" on abundance, spread and management by USGS 7.5-degree quadrangle (approximately 8 mi x 6 mi). We also incorporated datasets of occurrence observations from Calflora, The Consortium of California Herbaria, and agencies throughout the state. However, the vast majority of the presence documented in these maps comes solely from expert knowledge; no occurrence observations exist in online databases.

We predict suitable range for a given species by using modeling software that combines the species' current distribution with environmental variables (model results are reviewed by invasive plant experts). The resulting maps show areas that have the highest probability of being suitable. Future suitable range is based on commonly used scenarios from the Intergovernmental Panel on Climate Change. Details about modeling methods can be found at CalWeedMapper under About.

The distribution and suitability maps are not expected to be 100% accurate. Data drawn from expert knowledge, while having the great benefit of drawing on the extensive experience of individual local resource managers, can nonetheless be inaccurate. Data drawn from GIS datasets, though of higher precision, may not always be accurate, either, since those conducting the mapping may have misidentified the species or not captured the location correctly. In addition, conditions on the ground may have changed since the observation was filed, making the record out of date.

By engaging local experts statewide to check each others' work, CalWeedMapper can steadily increase the accuracy of the maps. Our goal is to maintain up-to-date statewide maps of invasive plant distribution.

C. The Cache Creek Watershed Weed Management Priority List

Cache Creek Priority Eradication Species

These species are top priority eradication species for the Cache Creek Watershed.



[Calflora](#)

Illustrated
Plant
List

20 Plants

[Acrotilon repens](#) *Russian knapweed*

- **invasive non-native**
Perennial herb

ASTERACEAE



© 2009 Ron Wolf



© 2001 CDFA

[Arctotheca calendula](#) *Cape weed*

- **invasive non-native**
Annual, Perennial herb

ASTERACEAE



© 2009 Doreen L. Smith



© 2001 CDFA

[Brassica tournefortii](#) *Mustard*

- **invasive non-native**
Annual herb

BRASSICACEAE



© 2008 lara hartley



© 2009 Thomas Stoughton

Cardaria pubescens *Hairy whitetop*

(TJM2: Lepidium appelianum)

- **invasive non-native**
Perennial herb

BRASSICACEAE



© 2001 Jeff Abbas



© 2011 Neal Kramer

Carthamus lanatus *Woolly distaff thistle*

- **invasive non-native**
Annual herb

ASTERACEAE



© 2006 Luigi Rignanese



© 2006 Luigi Rignanese

Centaurea calcitrapa *Purple star thistle*

- **invasive non-native**
Annual, Perennial herb

ASTERACEAE



© 2005 Luigi Rignanese



© 2005 Luigi Rignanese

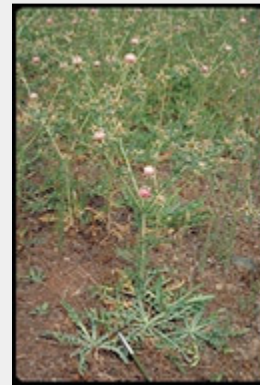
Centaurea iberica *Iberian knapweed*

- **invasive non-native**
Perennial herb

ASTERACEAE



© 2001 CDFA



© 2001 CDFA

Centaurea maculosa *Spotted knapweed*

(TJM2: *Centaurea stoebe* ssp. *micranthos*)

- **invasive non-native**
Perennial herb

ASTERACEAE



© 2005 Louis-M. Landry



© 2005 Louis-M. Landry

Cortaderia jubata *Andean pampas grass*

- **invasive non-native**
Perennial herb

POACEAE



© 2008 Neal Kramer



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Cynara cardunculus *Cardoon*

- **invasive non-native**
Perennial herb

ASTERACEAE



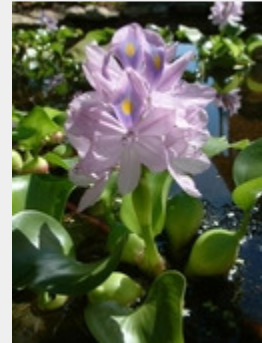
Eichhornia crassipes *Water hyacinth*

- **invasive non-native**
Perennial herb

PONTEDERIACEAE



© 2009 Barry Rice



© 2006 Louis-M. Landry

Euphorbia oblongata *Eggleaf spurge*

- **invasive non-native**
Perennial herb

EUPHORBIACEAE



© 2001 CDFA

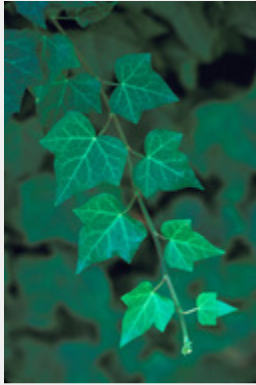


© 2008 Neal Kramer

Hedera helix *English ivy*

- **invasive non-native**
Vine, Shrub

ARALIACEAE



© 1985 Joe DiTomaso



© 2005 Dr. Amadej
Trnkoczy

Hydrilla verticillata *Hydrilla*

- **invasive non-native**
Perennial herb

HYDROCHARITACEAE



© 2001 CDFA



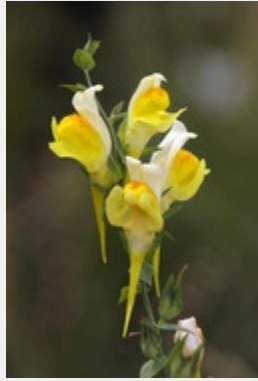
© 2001 CDFA

Linaria genistifolia ssp. Dalmatica *Broomleaf toadflax*

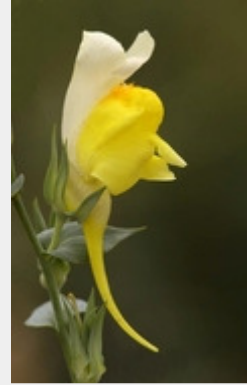
(AKA *Linaria genistifolia*)

non-native
Perennial herb

PLANTAGINACEAE



© 2010 Ron Wolf



© 2010 Ron Wolf

Ludwigia hexapetala *Six petal water primrose*

native
Perennial herb

ONAGRACEAE



© 2000 Joe DiTomaso

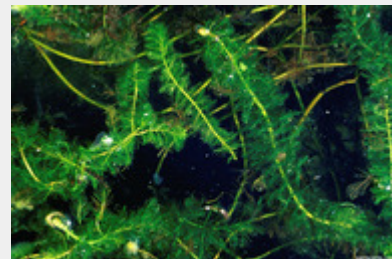


© 2000 Joe DiTomaso

Myriophyllum spicatum *Water milfoil*

• invasive non-native
Perennial herb

HALORAGACEAE



Onopordum acanthium *Scotch cottonthistle*

- **invasive non-native**
Perennial herb

ASTERACEAE



© 2001 CDFA



© 2001 CDFA

Saccharum ravennae *Ravennagrass*

- **invasive non-native**
Perennial herb

POACEAE



© 2011 Mike Perlmutter
2011



© 2011 Steve Matson

Sisymbrium irio *London rocket*

- **invasive non-native**
Annual herb

BRASSICACEAE



© 2006 Richard Zmasek



© 2007 Luigi Rignanese

Cache Creek Priority Containment Species

These species are top priority containment species for the Cache Creek Watershed.



[Calflora](#)

Illustrated
Plant
List

21 Plants

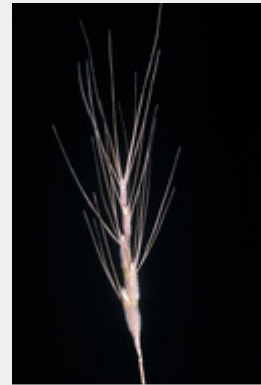
[Aegilops triuncialis](#) *Goatgrass*

- **invasive non-native**
Annual herb

POACEAE



© 2007 Neal Kramer



© 2001 Joe DiTomaso

[Ailanthus altissima](#) *Tree of heaven*

- **invasive non-native**
Tree

SIMAROUBACEAE



© 2007 Luigi Rignanese



© 2006 Louis-M. Landry

[Arundo donax](#) *Giant reed*

- **invasive non-native**
Perennial herb

POACEAE



© 2008 John Dittes



© 2007 Dr. Amadej Trnkoczy

Cardaria chalapensis *Lens-podded hoary cress*

(TJM2: *Lepidium chalepense*)

- non-native**
Annual, Perennial
herb

BRASSICACEAE



© 2000 Joe DiTomaso



© 2004 Steve Matson

Cardaria draba

[Centaurea solstitialis](#) *Yellow starthistle*

- **invasive non-native**
Annual herb

ASTERACEAE



© 2004 Carol W. Witham



© 2008 Luigi Rignanese

[Chondrilla juncea](#) *Skeleton weed*

- **invasive non-native**
Perennial herb

ASTERACEAE



© 2001 CDFA



© 2012 Richard Spellenberg

[Cirsium arvense](#) *Canada thistle*

- **invasive non-native**
Perennial herb

ASTERACEAE



© 2008 Keir Morse



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Cytisus scoparius *Scotch broom*

- **invasive non-native**
Shrub

FABACEAE



© 2009 Zoya Akulova



© 2008 Neal Kramer

Dittrichia graveolens *Stinkwort*

- **invasive non-native**
Annual herb

ASTERACEAE



[Elytrigia elongata](#) *Tall wheat grass*

(TJM2: Elymus ponticus)

non-native
Perennial herb

POACEAE



© 2008 Keir Morse



© 2008 Keir Morse

[Eucalyptus globulus](#) *Blue gum*

• invasive non-native
Tree

MYRTACEAE



© 2005 Robert E. Preston,
Ph.D.



© 2003 David A. Tharp

[Festuca arundinacea](#) *Reed fescue*

- **invasive non-native**
Perennial herb

POACEAE



© 2008 Keir Morse



© 2008 Steve Matson

Foeniculum vulgare *Fennel*

- **invasive non-native**
Perennial herb

APIACEAE



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© 2005 Brianna M.
Richardson

Isatis tinctoria *Dyers woad*

- **invasive non-native**
Perennial, Biennial
herb

BRASSICACEAE



© 2005 Luigi Rignanese



© 2007 Luigi Rignanese

Lepidium latifolium *Perennial pepperweed*

- **invasive non-native**
Perennial herb

BRASSICACEAE



© 2002 Jennifer Forman



© 2010 Zoya Akulova

Myriophyllum aquaticum *Parrot's feather*

- **invasive non-native**
Perennial herb
(aquatic)

HALORAGACEAE



Piptatherum miliaceum *Smilo grass*

- **invasive non-native**
Perennial herb

POACEAE



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© 2004 Keir Morse

Taeniatherum caput-medusae *Medusa head*

(TJM2: Elymus caput-medusae)

- non-native**
Perennial herb

POACEAE



© 2008 Keir Morse



© 2011 Steve Matson

Tamarix parviflora *Tamarisk*

- **invasive non-native**
Tree, Shrub

TAMARICACEAE



© 2009 Barry Rice



© 2009 Barry Rice

Tamarix ramosissima *Tamarisk*

- **invasive non-native**
Tree, Shrub

TAMARICACEAE



© 2010 Neal Kramer



© 1998 John Randall, Ph.D.

Cache Creek Priority Surveillance Species

These species are top priority surveillance species for the Cache Creek Watershed.



[Calflora](#)

Illustrated
Plant
List

28 Plants

FAMILY: AMARANTHACEAE

[Alternanthera philoxeroides](#) *Alligator weed*

- **invasive non-native**

Perennial herb

AMARANTHACEAE



© 2001 CDFA



© 2001 CDFA

FAMILY: ASTERACEAE

[Carduus nutans](#) *Nodding plumeless thistle*

- **invasive non-native**

Perennial herb

ASTERACEAE



[Centaurea diffusa](#) *Diffuse knapweed*

- **invasive non-native**
Perennial herb

ASTERACEAE



© 2001 CDFA



© 2002 Molly Elizabeth Bagley

[Crupina vulgaris](#) *Bearded creeper*

- **invasive non-native**
Annual herb

ASTERACEAE



© 2001 CDFA



© 2001 CDFA

[Delairea odorata](#) *Cape ivy*

- **invasive non-native**
Perennial herb

ASTERACEAE



© 2002 Tony Morosco



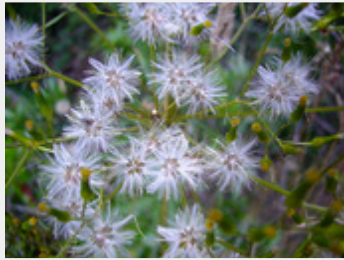
© 2008 Neal Kramer

Erechtites minima *Coastal burnweed*

(TJM2: *Senecio minimus*)

- **invasive non-native**
Annual, Perennial herb

ASTERACEAE



© 2008 Zoya Akulova



© 2008 Zoya Akulova

Senecio jacobaea *Tansy ragwort*

- **invasive non-native**
Perennial herb

ASTERACEAE



FAMILY: **BORAGINACEAE**

Echium candicans *Pride of madeira*

- **invasive non-native**
Shrub

BORAGINACEAE



© 2009 Neal Kramer



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FAMILY: **CARYOPHYLLACEAE**

Saponaria officinalis *Bouncing bet*

- **invasive non-native**
Perennial herb

CARYOPHYLLACEAE



© 2003 Penn Martin II



© 2008 Keir Morse

FAMILY: CHENOPODIACEAE

[Bassia hyssopifolia](#) *Five horn bassia*

- **invasive non-native**
Annual herb

CHENOPODIACEAE



© 2008 Steve Matson



Donald Myrick© 1999
California Academy of
Sciences

[Kochia scoparia](#) *Summer cypress*

- **invasive non-native**
Annual herb

CHENOPODIACEAE



© 2001 CDFA



© 2001 CDFA

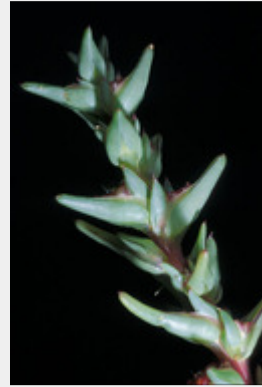
[Salsola soda](#) *Alkali russian thistle*

- **invasive non-native**
Annual herb

CHENOPODIACEAE



© 2009 Zoya Akulova



© 2000 Joe DiTomaso

FAMILY: FABACEAE

[Acacia dealbata](#) *Silver wattle*

- **invasive non-native**
Tree, Shrub

FABACEAE



© 2008 Neal Kramer



© 2002 Dean Wm. Taylor

[Ulex europaeus](#) *Gorse*

- **invasive non-native**
Shrub

FABACEAE



© 2006 David A. Tharp



© 2001 CDFA

FAMILY: **HYPERICACEAE**

[Hypericum canariense](#) *Canary island st. johnswort*

- **invasive non-native**
Shrub

HYPERICACEAE



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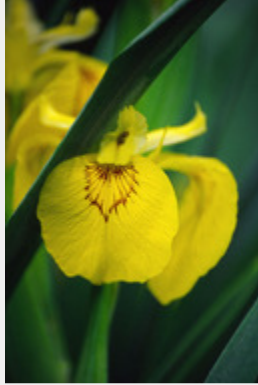
© 2007 Neal Kramer

FAMILY: **IRIDACEAE**

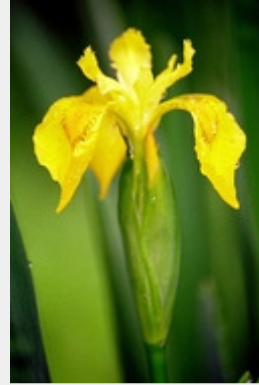
[Iris pseudacorus](#) *Horticultural iris*

- **invasive non-native**
Perennial herb

IRIDACEAE



© 2004 Nick Kurzenko



© 2001 Nick Kurzenko

FAMILY: LAXMANNIACEAE

Cordyline australis *Cabbage tree*

- **invasive non-native**
Tree

LAXMANNIACEAE



© 2005 Luigi Rignanese



© University and Jepson
Herbaria

FAMILY: LYTHRACEAE

Lythrum salicaria *Purple loosestrife*

- **invasive non-native**
Perennial herb

LYTHRACEAE



© 2005 Louis-M. Landry



© 2005 Louis-M. Landry

FAMILY: OROBANCHACEAE

Parentucellia viscosa *Yellow parentucellia*

- **invasive non-native**
Annual herb

OROBANCHACEAE



© 2009 Neal Kramer



© 2007 Carol W. Witham

FAMILY: OXALIDACEAE

Oxalis pes-caprae *Bermuda buttercup*

- **invasive non-native**
Perennial herb

OXALIDACEAE



Jo-Ann Ordano© 2005
California Academy of
Sciences



© 2005 Luigi Rignanese

FAMILY: **POACEAE**

Brachypodium distachyon *Purple false brome*

- **invasive non-native**
Annual, Perennial herb

POACEAE



© 2008 Zoya Akulova



© 2000 Joe DiTomaso

Glyceria declinata *Waxy mannagrass*

- **invasive non-native**
Perennial herb

POACEAE



© 2007 Neal Kramer



© 2007 Neal Kramer

Pennisetum clandestinum *Kikuyu grass*

- **invasive non-native**
Perennial herb

POACEAE



© 2009 Zoya Akulova



© 2009 Barry Rice

FAMILY: **ROSACEAE**

Cotoneaster franchetii *Cotoneaster*

- **invasive non-native**
Shrub

ROSACEAE



© 2001 Joe DiTomaso



© 2006 Peter Zika

Cotoneaster lacteus *Milkflower cotoneaster*

- **invasive non-native**
Shrub

ROSACEAE



© 2006 Peter Zika



© 2010 Robert Steers/NPS

Cotoneaster pannosus *Woolly cotoneaster*

- **invasive non-native**
Shrub

ROSACEAE



Prunus cerasifera *Cherry plum*

- **invasive non-native**
Tree

ROSACEAE



© 2008 Keir Morse



© 2002 James B. Gratiot

FAMILY: SALVINIACEAE

Salvinia molesta *Kariba weed*

- **invasive non-native**
Annual herb, Perennial herb

SALVINIACEAE



© 2001 CDFR



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D. Weed Management Permit Checklist

Weed Management Permit Checklist

Permitting Agency	Type of Requirement
Federal:	
U.S. Fish and Wildlife Service (USFWS)	Section 7 consultation if federal nexus (see ACOE), or Section 10 Permit.
U.S. Army Corps of Engineers (ACOE)	Clean Water Act, Section 404 Permit
U.S. Natural Resources Conservation Service	Permitting and technical advice
State:	
California Department of Fish and Game (DFG)	Streambed Alteration Permit (Section 1600)
DFG	Incidental Take Permit
California Department of Transportation (CalTrans)	Encroachment Permit
Regional Water Quality Control Board	401 Water Quality Certification or Waste Discharge Requirement
State Water Resources Control Board	General Industrial Storm Water Permit
Central Valley Flood Protection Board	Permission to Encroach on Waterways with Designated Floodways
State Lands Commission	Permission required if using State owned property
Local and Regional:	
City/County	Grading Permit
City/County	Environmental Health Department
County Agriculture Commissioner	Pesticide Use Permit
Local Resource Conservation District	Permitting and technical advice

*This list is not all inclusive. Consult with local NRCS/RCD or Agency representatives to ensure all permitting requirements are met prior to carrying out any action.

E. Organizations and Agencies

Organizations and agencies able to provide technical assistance for restoration projects.

USDA Natural Resources Conservation Service
221 West Court Street. Suite 1
Woodland, CA 95695
(530) 662-2037 ext 3.

USDA Natural Resources Conservation Service
100 Sunrise Blvd. Suite D
Colusa, Ca 95932-3246
(530) 458-5131

East and West Lake RCD's
889 Lakeport Blvd.
Lakeport, CA 95453
(707) 263-4180 ext 12.

Yolo RCD
221 West Court Street. Suite 1
Woodland, CA 95695
(530) 662-2037 ext 117.
www.yolorcd.org

Cache Creek Conservancy
34199 Co. Rd. 20
Woodland, CA 95695
(530) 661-1070
<https://sites.google.com/site/cccpactice2/>

Audubon Landowner Stewardship Program
(530) 795-0660

University of California Cooperative Extension
70 Cottonwood Street
Woodland, CA 95695
(530) 666-8143