Restoration and Beautification of the UC Davis Arboretum

Department of Environmental Design
Landscape Architecture Program
Wesley Downing
June 13, 2008

Restoration and Beautification of the UC Davis Arboretum

A SENIOR PROJECT

PRESENTED TO THE FACULTY OF THE

LANDSCAPE ARCHITECTURE PROGRAM

UNIVERSITY OF CALIFORNIA, DAVIS

IN FULFILLMENT OF THE REQUIREMENT FOR THE DEGREEE OF

BACHELORS OF SCIENCE OF LANDSCAPE ARCHITECTURE

ACCEPTED AND APPROVED BY:

Faculty Committee Member, Steve Greco

Faculty Committee Member, Truman Young

Faculty Sr. Project Advisor, Rob Thayer

Wesley Downing

June 13, 2008

TABLE OF CONTENTS

INTRODUCTION

The UC Davis Arboretum is one of the most beautiful, colorful, and educational public open spaces in Yolo County. The Arboretum has 125 acres of land along a 2-mile stretch of the north fork of Putah Creek. Of the 125 acres, only 95 are actually developed and rests have plans to be developed in the near future. Throughout the years, the Arboretum has spent thousands of dollars adding new gardens, plants, educational signs and pathways to create one of the most picturesque and educational living museums of plants and trees in California. Since it was founded in 1936, the arboretum has planted 22,000 different varieties of plants and trees from around the world (Arboretum 2006). With these plantings the Arboretum has the largest documented collection of native California plants in the interior of the United States. Its nationally known Peter J. Shields Oak Grove has more than 80 different varieties of oaks, it is one of the finest collections of western oaks in the United States and many of oaks that are in the collection are rare to cultivation. The arboretum also has the largest collection of Coast Redwoods, Sequoia sempervirens, outside of their native growing range, located in the Arboretum's Redwood Grove. These achievements and along with many more that were not listed are why the Arboretum has become one of the favorite recreational site for students and townspeople in the City of Davis (Arboretum 2006).

Even with all of the beautiful plants and collections throughout the arboretum, there are still sections that need to be redesigned and/or restored. For my senior project I will be redesigning two sections of the arboretum. These two sections are completely different from one another. They differ in the existing plants at each site, the stream bank conditions, and the topography. Problems that both sites have are erosion control and lack of native grasses to create a stable soil structure. The two sites are the Ericaceae collection on the far east end of the arboretum and the Cottonwood Grove on the west end. Both sites are in need of new or additional planting to increase their aesthetic beauty and their natural functions.

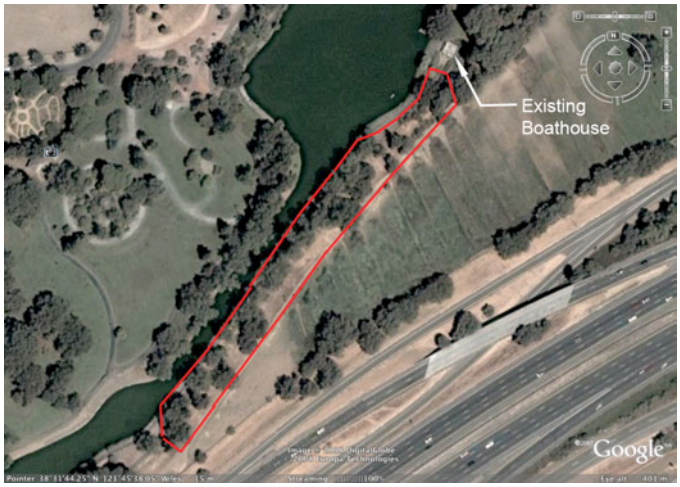
The objective of this project is to help restore and improve these two sections of

the arboretum that have been slowly diminishing over the years and turn them into places that the public can enjoy and learn from. The restoration of the native ecosystems and addition of native grasses will also help to control the erosion problems that trouble both sections. This will help keep the pathways clear of mud and hopefully enhance the nearby creek ecosystem.

With these additions to the arboretum, hopefully these two areas will become more aesthetically pleasing to the public and become frequently visited. These improvements, plus with the Arboretum's GATEways project, currently in the planning stages, will help the arboretum become a nationally known place and be visited by people from all over the world.

Site 1 (The Cottonwood Grove):

The first part of my proposal will be a restoration and design of the section to the west of the existing Arboretum boathouse called the Cottonwood Grove. This section, along with the rest of the arboretum, was historically a native riparian ecosystem. It is now an area that has been overtaken by non-native invasive grasses and plants. The only remnants of the historic native ecosystem are a string of dying Fremont Cottonwood along the existing pathway and a few scattered valley oaks. To stop the invasive grasses from spreading throughout the Arboretum, maintenance staff currently uses chemical sprays and mows down the weeds, which creates large areas of bare soil. The lack of native vegetation and bare soil forms an erosion control problem that creates dangerous conditions along the existing pathway. In addition to the lack of vegetation, weeds and bare soil produce an unpleasing section of the arboretum and may draw beauty away from surrounding collections.



The proposed design will restore the historic riparian ecosystem and its natural functions, including bank stability. The design will also incorporate a new pathway, seating and sign system that will allow instructors, students, families, and other visitors to learn about one of the native ecosystems of the City of Davis and the Putah Creek.

Site 2 (The Ericaceae section):

The Ericaceae section of the arboretum is located on the southern bank of Putah Creek between the existing A STREET Bridge and old A STREET Bridge. This section is about 220 feet long and about 70 feet wide and has a variety of different plants from the

Ericaceae plant family. Over the years the plantings in this area have slowly deteriorated, turning this section into somewhat of a desert environment with little to no groundcover, shrubs or trees. The lack of vegetation is causing erosion problems within this section. The soil is eroding under existing pathways, which causes sections of the path to break off, and others to split and crack. The eroding soil is also creating a buildup of sediments in nearby Putah Creek. The increased sediments in the creek are destroying the quality of the water and the existing ecosystem. The southeast corner of this section has a small amount of vegetation planted on it but has a lot of open land. The existing trees consist of a couple of giant sequoias trees, two cut leaf birch trees and some ceanothus.

For this section, I am proposing to construct a design that will integrate the existing vegetation with the addition of colorful native flowers and grasses to create a better soil structure, reduce the amount of erosion, and increase the overall aesthetic beauty of the site. I will also produce a design for a stage area along with colorful planting on the southeast corner of the site. As of today, the Wyatt deck and the large open space next to the white flower garden are the two locations used for performances in the arboretum but a formal stage should be created.

The Arboretum is a unique gem hidden on the southern border of the University of California, Davis campus. Throughout the years, the land that the Arboretum now sits on has gone through many changes from being an open riparian forest inhabited by native animals and Americans Indians to becoming the site where one of the top universities in California sits.

History of Putah Creek

Putah Creek was once a dense riparian woodland, two to three miles wide on both sides with thick canopies of Fremont cottonwoods, California sycamores, California black walnuts, and Valley oak trees. The understory had layers of Box elders, Oregon ash, Willows, Mexican elderberry, poison oak, California wild grape, and California pipe vine. The creek was once home to an estimated 22,000 acres of riparian forest, which was home to 83% of California's amphibian species, 40% of California's reptiles, and 25% of California's largest land animals (MacArthur 2000).

The original flow and what is most of today's current creek flow begins at Mount Cobb in Lake County and flows east through Napa County to Lake Berryessa and the Monticello Dam. The creeks' historic water flow use to meander right through the University of California, Davis campus, which is now called the North Fork, and then on to the Sacramento River. The creek flowed naturally until 1938 when the Yolo County Public works department built a small dam near the city of Winters to increase groundwater percolation. The creek had more changes in 1948 when the Army Corps of engineers came to the City of Davis and dammed the North Fork of the creek and put in man-made levees. These levees have and will further hinder the creeks natural ability to meander which leaves a slim chance for the riparian species to rejuvenate naturally. The Army Corps also bulldozed all vegetation along the banks of the creek to help prevent a 100-year flood event from occurring (Moyle 1999). In 1957, the Monticello Dam was finished which created Lake Berryessa and cut the amount of water flow through the

creek and hence changed the vegetation around Putah Creek. Also around this time, the Putah Creek Diversion dam was created, which diverted all incoming water from the Monticello Dam into the South Fork of the creek. From the diversion dam the water flows through the city of Winters, around Davis and into the Yolo Bypass. Now, along the Putah Creek watershed, there is no intact riparian forest but only fragments. There is only an estimated 2% of riparian forest still existing in California (Council 2005). Even though there had been many restoration projects along Putah Creek that tried to bring back some of the riparian systems natural functions, the historic dense of great ecosystem will never fully be restored.

Patwin Indians

The last know native inhabitants living within the lush and fertile riparian forest of Putah Creek were Wintun Indians, also known as the Patwin Indians. These Indians were said to have been very nice and a welcoming tribe. The Patwin, like most tribe in this era, lived in small groups with a main chief or general. Their villages ranged in the number of people but they have always tried to keep a sense of community within the tribe by creating buildings like dance and sweat houses where the tribe could gather. The buildings that the Patwin lived in are similar to "the domes" you see today on the western side of the UC Davis campus. They used natural materials to create 20 to 30 foot semi-subterranean dome like structures. The Patwin Indians used their surrounding environment in ways in which it would better their lives and help them survive. They used the acorns from the surrounding valley oak trees as a source of food. It was said that when there were fights with surrounding tribes, it was mostly like due to low acorn production years (Boucher 2005). Also in years of low acorn production, the Patwin would eat buckeye nuts or other plants and fruits from trees like pine cones, juniper berries, elderberries, manzanita berries, wild grape, and

blackberries. The Patwin also hunted a wide variety of animals for food, fur and trade. A list of riparian animals they hunted are deer, elk, antelope, black bears, grizzly bears, mountain lions, bobcats, foxes, wolves and beavers (Boucher 2005). In the spring or summers, they did control burns of the land surrounding the creek to encourage the growth of grasses and wildflowers and also encourage the growth of young Redbud trees. The Redbud was very important to the tribe since they used the branches to create baskets that would hold food and water.

The Patwins survived in the area of Davis for many years until Mexican, European, and American settlers came and either pushed them out, used them as slaves, or killed them. Remnants of the former village and cemetery were said to be found throughout the UC Davis campus but mostly close to Putah Creek (Arboretum 2006).

Pre-UC Davis

In the 18th century, Spain tried to colonize California for itself and was sending missionaries north to the pacific-northwest. Land grants were given to people living in newly created missionaries throughout California for them to in turn create ranchos. By 1800's, the Californian population of Mexican and Spanish colonizers was 1,700 people and many pueblos sprung up throughout California. Between 1805 and 1808, Spain had sent expeditions to the central valley to explore the Yolo/Solano area. But during this time, the Spanish were not the only explorers in the west. A Mexican army commander, Mariano Guadalupe Vallejo, was given the land of the central valley by the Mexican government sometime during the mid 1800's. Vallejo owned this land for many years until a group of travelers from Mexico called the Workman-Roland party headed to the central valley to explore the open west and join the popular trading business. Two members of the group were Don Juan Manuel Vaca and Juan Felipe Pena (or Armijo) (Matteson 1997). The party made their way through the unfamiliar terrain and ended up in Sonoma, California where they came in contact with Commander Vallejo. In 1842, the Mexican government gave both Don Juan Manuel and Juan Felipe Pena land grants that were around 44,300 acres, which was later called the Vaca-Pena Los Putos Ranchos. The

northern-border of the ranchos was the banks of Putah Creek. At this time Vaca and Pena were the only settlers on this land and without any Patwin Indians in sight. An expedition in 1829 led by a French Canadian, Alexandor Roderick McLeod and guided by Jedediah Smith camped along Putah Creek. According to their accounts, they found the Patwin (or Wintun) villages abandoned, the only evidence of human activity that remain were the skeletons of the Patwin tribe. It was said that the natives where killed by the Spanish that overruled that land for not cooperating with the church (Matteson 1997). Other Libaytos Indians, the main Patwin tribe, were said to be relocated (Matteson 1997). In 1841 a party called the Bartleson-Bidwell party from the east set west in search of a new life. In the Bartleson-Bidwell party was Colonel Joseph Ballinger Chiles, Colonel Chiles and his party made the tough journey to the west and in 1850 the Mexican government gave Chiles 47,600 acres of land north of Putah Creek. The land was called Rancho Laguna de Santos Calle and would remain under the ownership of Chiles until 1854 when Chiles sold portions of his land to his son-in-laws, Jerome C. Davis and Gabriel F. Brown. Davis paid $4,000 dollars for 12,000 acres of land that was directly in front of Putah Creek and ran alongside the creek for three miles (Matteson 1997). In 1862, Isaac Skinner Chiles, a nephew of Joseph Chiles, bought the 3,200 acres land for $2,000 dollars that was owned by Gabriel F. Brown. Isaac had made a great deal seeing how Gabriel had originally bought the land for $4,000 from Colonel Chiles. On Jerome Davis's piece of land, his father Isaac Davis was helping the growth of Davis by selling a portion of his farm land to California Pacific Railroad company in 1867 (MacArthur 2000). At this time, Yolo County was growing at an exponential rate with places like Winters, Woodland, Washington City, Cache Ville and others places that were being mapped. The central valley was turned into a cattle grazing land and the native riparian forest of the valley were being cut down and harvested for fire and fuel for the Sacramento steam boats (Matteson 1997). Farming was now the way of the land and people were planting many different crops along the banks of Putah Creek. One of the important plantings along the creek was a California black walnut grove. Robert B. Armstrong, who owned 320 acres of land on the southern bank of the creek, planted the walnut grove in 1870, which still stands today as the walnut

grove and picnic area next to the Putah Creek Lodge in the Davis Arboretum. The addition of farmlands and especially cattle caused the majority of the native ecosystems in the area to be destroyed, which in turned caused erosion problems along the banks of the creek. The destruction of the creek's natural functions and increase of erosion along the banks caused major flooding along the creek. The flooding caused a lot of farmlands and crops to be damaged or lost. In 1862, according to William H. Brewer, a member of the U.S. Geological Survey team, "…a region 250 to 300 miles long and an average of at least twenty miles wide…was under flood waters" (Matteson 1997). In 1871, using Chinese labor that was in the area for the construction of the railroad system, farmers dredged the Putah Creek channel, built up the bank walls and dug out another channel going southerly, which is now called the South Fork of Putah Creek.

The Creation of University California Davis/Arboretum

Peter J. Shields once said, "The College of Agriculture at Davis was conceived in his mind on a day in 1899," after he realized that the University of California did not have much of an agriculture program on the Berkeley campus at the time (Matteson 1997). The University of California, Davis was chosen in 1906 out of 69 proposed sites to become the university farm. It was said that Davis was chosen because of the large majestic trees that were seen at the site (MacArthur 2000). Classes at the University started in 1909 with only fifteen students attending classes. The land next to Putah Creek had not been set aside to be the Arboretum yet, but E.M. Major, the university farm manager and landscape design professor, was already coming up with plans to plant redwoods and other trees along the banks of the creek. Other faculty members wanted to use parts of the creek for recreation and shade during the hot summer months of the Central Valley. It was not until the late 1920's that the dean of the college of agriculture, Dean Merrill, and the director of the university farm, W.L. Howard, asked for a piece of land along the creek to be set aside for an arboretum. Although, it was not until 1936 that the college agreed to set aside some land, primarily due to the backing from the acting farmer director at that time, Dr. Knowles Ryerson and Peter J. Shields. The school received help from John W.

Gregg for a plan for the land that stretches from the County Road Bridge and the present California Avenue Bridge. The first step towards the creation of the Arboretum was on February 29, 1936, which was later determined to be the first ever Cal Aggie Labor day. On this day, students and faculty from the university, lead by John Stahl of the Landscape Gardening program, cleaned up the creek, removed any brush and took part in the first plantings on the site. The students and staff planted a variety of plants throughout the site including Jeffery and gray pines, incense cedars, native California oaks, California bay, coffeeberry, California fan palm, redbud and many more, all as a part of the native plant garden that was design by Gregg. This was all done on the $200 budget that the Arboretum was given when it was created and a very generous donation from the Gill Tract Nursery in association with the Forest Service's Civilian Conservation Corps Nursery. The first year following the initial plantings, students and gardeners would fill buckets of water from the creek and water the plants by hand. After the plants were established, the main concern of the Arboretum staff was the conservation of the creek since it seemed like the creek was used as a dump by the surrounding lands. They also had to keep the creek clear of weedy water plants like cattails that would absorb a great of water and turn the creek into a dry bed with medium-sized puddles. These puddles would house mosquito larvae, which was a huge problem during these times. In 1937, Dr. Elliot Weier thought it would be a good idea to form a committee to make the tough decisions about the growing Arboretum. The committee consisted of Weier, chairman, W.W. Robbins, Stanley Freeborn, and Knowles Ryerson. The committee made decision on: which plants to add, new plant collections, areas to be designated as public recreation or for private research, weed control, irrigation and any changes that might be done to the creek. From 1938 to 1939, more than 2,000 exotic conifers, California natives, Ceanothus, and redwoods were planted (Matteson 1997). The year 1941 came around and it turned out to be a good year for the Arboretum. This was the year that the Arboretum saw its budget increase from $200 to $2,000, and it was year that the Redwood Grove was planted, which is now one of the largest cultivated Redwood Groves in the interior United States (Matteson 1997). As the years past the future of the

Arboretum goes into a rocky time as World War II begins.

World War II

During World War II (WWII), the Arboretum was completely shut down. The campus was completely closed to students and only research was allowed to be done on campus grounds. On January 1, 1943 the University was turned over to the U.S. Army's Western Signal Corps and the name was changed to Camp Kohler (MacArthur 2000). More than 2,000 troops came to Camp Kohler and were trained in militarily tactics, which included testing explosives on the campus grounds and in the creek bed. During the Camp Kohler era, many cork oaks were planted throughout campus in fear of a cork shortage. A Victory Garden was also planted near the existing Davis Commons during the era. Camp Kohler closed on October 31, 1944 and non-degree courses were resumed in March of 1945. Degree courses were not taught again on the campus until October of 1945. In the five years that followed, the Arboretum was pretty quiet without any new plantings and no changes were made until 1948 when the Army Corps of Engineers dammed up the North Fork of the creek.

The Rebirth and Near Death

The planting drought lasted for almost 11 years and it was not until 1955, with a $3,000 grant from the California Foundation for Horticulture, that kick started activity in the Arboretum. The grant was giving to the Arboretum as a research grant for drought-tolerant plants species. In 1954, Lawrence Halprin was brought to the Arboretum to create a design that would connect the Arboretum to the Davis campus. The Halprin plan was not implemented due to the lack of funds, but it is said that many of the additions between 1957 and 1958 under the direction of Dr. John Tucker, acting chairman at the time, came from Halprin's plan (Matteson 1997). In 1955, a survey was conducted to map the native plants throughout the Arboretum. Also during that year, propagation of new plants was implemented, irrigation systems were installed, and a tougher weed management practice was started (Matteson 1997). Plans for new paths throughout the

Arboretum and improvements to the waterway were also started during this year. More additions were added in 1956, when John Madison, acting chairman of the Arboretum, led a team of students in building and installing bulletin boards, picnic tables and a huge memorial stone that would later be dedicated to Peter J. Shields and his wife, Carolee Shields. It was sometime during that decade that the Arboretum was divided into geographical and taxonomic sections (MacArthur 2000). Dick Harris took over as acting director in 1958 and the under his reign, more collections were added. But even with the new additions of plants and features, many people did not know the Arboretum even existed. Harris said, "It just looked like a dry, weedy abandoned stream bed, especially in late spring, summer and early fall. It just looked like the rest of Putah Creek, to the east and west," (MacArthur 2000). Harris tried to do whatever he could to get people to recognize the Arboretum and in 1959, Harris then wrote a report the Dean. In his report, Harris requested the Arboretum be extend to the Davis airport and he also requested improvements of the creek, constructed paths that would run the length of the Arboretum, development of an oak grove across from the sewage plant that would act as a picnic and recreational area, and construction of a central headquarter. Some of these request, creek improvements, grading, new paths and waterlines, were approved in the mid 60's. The waterway improvements included dredging of the creek and expanding three sections to create scenic lagoons (MacArthur 2000). Knowles Ryerson knew that if the Arboretum was going to expand and become a place of importance, the Arboretum would need more money. Ryerson needed help and this was one of the reasons that he and Dean Emeritus created an organization called the Friends of the Arboretum. This organization raised $5,000 the first year and would become instrumental in the creation of many projects and keeping the Arboretum afloat. On April 15, 1962 the Shields Oak Grove was dedicated to Peter J. and Carolee Shields. The Shields Oak Grove is 15 acres on the west-end of the Arboretum designed by Robert Danielson, the campus landscape designer, and serves as a collection of landscaped trees, 450 different species of oak, for educational and aesthetic value (Matteson 1997). In 1962, Dr. Eric E. Conn, who was researching cyanic acid, encouraged that the creation of the Acacia grove. In 1968, the

Putah Creek Lodge, boathouse and footbridge where added to the Arboretum. The Shields family had another dedication in May of 1965, when the Shields White Flower Garden was dedicated to Carolee. In 1969, it was time for the Redwood Grove to be dedicated to the man who had a huge part in creating it, Elliot Weier.

Everything was going good for the Arboretum and it was expanding and becoming more included into the campus. But on October 14, 1969 a hot plate in the field headquarters set the building on fire and lasted throughout the night. All of the equipment that the Arboretum owned was lost, so were plant and propagation records, and the entire seed collection. A suitable groundcover research project, trail species of Ceanothus, an acorn germination project, all the seeds intended to be planted in the fall, and most unfortunately, most of the photographic and slide records of the development of the Arboretum were also lost in the fire (Matteson 1997). After the fire, all the staff worked strenuously to recover seeds that were collected in places like South Pacific, Hawaii, Mexico and Central America. After all that effort the staff went through to restore those seeds, all those hours were worthless because on July 1, 1971 all funds to the Arboretum were cut and all maintenance was transferred to the Ground's Division. This monetary cut, came from Governor Ronald Reagan. Not only did the Davis Arboretum feel the budget woes, but it also affected the entire University of California school system (MacArthur 2000). People who loved the Arboretum were not simply going to let the Arboretum go down without a fight. Lloyd Ingraham, President of the Friends of the Arboretum, wrote a letter to Mrs. Reagan trying to get her to do anything she could to get the Arboretum up and running again. Mrs. Reagan wanted to see what all the fuss was about and actually took a trip to the UC Davis campus in June of 1971. She enjoyed the Arboretum and saw the passion from the people fighting to get it back and wanted to do whatever she could to help out. On June 29, 1971 Mrs. Reagan initiated a plan with the Department of Public Works for the Arboretum to help pick plants for sections of freeways throughout California (MacArthur 2000). This was one of the reasons the Arboretum was given back a budget but one of the main reasons was the relentless support and dedication from the Friends of the Arboretum organization. During the

budget cut, the Friends of the Arboretum created a march, which raised money and gathered volunteer support to keep the Arboretum operating through the first year with no budget. Also, funds bequeathed to the Arboretum from the Carolee Shields' Estate, that was approximately $200,000 dollars, not only helped the Arboretum through the first year with no budget but it was treated as an endowment and has brought the Arboretum $20,000 a year. The budget was finally reinstated during the 1972-73 year (MacArthur 2000).

After the budget was restored to the Arboretum and with the money received from the Shields' estate, the Arboretum had the money to begin adding more plants, new collections, hire employees and implement new plans. Throughout the 70's, many educational programs were developed to encourage public involvement. Topics for the programs included plant exploration, orchids, native plants, home gardening advice, irrigation, botanical travel reports, and others extremely helpful programs. Another program that was developed in these years was the Arboretum's plant sale. The plant sale started in 1974 when a very beloved Iris Garden was being phased out due to many complications. Instead of just killing the iris plants or simply giving them away, the staff decided to sell them and raise money for future developments. The Botany Department and Environmental Horticulture also chipped in with some of their surplus plants for the plant sale. People from near and far came to the sale and some even came with shovels to dig out the plants they wanted. The sale raised a tremendous amount of money on that single day and currently still does. The plant sale brings in about $30,000 each sale the Arboretum hosts. With its dramatic increase in revenue, the Arboretum was able to begin hiring staff members. In the past, there were no full-time staff members for the Arboretum and only the director was a paid position. One of the first and the most important employee hired was on October 2, 1972 when the Arboretum hired Warren Roberts as Superintendent. Roberts was known for his extensive knowledge of plants, helped picked plants that were going to be included in previously established collections throughout the Arboretum. He was especially helpful in the plant selections in the collection that was created after he was hired. In 1977, with an $18,000 endowment, the

Mary Wattis Brown California Native Plant Garden was created. The next year, the Ruth Risdon Storer Garden was dedicated with a $20,000 gift from Dr. Ruth Storer, which is a half-acre Drought-tolerant and Demonstration Garden. Ruth even planted the first plant in that garden.

In the 1980's more people were hired and more collections were added. The Eucalyptus Grove was added to the collection in 1981, which was previous a trail through a grove of planted eucalyptus, called the Eucalyptus Trail. These eucalyptus trees were planted before the Arboretum was even created. Early settlers planted eucalyptus trees along the banks of Putah Creek for lumber. Even though it turnout that eucalyptus was not the best wood for lumber, it does make a good addition to the Arboretum's collection. At the time of the dedication, it was said that the Eucalyptus Grove had 42 different species within the collection. The Eastern Asian Collection, Cottonwood Grove and Fall Color Collection, and Mediterranean Collection were created in the 1980's. The Eastern Asian Collection has plantings that came from the Asian region and included species of deodar cedar, Chinese flame tree, formas, dawn redwoods, Korean hackberry, dwarf nectarines, butterfly bushes and much more. The Cottonwood Grove and Fall Color Collection include cottonwoods, Chinese pistache, black locusts, aspens and maples. Also during the 1980's the Arboretum library was donated (MacArthur 2000). Other collections within the Arboretum include the North Coast Collection, the California Foothill Collection, American Desert Collection, the Conifer Grove, Valley Oak Grove, Californio and Early California Garden. Recently added to the Arboretum was the Davis Home Demonstration Garden, next to Border's bookstore in the current Davis Commons shopping center.

Throughout the years, the Arboretum went from a weedy dump that no one knew about to an exciting place to visit and one of the student's favorite places to hang out and relax. It is the home of the largest collection of oaks in the world and the largest documented collection of native California plants in the interior United States. These accomplishments plus all the other wonderful plants, waterway and animals makes the UC Davis Arboretum a beautiful place to visit and enjoy.

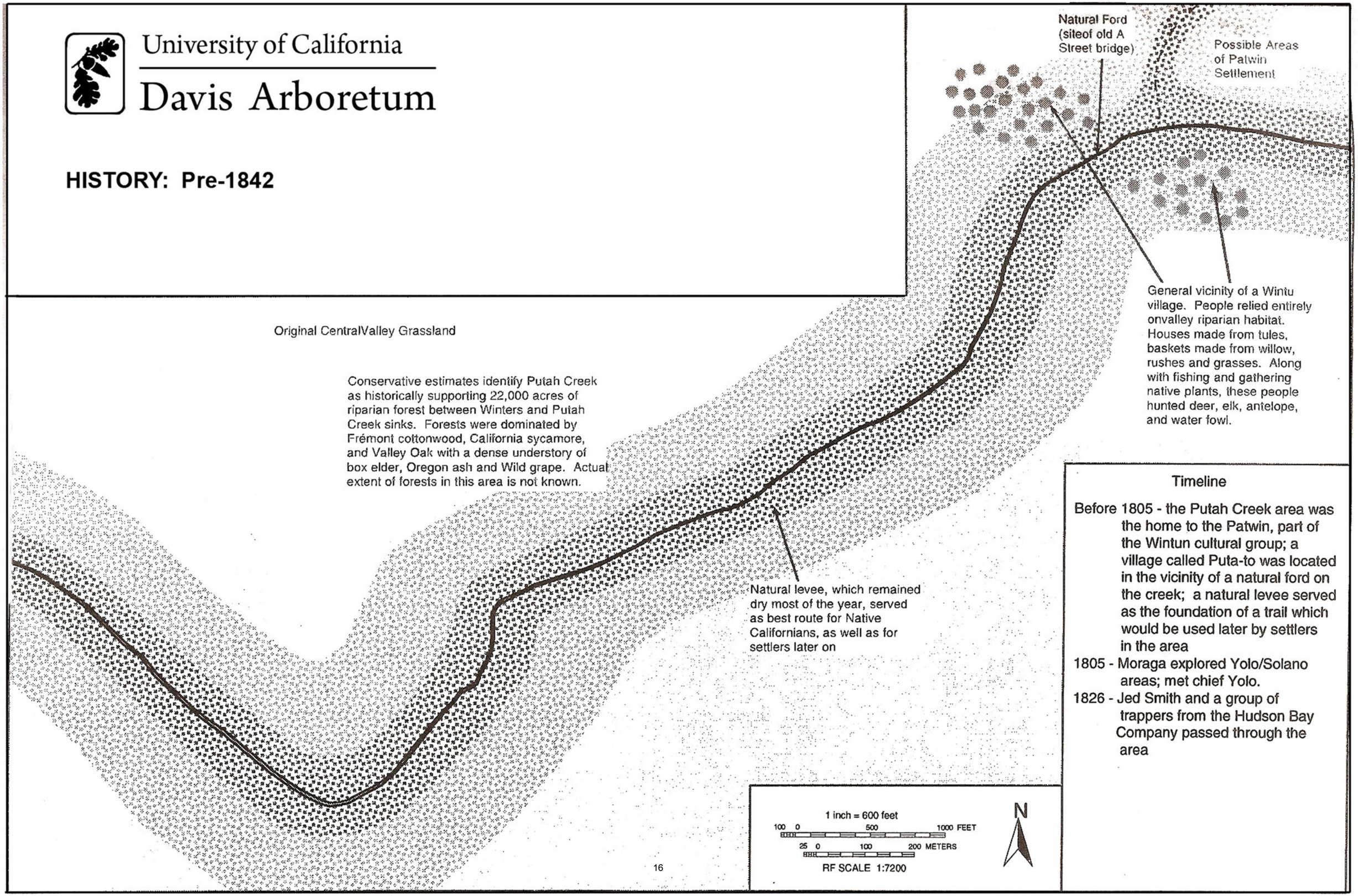
University of California

Davis Arboretum

HISTORY: Pre-1842

Original CentralValley Grassland

Conservative estimates identify Putah Creek as historically supporting 22,000 acres of riparian forest between Winters and Putah Creek sinks. Forests were dominated by Frémont cottonwood, California sycamore, and Valley Oak with a dense understory of box elder, Oregon ash and Wild grape. Actual extent of forests in this area is not known.



1 inch = 600 feet

100 0 500 1000 FEET

25 0 100 200 METERS

RF SCALE 1:7200

N

Timeline

Before 1805 - the Putah Creek area was the home to the Patwin, part of the Wintun cultural group; a village called Puta-to was located in the vicinity of a natural ford on the creek; a natural levee served as the foundation of a trail which would be used later by settlers in the area

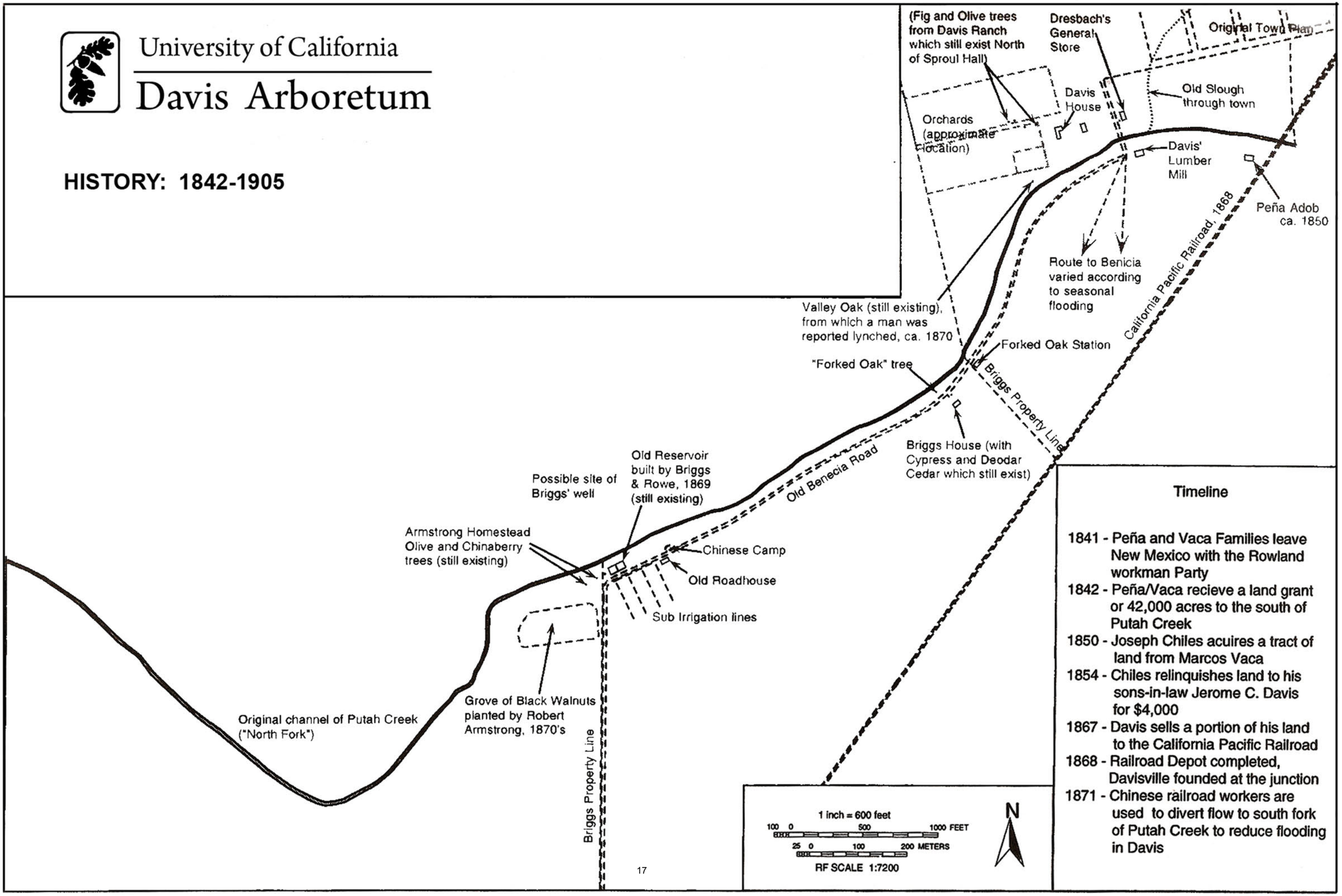
1805 - Moraga explored Yolo/Solano areas; met chief Yolo.

1826 - Jed Smith and a group of trappers from the Hudson Bay Company passed through the area

University of California

Davis Arboretum

HISTORY: 1842-1905



Timeline

1841 - Peña and Vaca Families leave New Mexico with the Rowland workman Party

1842 - Peña/Vaca recieve a land grant or 42,000 acres to the south of Putah Creek

1850 - Joseph Chiles acuires a tract of land from Marcos Vaca

1854 - Chiles relinquishes land to his sons-in-law Jerome C. Davis for $4,000

1867 - Davis sells a portion of his land to the California Pacific Railroad

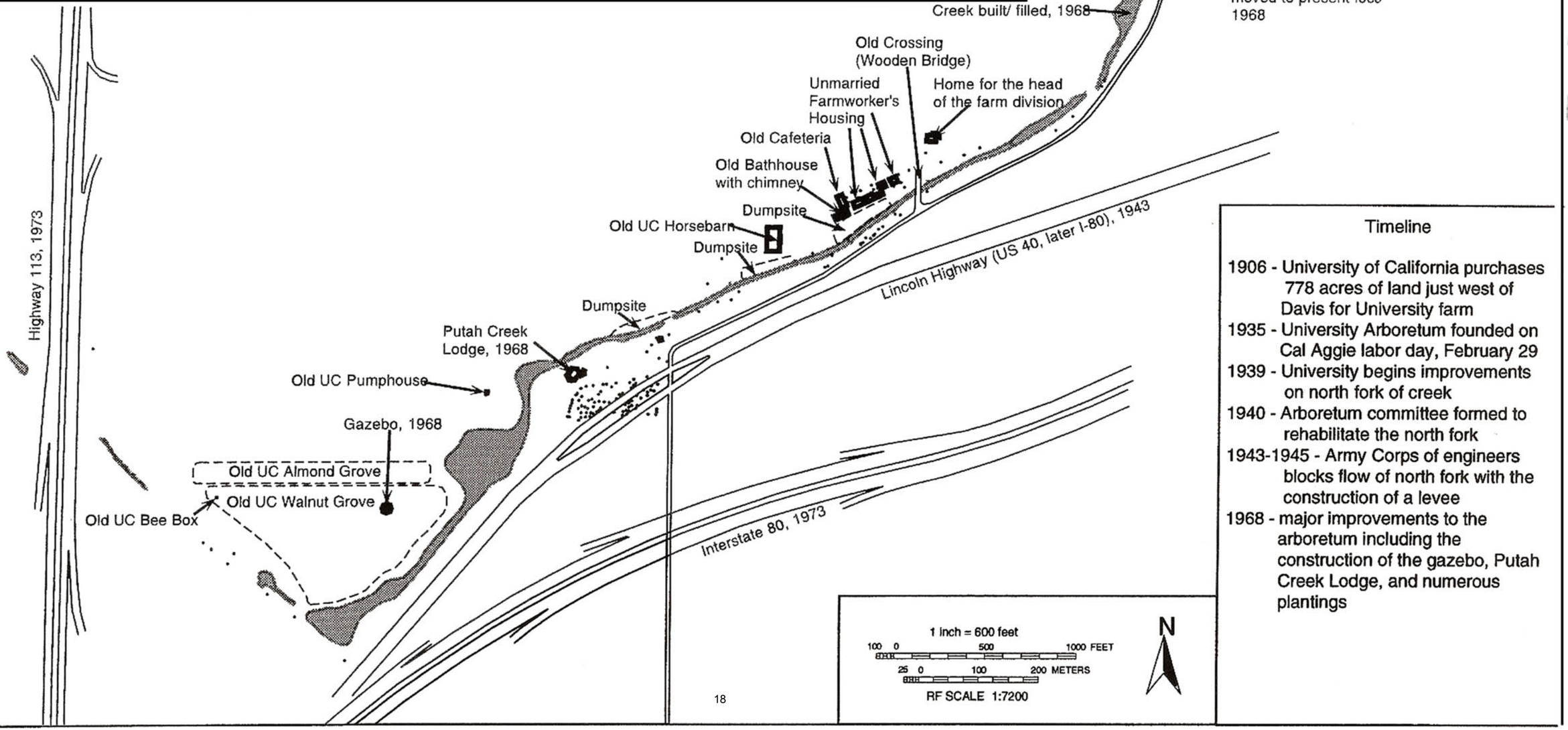
1868 - Railroad Depot completed, Davisville founded at the junction

1871 - Chinese railroad workers are used to divert flow to south fork of Putah Creek to reduce flooding in Davis

University of California

Davis Arboretum

HISTORY: 1905-Present



Timeline

1906 - University of California purchases 778 acres of land just west of Davis for University farm

1935 - University Arboretum founded on Cal Aggie labor day, February 29

1939 - University begins improvements on north fork of creek

1940 - Arboretum committee formed to rehabilitate the north fork

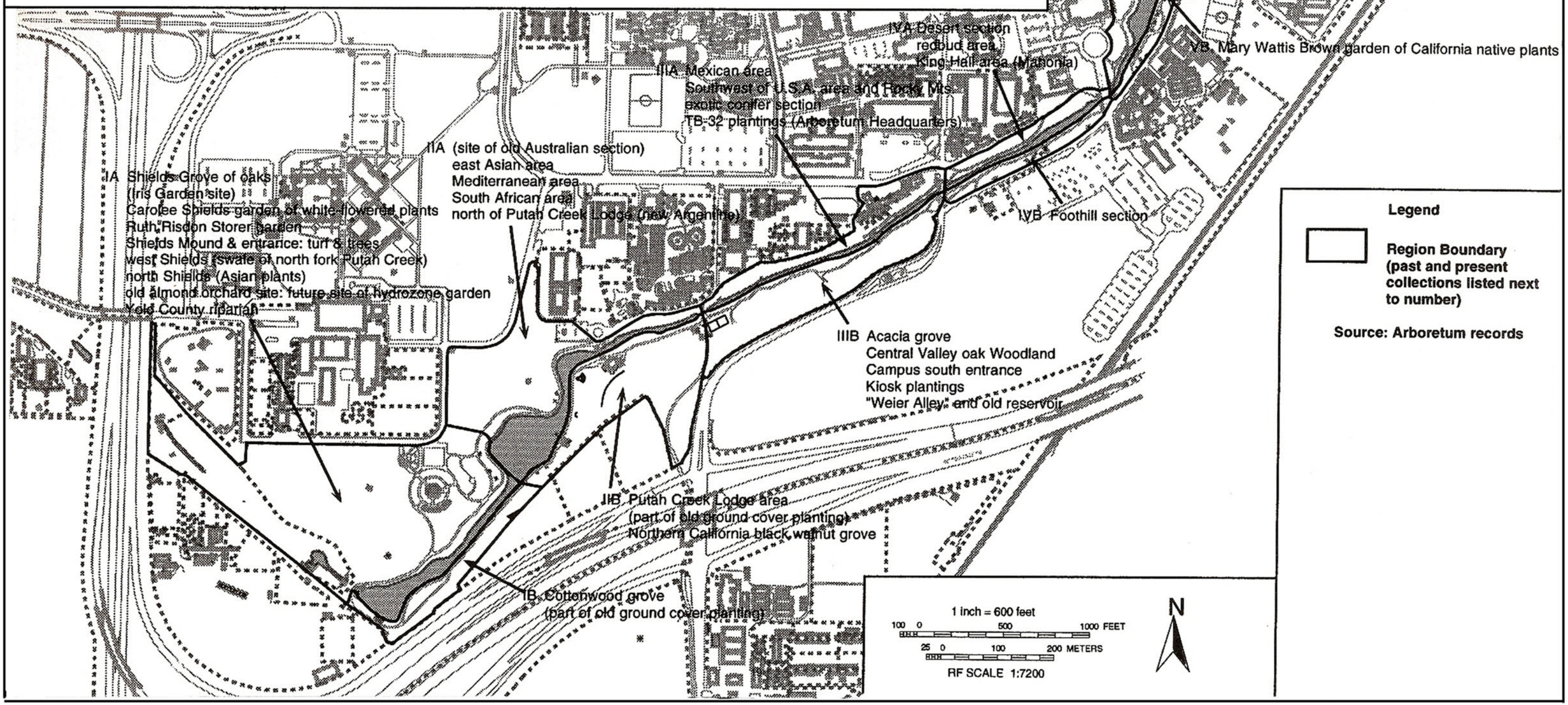
1943-1945 - Army Corps of engineers blocks flow of north fork with the construction of a levee

1968 - major improvements to the arboretum including the construction of the gazebo, Putah Creek Lodge, and numerous plantings

University of California

Davis Arboretum

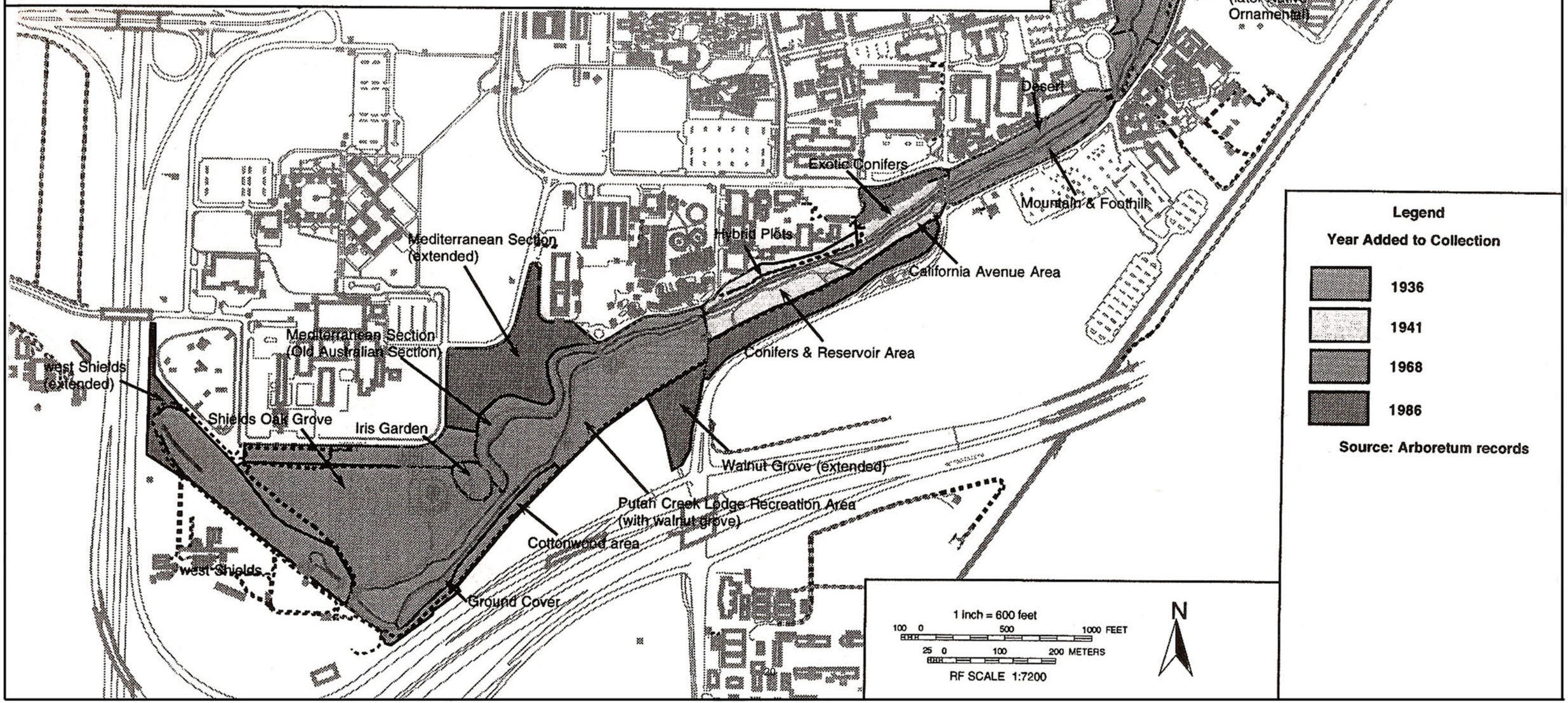
Historic Collections: Recent



University of California

Davis Arboretum

Historic Collections: Growth of the Arboretum



Riparian forest or riparian buffers zone are very important to many different organisms, plants and animals. They provide important benefits to its natural ecosystem, which directly or indirectly benefits the people in the surrounding communities. These benefits include water quality, flood and erosion control, habitat and food for wildlife, human recreation, increased property values, and an increase in local economies. Below is a list of benefits the riparian zones provide to nature and humans.

Water Quality

Every year millions of dollars are spent on water treatment centers to monitor the quality of drinking water. In 1991, the cost to treat contaminated water was estimated to be $10 to $15 per month family of three (Klapproth 2001). A natural riparian environment helps to clear containments from our drinking water using natural filtering systems. Riparian zones can help to filter nutrients, sediments, pesticides, and bacteria from runoff entering the stream from surrounding areas. Studies have shown that the amount of nitrogen in runoff and shallow ground water can be reduced as much as 80% after passing through a streamside forest (Llewellyn 2006). Studies have also shown that flood plain deposition reduces sediments by 50%, nitrates by 80%, and phosphorous by 50% (Llewellyn 2006). If a riparian environment is put in the correct location, it can remove 21 pounds of nitrogen and four pounds of phosphorous per acre per year (Klapproth 2001). When there are excess amounts of nitrogen and phosphorous in streams and waterways, they can cause dramatic disturbances in the systems ecosystem; high amounts of nitrogen and phosphorous cause rapid growth of algae and other unwanted aquatic plants and microbes. This can causes the oxygen levels within the stream to decrease, which can kill fish and other aquatic organisms. This affects the natural function of the stream and causes the drinking water to have a bad taste and odor. Riparian areas also act as nutrient sinks by sequestering nitrogen and phosphorous in biomass and approving the ability of soils to hold nutrients. The plants in these systems

takes in the nutrients and incorporates them into their plant material (Klapproth 2001). Sediments are another problem in water quality. Sediments are carried in the stream from many different sites, especially from eroding croplands, pasture erosion, stream bank deterioration, road and construction sites, (Llewellyn 2006). These sediments can disrupt native systems, which will hinder the streams natural functions and affect the drinking water. These sediments, when suspended in the waterway, block light from entering the water. When this happens, it impedes the growth of the important aquatic plants. But the plants are not the only organisms that are affected by increased amounts of sediments in the water. Fish populations are extremely affected by the suspended sediments since it makes the water cloudy, which in turn makes it hard for the fish and other organism to find food. These sediments also can get trapped and damage the gills of the fish living in the water. But most importantly, the sediments destroy fish spawning areas by settling to the bottom of the stream and creating unnatural conditions (Llewellyn 2006). These unnatural conditions at the bottom of the streams also affect the organisms that feed on the stream floor like fish and aquatic insects, which will weaken the food chain and cause a keystone affect, and in the end disturbing the whole ecosystem. Riparian forest can help reduce the amount of sediments in the water by filtering them out. The sediments settle out into the forest floor when it reaches plant root systems, leafs, twigs, and branches (Klapproth 2001). Riparian forest can reduce the amount of sediments from upstream croplands by 80% (Klapproth 2001). These natural functions do not cost any money and riparian buffers are less expensive to construct then a storm water treatment center. This fact alone should lead to the restoration of many riparian areas across the United States.

Flood & Erosion Control

Floods can cause major damage to its surrounding environments, but when there is some kind of natural buffer between the body of water and developed areas, the damage can be drastically reduced or be entirely avoided. When floodwaters enter riparian ecosystems, it is slowed down by the roughness of the riparian forest floor and vegetation (Klapproth 2001). The slow moving water now has time to slowly percolate into the soil,

move downward and recharge groundwater tables (Anderson and Masters 2007). The slowing of the water also allows any sediments and nutrients from upstream runoff to settle out onto the forest floor. The trees and other vegetation absorb these nutrients and it promotes further growth and increased root size (Klapproth 2001). These buffers or riparian forests also help to minimize flooding downstream. By riparian plants absorbing the sediments, it keeps them from settling out on the stream floor, which keeps the bottom of the stream deep and keeping floodwaters low (Klapproth 2001).

Riparian areas also are important in stopping soil erosion. A lot of erosion problems are associated with flooding in those areas. The roots of the riparian vegetation help to solidify the soil by acting as an anchor. The soil stability is especially important when there is a flood. If the soil has a strong cohesion with the roots, it will not be swept away by moving water. The vegetation also acts as a protective layer for the soil too. When it rains, vegetation helps to protect falling rain from pounding any bare soil. The continuous pounding can cause soil stability to be weakened and increase erosion. Any debris that is on the floor also prevents the soil from getting constantly pounded by the rain (Authority 2006).

Wildlife

Riparian forests supports a large list of species ranging from large animals like bears and mountain lions, down to small animals like fish, reptiles and amphibians. Many of these species and a lot of endangered species require a forested area along a stream for food and shelter (Anderson and Masters 2007). Many animals avoid large areas of open land mostly due to predation and lack of shelter. Many of the smaller animals use the woody debris from riparian areas as a source of food and shelter. Birds and fish depend on the insects that live in riparian forest for food. These forests do not only act as shelter and a place to find food but they also act as a corridor from one patch of forest to another. Corridors allow animals to safely move from one area to another safely without traveling through large areas of open land or areas that are populated by humans. This movement between forest ecosystems will increase biological diversity and richness

within these areas. This is very important because without diversity, those systems will not have all the components required to survive and will eventually die out.

Riparian areas also aids in keeping the nearby stream ecosystems thriving. Riparian vegetation provides shade for the nearby streams, which keeps the stream temperatures low and maintains the level of oxygen in the stream at a healthy level. A stream without shade from nearby vegetation can be 10-15 degrees higher than a stream that is shaded and if a streams temperature is raised above 60 degrees, phosphorous is released from sediments which affects water quality. A study has also shown that trout populations decreased by 85% when the shade of a stream is reduced by 35% (Llewellyn 2006). Without shade, water quality would decrease and so would aquatic life.

Recreation, Aesthetic, and Economics

Riparian areas not only provide benefits to the animals that inhabit them but it also provides benefits to people. These areas can provide recreational activities, beautify an area and increase property value.

The aesthetic value of any area increases when natural vegetation is added. If you look at a real estate price for homes or apartments next to large parks or rivers, the price is usually higher than homes that are not. Contributing factors to the increase property value could be the scenic views, a decrease in noise from traffic, other city life and the increase privacy. Riparian zones also provide windbreaks to certain properties and residents in these areas do not have to worry about erosion control problems either (Authority 2006). Streams that have thick natural vegetation surrounding properties interest people more than ones that do not. This could be due to that fact that the vegetation gives the people the feeling of being in a natural, wild landscape (Klapproth 2001). The vegetation also adds a natural beauty to the stream, which increases the overall beauty of surrounding land. Plus, with natural vegetation comes wildlife and people like to see wildlife up close, it gives them a feel of being in the wild.

Riparian areas bring recreational activities to it surrounding environments. The natural nutrient filtering abilities of a riparian site makes the water safe for people to

participate in many water recreational activities such as swimming, rafting, canoeing, and motor boating. The natural filtering systems also keep fish populations healthy. Healthy fish populations allow recreational fishing to take place, which brings in money for the local economy. Although, not all activities created by natural riparian sites are water related, depending on the density and size of the riparian area, outdoor activities such as hiking, bike riding, camping, and picnics are all possible. Bird watching can be done in riparian areas and if the season is right and if the local laws permit, a little hunting can be done too. In Virginia, recreational fishing contributes $82 million dollars to the state's economy, hunting contributes $519 million dollars, and $698 from wildlife observing, feeding and photographing (Klapproth 2001). This is a tremendous amount of money and other states have similar numbers for recreational income.

Conclusion

As you can now tell, riparian forest or buffers zones provide many beneficial elements to their natural systems and to humans as well. Without riparian systems, we would still survive but at what cost? We will have to spend an incredible amount of money on the construction and maintenance of water treatment centers and repairing damages that floods and eroding landscapes would cause. The money the state receives from outdoor recreational activities from riparian areas will be less then want they will receive if the riparian areas were not around. Other benefits that humans would enjoy from riparian areas will not exist. Even though riparian forests are not necessary for the existence of all life, they might make it a little easier for most to survive.

For every restoration project there are certain steps that are taken, from picking the location of the site, creation of goals and objectives, plans, plant selection, management strategies and monitoring. These steps may or may not be different depending on the location and type of restoration project that is being created. Riparian restoration is becoming a common practice along the banks of streams throughout the central valley of California. The steps and techniques that are commonly used throughout the United States to create a successful project have little differences. Below is a list of steps and brief descriptions from a combination of different references, these steps will help with the creation and success of a riparian restoration projects.

Site Selection

Choosing the right site for your restoration project is very important in determining the success of your project. There are many factors to considered when determining the precise site from the location, size, existing plants and wildlife; these factors will make or break your project.

When selecting a site, a good place to begin would be the location and size of proposed locations. The size of the site will determine the amount of re-vegetation that will occur and the amount of natural benefits that will be restored. Benefits to water quality, fish and wildlife are much higher when applied to long continuous lengths streams and across entire flood plains (U.S. Fish and Wildlife Service 2004). The size of the site also has cost implications. As the site gets larger in size, the cost goes up for site preparation, planting materials, weed control and management. Location is more important to factors such as access to the site and ways the site might be used. If the site is relatively close to development or is going to be used for educational proposes, then a site that is easily accessible is needed. You also do not want a site that will be tough to access since supplies and large machinery will be needed to restore the site.

The next step would be looking at the existing vegetation, stream structure, and

wildlife. The current vegetation of the site will have a huge affect on new plant establishment. Existing vegetation, like weeds, will compete with the newly planted seedlings for elements need to survive. Sites with a large area of weeds will need to have extensive site preparation done to give the new plantings a fighting chance to survive. Existing trees could affect growth by creating large amounts of shade. On the other hand, no tree cover can result in excess amounts of sun exposure, which could also hinder the growth of the newly planted species. Existing wildlife is another factor that could hinder or kill newly planted vegetation. Animals such as: deer, elk, and livestock will browse the newly planted vegetation and rodents are known to girdle vegetation, both will inhibit growth and may cause mortality to newly planted vegetation. Sites that have a high volume of wildlife may not be suitable for restoration. If those sites are chosen, extra costs will be added to the project in order to keep wildlife from destroying new plantings.

Stream size is another factor that should be considered when picking a location. Stream size and channel characteristics will influence restoration and improving natural benefits. As the size of the stream increases, the ability to significantly influence riparian functions decreases (Bennett and Ahrens 2007). Also, wide channels may be unstable and are vulnerable to frequent floods, which could wash away any vegetation planted on banks (Bennett and Ahrens 2007).

Other factors to consider for site selection are soil compaction, poor soil drainage, depth of deep summer water tables, high amounts of sediments deposition, and high soil salinity (U.S. Fish and Wildlife Service 2004). These are all factors that can also affect growth and survival of newly planted vegetation. These factors will probably take time to find out and will probably be done in the final steps in considering a site due to the money involved in determining these factors.

Designing the Project

When the designing stage is reached for a restoration site, the first step should be developing objectives and goals that will restore or enhance natural riparian functions to the site. These natural functions will return the benefits that were listed in the previous

section and improve overall ecosystem quality. Most restoration work is restoring ecosystems back to pre-European settlement and most goals are set to resemble these conditions. It will be difficult to restore a site back to pre-settlement conditions due to human interferences to natural processes. Processes like fire, flooding and landslide were all a natural part of native riparian areas but human development, changes to stream structure and structural additions have hindered natural riparian processes. Due to human involvement, a reference site near the purposed site should be used as a guide to restoration. These sites are the closes to pre-settlement times that you will find and will give you the best look at what the site should look like when it is fully restored. Data that should be collected from the reference site should be plant distribution and colonization, percent shade cover, lower limits of vegetation, depth of groundwater, soils, human and wildlife uses of the site, and hydrology and geographic conditions (U.S. Fish and Wildlife Service 2004). This information will be instrumental in the designing process.

The design of the project itself should include the location of plants, spacing between plants, fencing, access for people and equipment, in-stream structures, future maintenance, and monitoring (Bennett and Ahrens 2007). When designing, the width of the buffers zones or restored area should be considered. Wider zones provide more benefits to the system, which creates a more stable and strong environment. Although, the width for the whole site should be varied with the ends being wider and the rest at different widths, the variety in the width of the buffer will support different riparian functions (Bennett and Ahrens 2007).

With the width of the site figured out, the next step is to move onto plant selection and spacing. Once the location of the site has been assessed and all the variables are known, you can now plant species in appropriate zones and create a planting plan. In the *Guide for Planting Riparian Trees in Southern Oregon* by Oregon State University, a brief description for plant spacing and design is given. It suggested planting fast growing hardwoods like willows, cottonwoods, and alders closer to the stream. The high terraces of the site should be planted with conifer and other upland species. The spacing of the plants is not really a science yet but according to the report, plants should be planted in

rows with usually 6-10 feet between each so that there is enough space for large machinery like mowers, trackers and ATV's to move through and perform management practices. Upland species are usually spaced 10 or 12 feet apart since closer spacing would require thinning of plants earlier in management of the site. Closer spacing, clumping or uniform planting is fine but management of the site will be tougher and manual labor will become a larger part of your management plan.

Another report done by the U.S. Fish and Wildlife Service, called Riparian Restoration and Management, had some different methods to design a planting plan. They suggest that vegetation on the stream banks and floodplains should be done in a "plant per linear foot" basis if planting along the water's edge and a "foot on center" based on

Plant Material Type	**Planting Density (highly site dependent)**
Cuttings	1-2 ft on-center or planted in bundles, dense rows, brush mattresses[18] or other bioengineering method
Containerized herbaceous plantings	1.5 to 2 ft on-center
Containerized shrub	3 ft to 5 ft on-center depending on the species
Containerized tree	10 ft on-center (435 plants per acre). This is species related. Too close and the plants can be overstressed.
1.5inch-diameter stem, ball & burlap tree	20 ft on-center
Bare-root stock	5 to 10 feet on-center for shrubs; 10 to 20 feet on center for trees
Seed mix	Seeding rate depends upon species

U.S. Fish and Wildlife Service, 2004

larger or wider areas. Plants should be distributed uniformly across the appropriate hydrology zones. When planting similar plants in the same area try to group them together, this will mimic natural plant distributions. This clumping strategy will be more aesthetically pleasing (U.S. Fish and Wildlife Service 2004). Try to group plants together that would grow as thickets in the wild to give them a natural look and spread solitary plants, like trees, wider apart. Some spacing should be implemented to allow mowers to move easily through the site and kill any unwanted plants (U.S. Fish and Wildlife Service

2004).

Another component that needs to be considered is the design of an irrigation system. An irrigation system may be helpful depending on the climate and summer rain of the site. Irrigation systems may be appropriate in areas where summer drought is a concern or if you want to provide extra water in the first couple of growing seasons. Other conditions where an irrigation system may be needed is when you are planting water-loving plant species such as willows, alders and cottonwoods, and stock planting where they might not be able to reach the water table. Also, irrigation systems will be required when planting on coarse soils with low water holding capacity and to ensure survival and to meet growth objectives. If these factors occur at the proposed site, then an irrigation system should be designed, but good survival and growth can be achieved without irrigation (Bennett and Ahrens 2007).

Site Preparation

Before any of the proposed design is implemented, the removal of any unwanted vegetation and any other elements that might affect the goals of the restoration project should be done. Good site preparation can greatly increase the survival and growth rates of planted stocks. Site preparation starts with the removal of invasive and weedy plants. Weeds and invasive plants will compete with native plants for water, light, space and nutrients and most of the time they will win. Grasses are extremely tough competitors for newly planted stock. Grasses have dense fibrous roots systems that rapidly absorb soil moisture and can create a dense groundcover. This grass ground cover creates a habitat for rodents and these rodents will girdle the bases of new stocks and eventually kill them. The most effective way to kill weeds is to kill both their roots and shoots (Bennett and Ahrens 2007). The most effective way to do this is to spray the weeds with some kind of herbicide. Removal of just of the top portion will temporarily remove competition from recently planted plants but most weeds will re-sprout from underground reproduction organs and begin competition once again. Tilling to remove roots of unwanted plants can control weeds but by doing so, you expose rich mineral soil that can

be invaded by weeds in the surrounding areas (Bennett and Ahrens 2007). The best bet, if herbicides are not an option, is to till in rows and apply mulch afterwards. This will rid any unwanted weeds and mulching exposed soil can prevent re-colonization from other invasive plants. Make sure that removal of weeds and other unwanted plants will not cause problems like erosion and bank stability.

Soils that are heavily compacted will be a problem for a restoration project and will need to be tilled before planting can occur. Compacted soils will reduce the growth of the root systems of plants growing at the site and these soils will have low water and nutrients levels. To fix this problem, dusking, scalping, or plowing can be done to loosen the soil and allow nutrients, water and roots system to move through it. Soil fertilizers may also be used to promote growth in poor soils but is usually not needed in riparian systems. Riparian plants are adapted to low fertile soils and if a fertilizer is going to be used, it should be a slow release organic product mixed into the rooting zone (U.S. Fish and Wildlife Service 2004).

Table 5.—Site preparation methods for vegetation types.

Method	Effectiveness and duration*	Cost per acre per application	Comments
Grasses and herbaceous vegetation			
Herbicides: applied with vehicle and boom spray or hose, or with backpack or hand sprayer	High 1–2 years	$50–$150	Can apply to strips or planting spots – minimum area 3 x 3 feet, centered on seedling. Dead plant material temporarily protects soil, delays weed reinvasion from seed.
Mechanical: tilling	High 2–4 months	$80–$160	Exposed soil is rapidly reinvaded by weeds sprouting from seed.
Mechanical: mowing	Low 1–4 weeks	$40–$120	Mowing does not stop moisture competition but may reduce rodent problems. Must be repeated often.
Manual: scalping, hoeing	Medium 3–6 weeks	$100–$300	Exposed soil is rapidly reinvaded by weeds sprouting from seed.
Mulch mats	Medium 1–2 years	$150–$400	Must be well secured and lie flat on ground. Mulch mats can harbor rodents and might wash away in high water.
Woody shrubs			
Herbicides: applied with vehicle and boom spray or hose, or with backpack or hand sprayer	High 1–3 years	$50–$200	Complete spray coverage is most effective. Dead plant material provides temporary soil protection, delays weed reinvasion from seed.
Herbicides: cut-stem or basal-bark treatment	High 1–3 years	$40–$100	Water-soluble formulations applied to cut stem surfaces. Oil-soluble formulations applied to penetrate bark. Standing dead material provides dead shade; debris and leaf litter cover soil.
Mechanical: grubbing roots, raking	High 1–2 years	$500–$800	Exposed soil is rapidly reinvaded by weeds sprouting from seed.
Mechanical: mowing	Low 1–4 weeks	$80–$160	Doesn't kill roots, which rapidly resprout. Must be repeated often.
Manual: slashing	Low 1–6 weeks	$300–$500	Doesn't kill roots, which rapidly resprout. Must be repeated often.
Manual: grubbing roots	High 1–2 years	$1,000–$2,000	Exposed soil is rapidly reinvaded by weeds sprouting from seed.

*Effectiveness at reducing competition for site resources; duration is the period that competition is significantly reduced.

Bennett and Ahrens 2007

Plant Selection and Planting Techniques

Similar to many of the other processes that goes along with restoring a riparian site, picking the vegetation to be planted in the site is done by searching through many factors. The species of plants that are going to be used are usually picked during the design process or the planting plan. But, the selection of the plants from a nursery or cuttings is done after the design is completed. This section will go over the how to pick the right plants for the site and the different methods of selecting the actually plants.

When selecting plants for the restoration site, you have to make sure that they can survive in the condition they are going to be planted in. The best way to do this is to choose plants that are native to the area, since they are already adapted to the surrounding environments. Native plants should have a better chance of competing with invasive plant species and are should be resistant to native insect infestation. Natives also provide great benefits to native fish and wildlife communities. But even native plants might have troubles in an environment that has been disturbed. Consequently, when picking plants for a riparian site a couple factors should be considered. In natural riparian environments, flooding is a part of the system and this is a important factor in plant selection. Plantings that will be close or next to the stream should have a high tolerance to flooding and plants selected for the floodplains should have a medium flood tolerance (Bennett and Ahrens 2007). Another factor in plant selection is drought and moisture needs, since water availability in the summer is low. This should be base on the local climate, soil moisture, and topography (Bennett and Ahrens 2007). Shade tolerance is a small factor in plant selection. Mature riparian areas usually have a high crown cover percentage and understory plants will not see a lot of sun. So plants with a low shade tolerance should not be selected.

After deciding what plants best fit for your site, the plants can physically be bought for the site. There are many different ways to get plants but here are some factors you should think of when picking your plants: availability, handling sensitivity, cost, ease of transport and planting, survival and growth potential, benefits to wildlife, and plant diversity (Bennett and Ahrens 2007). There are also a couple of different ways you can buy plants. Plants can come in containers, bare-root, ball and burlap, cuttings, wildlings and seeds.

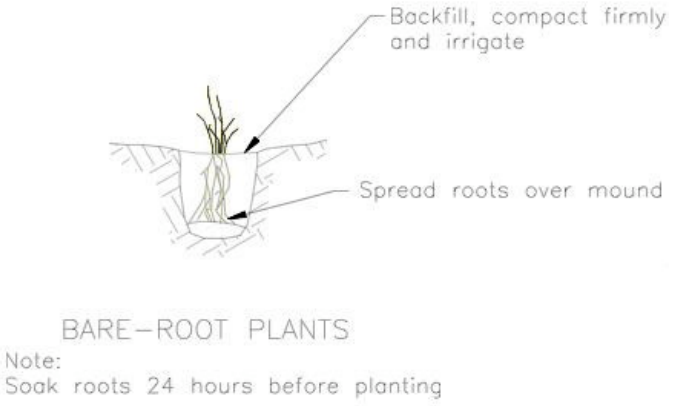
Bare-root:

Bare-root seedlings are woody plants that are usually grown in nursery beds for two years. Bare-roots are designated in two different ways. “2-0” means the plant was only grown in a nursery bed for two years and never moved. “1-1” means that the plant

was grown for one year in a nursery bed and then moved to a transplant bed. The "1-1" plants tend to be a little larger than the "2-0" plants and tend to have a more extensive fibrous root system (Bennett and Ahrens 2007). The soil is usually removed from the plant and it is packed with damp sphagnum moss or saw dust and sold in bundles (U.S. Fish and Wildlife Service 2004).

Planting:

Planting of bare-root stock should be done during the winter season when plants are dormant. Planting should be done quickly since exposure to wind and sun for more than 30 seconds could damage the plants root system (U.S. Fish and Wildlife Service 2004). When digging the hole, make sure the hole is twice the size of the root ball so it will go in with ease. The hole should be deep enough that the root collar will not be exposed. Make sure the plant is straight and backfill the hole. The backfill should be native soil and tamping the area after planting is recommended. Create a trough or berm around the plant to retain water.



U.S. Fish and Wildlife Service, 2004

Advantages:

Bare-root stocks are less expensive than other forms of stock, easy to transport, and there is usually a wide variety of species available in this method, especially

conifers.

Disadvantages:

Bare-root stock is less expensive but does have a low survival rate. It also has a smaller planting window than other methods, more skill is needed when planting stock, and roots are very sensitive to wind and sun exposure.

Wildings:

Wildings are simply trees that have been uprooted from a natural environment. This usually takes place where seedling of a certain species is abundant and will not affect the ecosystem in which they are pulled from.

Planting:

Planting should be done right after the plant is removed from its natural environment but it can be stored in a container and planted when desired. Planting hole should be wide enough to plant seedling with ease and deep enough that the root collar is not exposed.

Advantages:

The advantages of wildings are that they are free and it should be adapted to local conditions (depending if location of the stock was pick from).

Disadvantage:

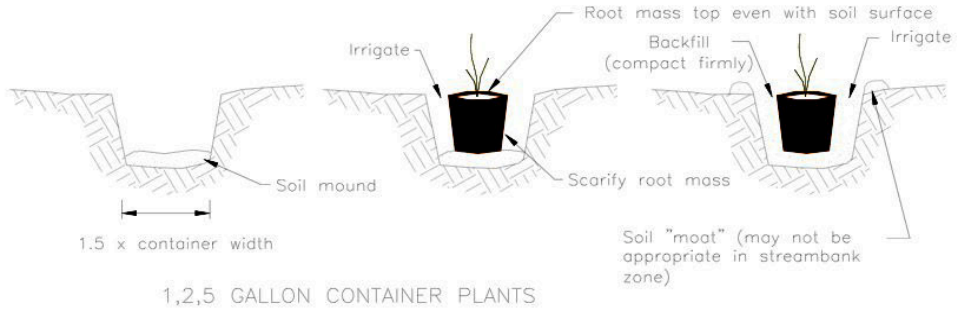
The disadvantages of wildlings are they require a lot of labor to find the seedling, uproot it, transport and replanting. It is also difficult to find an environment with an abundance of your species you want.

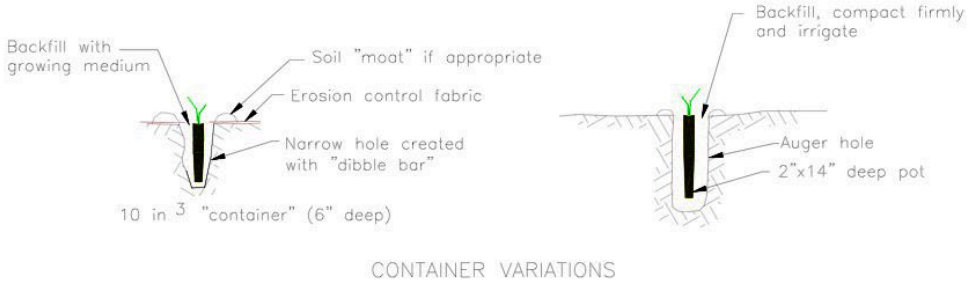
Container Seedlings:

Container seedlings are grown in a variety of different size. They range from smaller containers sometime called plugs to large containers that can reach the size of 45 gallons. They can even be grown in polyvinyl chloride (PVC) pipes that are 24 inches long. Container stock should have a well-developed root system.

Planting:

Planting is usually done in the spring or when the weather is decant enough to plant. When planting container stock, make sure to water before planting and cut, loosen or uncoil any twisted or circling roots. Make sure to keep the soil-root mass together when planting containers stock. The hole should be at least twice the width of container the stock came in. The top of the soil/root mass should be flush with or slightly higher than the soil surface. Back fill with native soil and tamp down soil after planting. Create a trough or berm around the plant to retain water.





U.S. Fish and Wildlife Service, 2004

Advantages:

Container stocks have a large planting window, there is less potential in damage during planting and less skill is needed in planting.

Disadvantage:

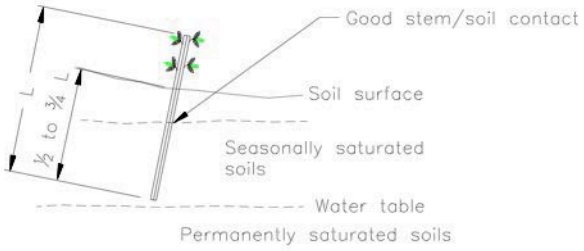
The disadvantages of using container stock are the cost of container seedlings are higher than other methods and container stock commonly have root problems like girdling and lack of root development.

Cuttings:

Cuttings are stems cut off trees or shrubs that are dormant. Cuttings come in a variety of different lengths. Canes or whips are cuttings that range from 1-4 feet in length and can be up to an inch in diameter. They are called whips due to their flexibility. Poles are cutting that are usually larger and have more length than whips (Bennett and Ahrens 2007). Cutting should be collected from a healthy, vigorous plant and should be taken for the center or bottom of the plant.

Planting:

Cuttings should be planted in early summer or early fall and should be planted days after being cut. The cutting should be soaked in water for 1-10 days before planting (Bennett and Ahrens 2007). Since cuttings are so small, they can be planted by hand or using hand tools. Cuttings should only have a fourth to a half of it extended above ground and also should be planted deep enough to reach the summer water table after roots are established.



LIVE CUTTINGS PLANTED INTO STREAMBANK

General notes:

1. Soak cuttings in water for 24hrs. to 10 days before planting.
2. See text and references for additional information.

U.S. Fish and Wildlife Service, 2004

Advantages:

Cuttings are low in cost, easy to plant, have rapid establishment, they are tolerant to flooding, and can grow quickly after they have established a root systems.

Disadvantage:

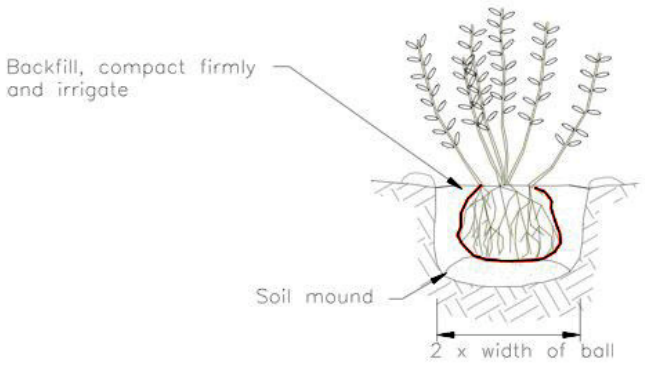
The only disadvantage of cuttings is they might not develop a root system.

Ball and Burlap:

Ball and burlap stock are plants that have their root system and the soil surrounding the roots wrapped in a burlap sack. These plants are usually mature trees that range from 6-12 feet in height. When picking ball and burlap stock, make sure root systems are dense and fibrous and shoots should be dense and well branched. The root to shoot ration should be 1.5:1 (Bennett and Ahrens 2007).

Planting:

The window for planting is usually late winter to early spring. Prepare a hole at least twice the size of root mass and deep enough that root collar is not exposed. The upper third of the burlap should be cut and slowly removed. The top of the root ball should be flush or slightly higher than soil surface. Backfill with native soil and tamp down soil after planting. Create a trough or berm around the plant to retain water.



BALL AND BURLAP PLANTS

U.S. Fish and Wildlife Service, 2004

Advantages:

Ball and burlap stock have good survival rates, are less likely to become stressed and usually have good growth. The size of the stock also adds to the structural diversity of the site.

Disadvantage:

The large size of the stock will make it harder to plant and the cost is more expensive then some of the other possibilities.

Seeds:

Seeds can be used as an easy way to plant a site. You can get a variety of different type of seeds from nursery, stores and can collection them from a reference site.

Planting:

Seeds can be planted in early spring. There are four different ways to plant seeds. These methods are drilling, broadcasting and hydroseeding and are very different. There is always hand planting of the seeds but for larger sites, it is not recommended. The method used will depend on the slop of terrain, accessibility for large machinery, soil characteristics and time of seeding. The preferred method is drill seeding, which is where a machine mechanically drills seeds into the ground. Drill seeding requires access to the site and may not be possible at all locations. Broadcast seeding is the method of a laborer using a spreading device to broadcast seed over a large area. It is labor intensive but if access is limited, it is the best way to spread a lot of seeds across a site. Hydroseeding is a method where a seed mixture is sprayed over previously laid mulch. This method is the least effective and if flooding occurs at your site, the water will wash away the seeds, mulch and binder.

Advantages:

Seeds come in a large variety, they are cheap and can be bought at a number of locations, and machinery can be used to plant a large number.

Disadvantage:

There are no guarantees that the seed will grow.

Drill Seeding	**Advantages**	**Disadvantages**
	Proven high revegetation rate	Cannot be used on rocky soils or steep slopes
	Most successful on slopes 3:1 or flatter	Unless specially modified drills are used, all seeds, regardless of size will be planted at the same depth; the smallest seeds are likely to be planted too deep
	Seed depths and seeding rates can be closely controlled	Seeds drilled in rows may suffer from high inter-seedling competition
	Seed to soil contact is high, maximizing germination	Leaves rows, which often persist for many years, which may be visually unacceptable.
Broadcast seeding	Can be used on slopes that are steep, rocky, remote or inaccessible	Germination and establishment tends to be lower
	The variable planting depths that result from broadcast seeding allows better establishment of small seeds lower seed to soil contact without some kind of packing or dragging	Requires double or triple the seeding rate of drill seeding and seeding rate calibration is less precise.
	Vegetation not in rows	
Hydroseeding	Can be used on slopes that are steep, rocky, remote or inaccessible	Results less satisfactory due to poor seed/soil contact; fewer seeds germinate
	Vegetation not in rows	Dependent on local water supply

U.S. Fish and Wildlife Service, 2004

Management

Managing the site will start the moment after the last plant is planted. Management of the site may consist of weed control, irrigation repair (if needed), plant replacement, and animal control. This will become a huge part of the site reaching the goals that were set during the planning stage.

Young plants may need a lot of support and is very critical during the first years of establishment. Young trees and shrubs are very susceptible to drought and competition from weeds and invasive plants. Annually inspection for three years following planting is recommended. This is to identify any problems that will occur and implement any repairs that are necessary (U.S. Fish and Wildlife Service 2004).

Weed control will be a big factor in insuring that young plants get established. There are many different ways you can control weeds including chemicals, mowing and mulching. The use of herbicides is effective in killing of any weeds that might enter the site but make sure that the herbicide used will not affect any of the newly planted stock.

Mowing or weed whacking will also knock down any weeds but this will be only temporarily and weeds then will return. Mowing twice a year is recommended for the first two growing seasons, once in the spring and once during the summer (U.S. Fish and Wildlife Service 2004). Mulching is another way to control weeds. The mulch will block any light from entering the soil and in turn will inhibit the germination of any unwanted seeds.

Another management practice is animal protection. Many different types of animals may occur at the site and browse on the plants. Fencing might be a part of the management practices to kept animals such as livestock, elk, deer and other animals out of the site. Since deer and elk can jump over normal livestock fencing, fencing 6-8 feet tall should be installed for non-livestock animal prevention. Foliar repellants, bud caps, mesh tubing and stem screens may also be used to protect the plants (U.S. Fish and Wildlife Service 2004). Rodents are also a problem and aluminum foil, arbor guards, and plastic tubing can be added to control these pests (U.S. Fish and Wildlife Service 2004).

If irrigation is installed on your site, management of the system will be necessary. Drought might be a problem during summer months and watering the new stocks for at least the first growing season is recommended (U.S. Fish and Wildlife Service 2004). Watering every 10-14 days is a common practice, reducing the amount as summer progresses (Bennett and Ahrens 2007). Watering the stocks will encourage root growth, which will allow roots to migrate to water tables in the area. For container or bare-root stocks, 1-2 gallons of water each during watering is a good practice (Bennett and Ahrens 2007) .

Monitoring

Once your site has been planted and every aspect of the design is implemented, it is now time to monitor the site and make sure you do everything to reach the goals and objectives set during the planning stage. Monitoring will consist of recording plant grow, plant mortality rates and which plants have died, weed control methods (which ones are working and which ones are not), comparison to reference site for any immediate needs,

and documenting the project for funding purposes. Objectives of monitoring should be clearly specified and consistent with project goals (U.S. Fish and Wildlife Service 2004). Determining the success of a project may require monitoring for three or more years. A realistic goals for monitoring a site is more like 3-5 years (U.S. Fish and Wildlife Service 2004).

Monitoring of plant growth and mortality is an essential part of the monitoring processes. Within the goals and objectives of the project, plant growth and density should have estimated numbers. Plants should be monitored annually and especially during the growing seasons. For arid regions, a more frequent monitoring process should be done in early spring and late summer. The planting plan can help keeping track of what plants didn't make it and which ones did. Monitoring any animal activities should be documented as well. Photos of plants are a great way to document any data that is collected and a way to document the success or failures of the project.

Weed control should also be monitored. Data should be recorded specifying the location of weed control, method of weed control and successes of each spot. This will help to better understand which methods (if multiple were used) worked and help with future weed control. You also want to monitor if plants in areas where weed control methods were used are showing any symptoms of die back or lack of growth.

DESIGN PROCESS – NATIVE RIPARIAN ZONE

The Cottonwood section of the Arboretum is in need of a new design scheme and new plantings. The existing plants are sparse and the section is open to invasion from non-native grasses and invasive weeds. For this section, my plan was to restore a native riparian system, with the additions of educational signage and pathways on the upper terrace to comply with the mission of the Arboretum. This will allow visitors and students to walk through the riparian section and educate themselves about the native ecosystem of Putah Creek.

This section had a long and difficult layout process before the final design was set. I had to first go the site, with the planting records from the arboretum and do an analysis of the site. The problem arose with the planting plan that the Arboretum had provided me, since the plan was not to any specific scale. This plan made evaluation of the existing vegetation more difficult, and caused a major problem during the layout of the base plan. After the analysis was done, I had to try to match the planting plan to an aerial of the site. Due to the lack of a scale on the plan and not being able to know where the trunks of the trees exactly were on the aerial map, made it tough to produce an exact layout of the existing site.

Once the base plan was completed, I started with the layout of the new pathway system on the upper terrace of the site. The Californio Garden is the boundary of the eastern side of the Cottonwood Section. Within the Californio Garden is a path system that has one path leading to nowhere, which faces the Cottonwood Section. I looked at this path as a starting point for the new Cottonwood pathway. The new path will also connect to the main asphalt pathway. Since the site sits on a pretty steep bank stairs will have to be added to allow visitors to reach the upper terrace. The first entrance will start from the Californio Pathway and would lead to a set a stairs set in between two mature valley oaks. As for the entrance for the western side of the site, I looked for a spot that already had somewhat of a slope leading to the section below, and I also searched for a spot that would not keep visitors on the upper terrace too long after the section ended.

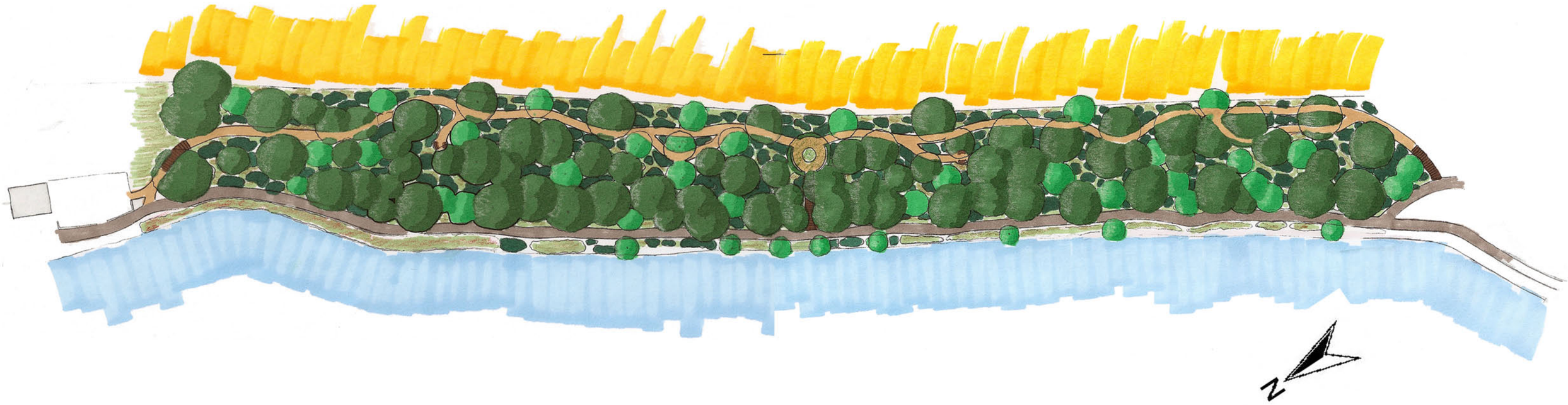
This pathway would also have a staircase leading down from the upper terrace. I also added a stairway in the middle of the section to give the visitor another option to enter or leave the upper terrace. This stairway would lead to a circular seating area that would have a circular planting area in the middle with a valley oak planted within it. The seating for this area will be a seating wall that would outline the circular layout and stop at the three paths connection at this main gathering point. As for the rest of the pathways throughout the upper terrace, it is mostly a meandering pathway system that will allow for pockets of vegetation to be planted on both sides of the pathway and at the same time hide the fence that leads to the open fields to the south. There are two paths that separate from the main pathway and lead to secluded areas. These secluded areas will have benches within them and will act as a prospect refuge. If the canopies of the new planting on the slope allow, these areas will give a great view of the waterway and other parts of the arboretum. Along the proposed pathways, educational signage would be installed giving visitors of this section information on the new vegetation. These sign would display to visitors the history of the creek, benefits of a riparian ecosystem, and existing and historical distribution of riparian areas in California.

The planting for this section had to been designed to resemble a native riparian forest. To create a resemblance, I had to research the stand structure of a native central valley riparian forest. I found a great reference in a symposium sponsored by the Institute of Ecology at the University of California, Davis and the Davis Audubon Society. This symposium, called *Riparian Forest in California: Their Ecology and Conservation*, has information on the stand structure which plants are native to which riparian area throughout California, and plants location within the forest. With this information, I was now able to prepare a plan that would have the correct native plants in their correct location. Usually for a restoration site the planting are usually placed in rows and are spaced part just enough for machinery like mowers to pass through and make management of the site easier. Since this site is upon a steep bank, machinery would not be able to run through the site. This allowed me to space the plants at a distance in which I thought would work. From the information I gathered from the symposium, the lower

section of the bank has a higher density of trees and shrubs and the upper terrace is more open. I also added some plants that are usually from closer to the stream a little higher on the slope to give the upper terrace a higher aesthetic value.

With the addition of new planting and a new pathway system, this degraded section of the arboretum will become a location where people can learn about a native ecosystem that used to run along Putah Creek. This design fits in perfectly with the goals of the Arboretum of creating "an outdoor classroom and laboratory, supporting research and teaching" and creating "a living museum that connects people with the beauty and value of plants" (Arboretum 2006).

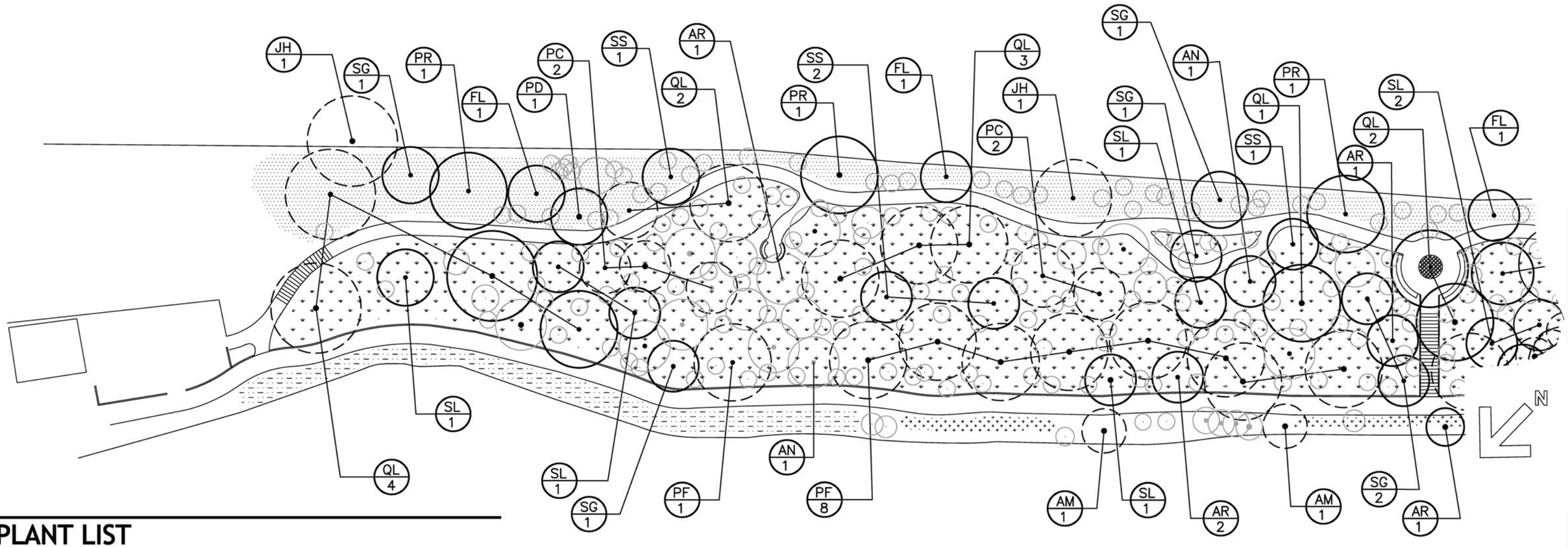
CONCEPT PLAN



COTTONWOOD SECTION

NTS

RESTORATION AND BEAUTIFICATION
OF THE UC DAVIS ARBORETUM



SCALE:1"= 20'–0"

PLANT LIST

SYMBOL	BOTANICAL NAME	COMMON NAME	QTY
TREES			
PF	POPULUS FREMOMTII	FREMONT COTTONWOOD	19
QL	QUERCUS LOBATA	VALLEY OAK	23
PR	PLATANUS RACEMOSA	CALIFORNIA SYCAMORE	6
JH	JUGLANS HINDSII	CALIFORNIA BLACK WALNUT	5
SL	SALIX LAEVIGATA	RED WILLOW	11
SS	SALIX LASIANDRA	PACIFIC WILLOW	10
SG	SALIX GOODINGII	SAN JOAQUIN WILLOW	9
AM	ACER MACROPHYLLUM	BIG LEAF MAPLE	3
PC	PINUS CANARIENSIS	CANARY ISLAND PINE	7

TREES

PP	PINUS PINEA	STONE PINE	3
PD	PRUNUS DULCIS	SWEEY ALMOND	1
AR	ALNUS RHOMBIFOLIA	WHITE ALDER	8
AN	ACER NEGUNDO	BOXELDER	6
FL	FRAXINUS LATIFOLIA	OREGON ASH	6

GROUND COVERS / GRASSES

	JUNCUS EFFUSUS	COMMON RUSH	flats
	MUHLENBERGIA RIGENS	DEER GRASS	N/A
	MATIX OF AVENA BARBATA AND AVENA FATUA	SLENDER OAT AND WILD OAT	flats
	NASSELLA PULCHRA	PURPLE NEEDLE GRASS	flats

TREE SYMBOLS

SYMBOL	DESCRIPTION
	PROPOSED PLANTINGS
	EXISTING PLANTINGS

PROJECT:
ARBORETUM BEAUTIFICATION AND RESTORATION

CLIENT: UC DAVIS ARBORETUM

DESIGNERS:
EDG
Eden Design Group

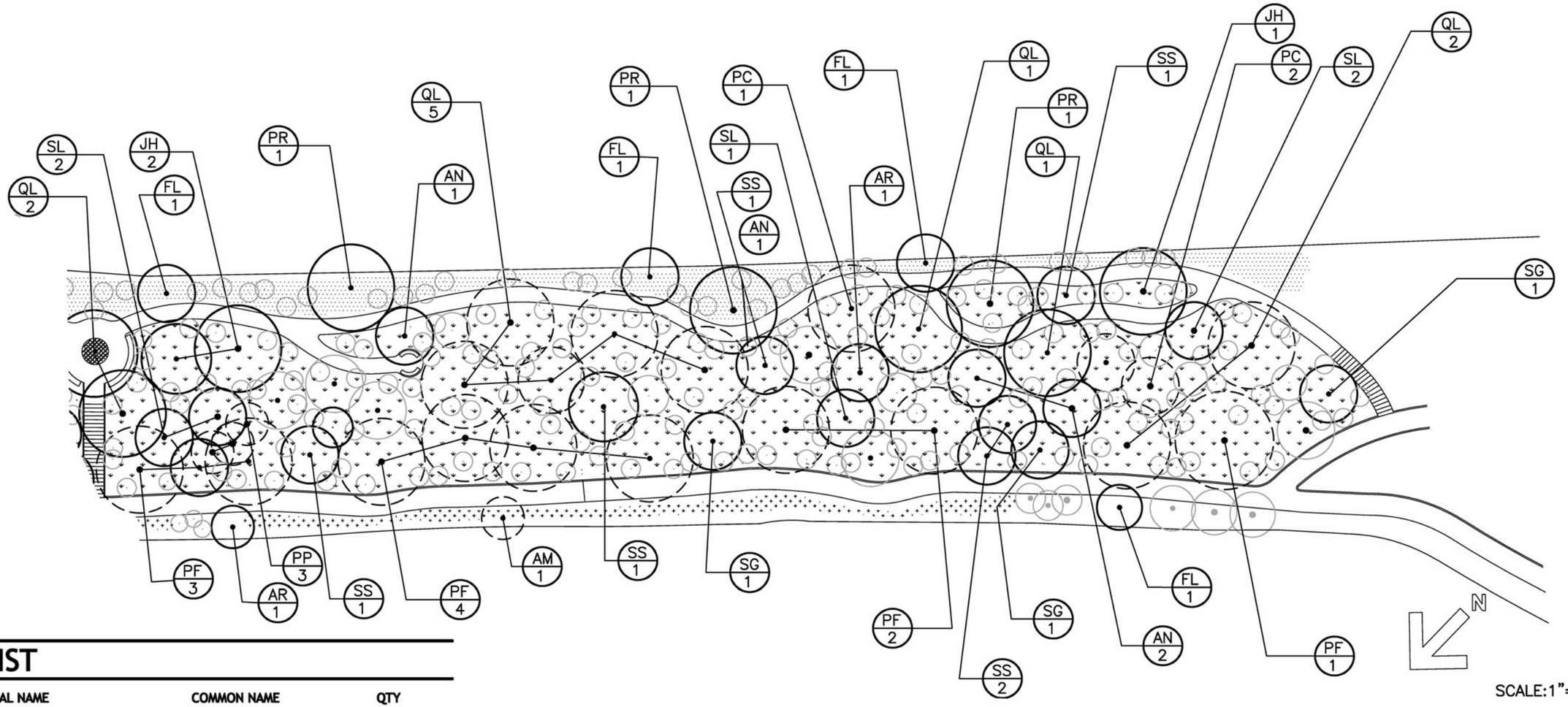
CONSULTANTS:

LICENSED LANDSCAPE ARCHITECT (Name & License No.) Signature Renewal Date Date STATE OF CALIFORNIA

47

PLANTING PLAN COTTONWOOD TREE/GRASSES

DRAWN BY: W.D. CHECKED BY: W.D.
DATE: 5/28/08
REVISIONS:
SHEET #: L4
4 OF 5



PLANT LIST

SYMBOL	BOTANICAL NAME	COMMON NAME	QTY
TREES			
PF	POPULUS FREMONTII	FREMONT COTTONWOOD	19
QL	QUERCUS LOBATA	VALLEY OAK	23
PR	PLATANUS RACEMOSA	CALIFORNIA SYCAMORE	6
JH	JUGLANS HINDSII	CALIFORNIA BLACK WALNUT	5
SL	SALIX LAEVIGATA	RED WILLOW	11
SS	SALIX LASIANDRA	PACIFIC WILLOW	10
SG	SALIX GOODINGII	SAN JOAQUIN WILLOW	9
AM	ACER MACROPHYLLUM	BIG LEAF MAPLE	3
PC	PINUS CANARIENSIS	CANARY ISLAND PINE	7

TREES			
PP	PINUS PINEA	STONE PINE	3
PD	PRUNUS DULCIS	SWEEY ALMOND	1
AR	ALNUS RHOMBIFOLIA	WHITE ALDER	8
AN	ACER NEGUNDO	BOXELDER	6
FL	FRAXINUS LATIFOLIA	OREGON ASH	6
GROUND COVERS / GRASSES			
	JUNCUS EFFUSUS	COMMON RUSH	flats
	MUHLENBERGIA RIGENS	DEER GRASS	N/A
	MATIX OF AVENA BARBATA AND AVENA FATUA	SLENDER OAT AND WILD OAT	flats
	NASSELLA PULCHRA	PURPLE NEEDLE GRASS	flats

TREE SYMBOLS

SYMBOL	DESCRIPTION
	PROPOSED PLANTINGS
	EXISTING PLANTINGS

PROJECT:
ARBORETUM BEAUTIFICATION AND RESTORATION

CLIENT:
UC DAVIS ARBORETUM

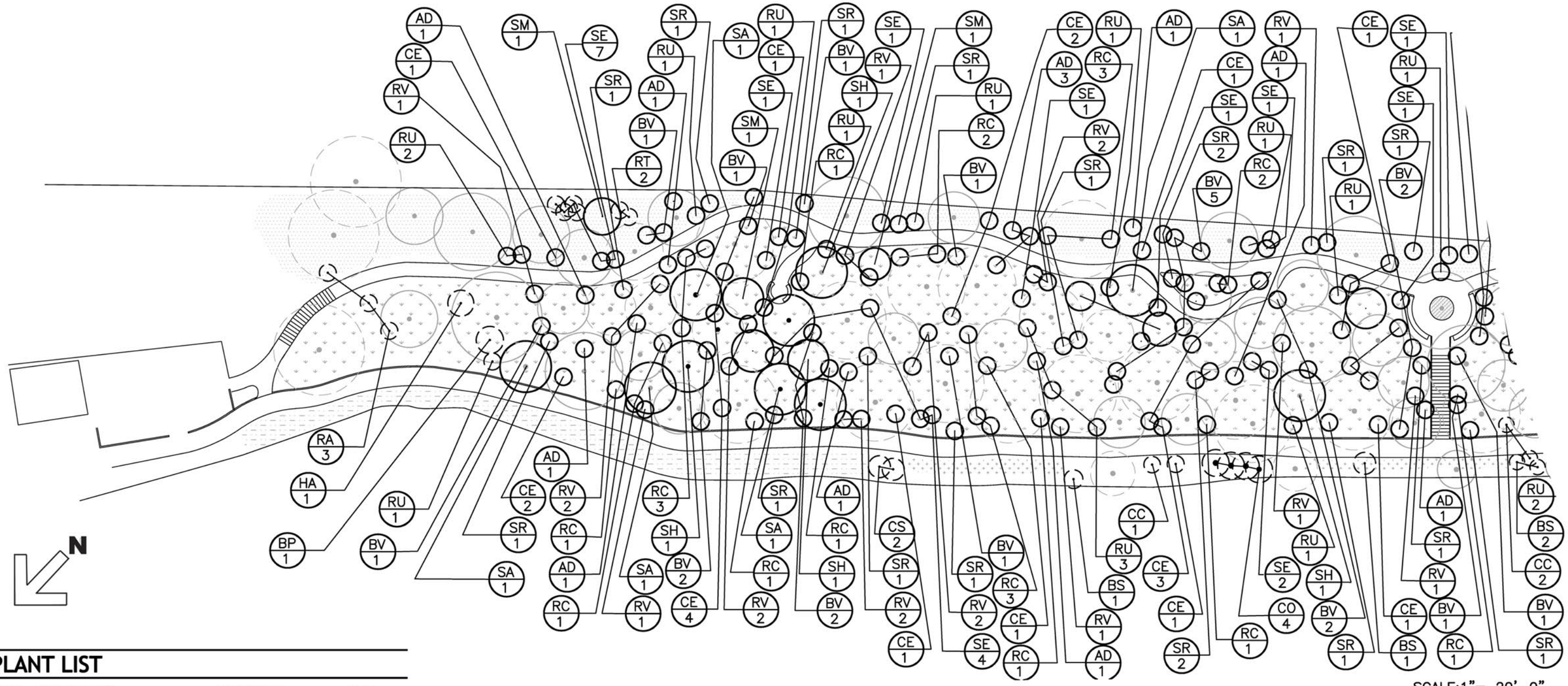
DESIGNERS:
EDG
Eden Design Group

CONSULTANTS:

LICENSED LANDSCAPE ARCHITECT (Name & License No.) Signature Renewal Date Date STATE OF CALIFORNIA

PLANTING PLAN COTTONWOOD TREE/GRASSES

DRAWN BY: W.D. CHECKED BY: W.D.
DATE: 5/28/08
REVISIONS:
SHEET #: L5
5 OF 5



SCALE:1"= 20'–0"

PLANT LIST

SHRUBS/ PERENNIALS

SYMBOL	BOTANICAL NAME	COMMON NAME	QTY
AD	ARTEMISIA DOUGLASIANA	MUGWORT	38
BV	BACCHARIS SALICIFOLIA	MULE FAT	52
CE	CEPHALANTHUS OCCIDENTALIS	BUTTON–WILLOW	52
RC	ROSA CALIFORNICA	WILD ROSE	46
RU	RUBUS URSINUS	WILD BLACKBERRY	32
RV	RUBUS VITIFOLIUS	PACIFIC DEWBERRY	39
SM	SALIX MELANOPSIS	DUSKY WILLOW	10
SE	SAMBUCUS MEXICANA	ELDERBERRY	45
SR	SYMPHORICARPOS RIVULARIS	SNOWBERRY	35
CC	CALYCANTHUS OCCIDENTALIS	SPICE BUSH	3

SHRUBS/ PERENNIALS

CS	SYMPHORICARPOS RIVULARIS	SNOWBERRY	35
RL	CORNUS SERICEA	REDOSIER DOGWOOD	2
SA	SALIX LASIOLEPIS	ARROYO WILLOW	9
SH	SALIX HINDSIANA	SANDBAR WILLOW	7
CO	CERCIS OCCIDENTALIS	WESTERN REDBUD	6
RA	RHAMNUS CALIFORNICA	COFFEEY BERRY	3
HA	HETEROMELES ARBUTIFOLIA	TOYON	1
BP	BACCHARIS PILULARIS	COYOTEBRUSH	1
RT	RHAMNUS TOMENTELLA SSP CRASSIFOLIA	VELVET LEAF COFFEEYBERRY	2

TREE SYMBOLS

SYMBOL	DESCRIPTION
	PROPOSED PLANTINGS
	EXISTING PLANTINGS

PROJECT:
ARBORETUM BEAUTIFICATION AND RESTORATION

CLIENT: UC DAVIS ARBORETUM

DESIGNERS:
EDG
Eden Design Group

CONSULTANTS:

LICENSED LANDSCAPE ARCHITECT (Name & License No.) Signature Renewal Date Date STATE OF CALIFORNIA

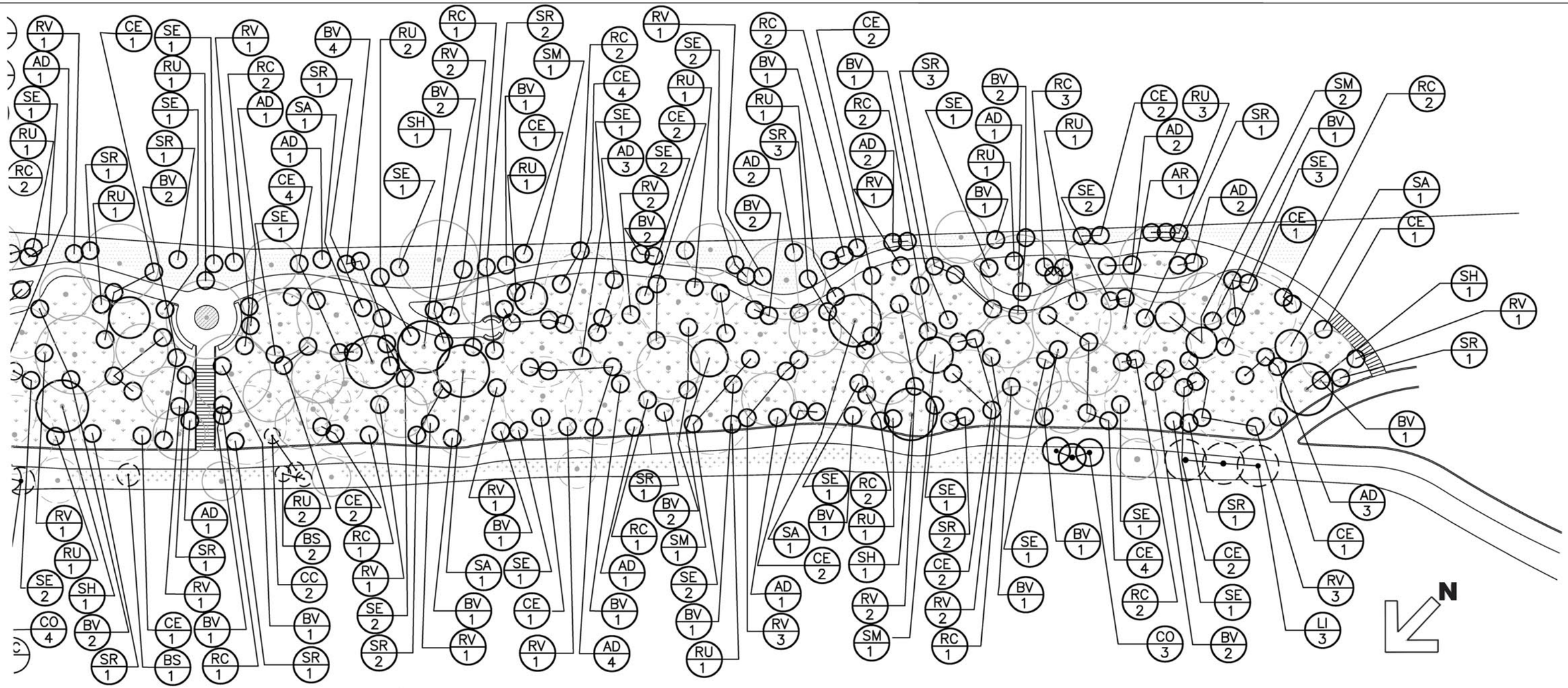
PLANTING PLAN COTTONWOOD SMALL TREE/SHRUB

DRAWN BY: W.D. CHECKED BY: W.D.

DATE: 5/28/08

REVISIONS:

SHEET #: L2 2 OF 5



SCALE:1"= 20'–0"

PLANT LIST

SYMBOL	BOTANICAL NAME	COMMON NAME	QTY
SHRUBS/ PERENNIALS			
AD	ARTEMISIA DOUGLASIANA	MUGWORT	38
BV	BACCHARIS SALICIFOLIA	MULE FAT	52
CE	CEPHALANTHUS OCCIDENTALIS	BUTTON–WILLOW	52
RC	ROSA CALIFORNICA	WILD ROSE	46
RU	RUBUS URSINUS	WILD BLACKBERRY	32
RV	RUBUS VITIFOLIUS	PACIFIC DEWBERRY	39
SM	SALIX MELANOPSIS	DUSKY WILLOW	10
SE	SAMBUCUS MEXICANA	ELDERBERRY	45
SR	SYMPHORICARPOS RIVULARIS	SNOWBERRY	35
CC	CALYCANTHUS OCCIDENTALIS	SPICE BUSH	3

SHRUBS/ PERENNIALS			
CS	SYMPHORICARPOS RIVULARIS	SNOWBERRY	35
RL	CORNUS SERICEA	REDOSIER DOGWOOD	2
SA	SALIX LASIOLEPIS	ARROYO WILLOW	9
SH	SALIX HINDSIANA	SANDBAR WILLOW	7
CO	CERCIS OCCIDENTALIS	WESTERN REDBUD	6
RA	RHAMNUS CALIFORNICA	COFFEEY BERRY	3
HA	HETEROMELES ARBUTIFOLIA	TOYON	1
BP	BACCHARIS PILULARIS	COYOTEBRUSH	1
RT	RHAMNUS TOMENTELLA SSP CRASSIFOLIA	VELVET LEAF COFFEEYBERRY	2

TREE SYMBOLS

SYMBOL	DESCRIPTION
	PROPOSED PLANTINGS
	EXISTING PLANTINGS

PROJECT:
ARBORETUM BEAUTIFICATION AND RESTORATION

CLIENT:
UC DAVIS ARBORETUM

DESIGNERS:
EDG
Eden Design Group

CONSULTANTS:

LICENSED LANDSCAPE ARCHITECT (Name & License No.) Signature Renewal Date Date STATE OF CALIFORNIA

PLANTING PLAN COTTONWOOD SMALL TREE/SHRUB

DRAWN BY: W.D. CHECKED BY: W.D.

DATE: 5/28/08

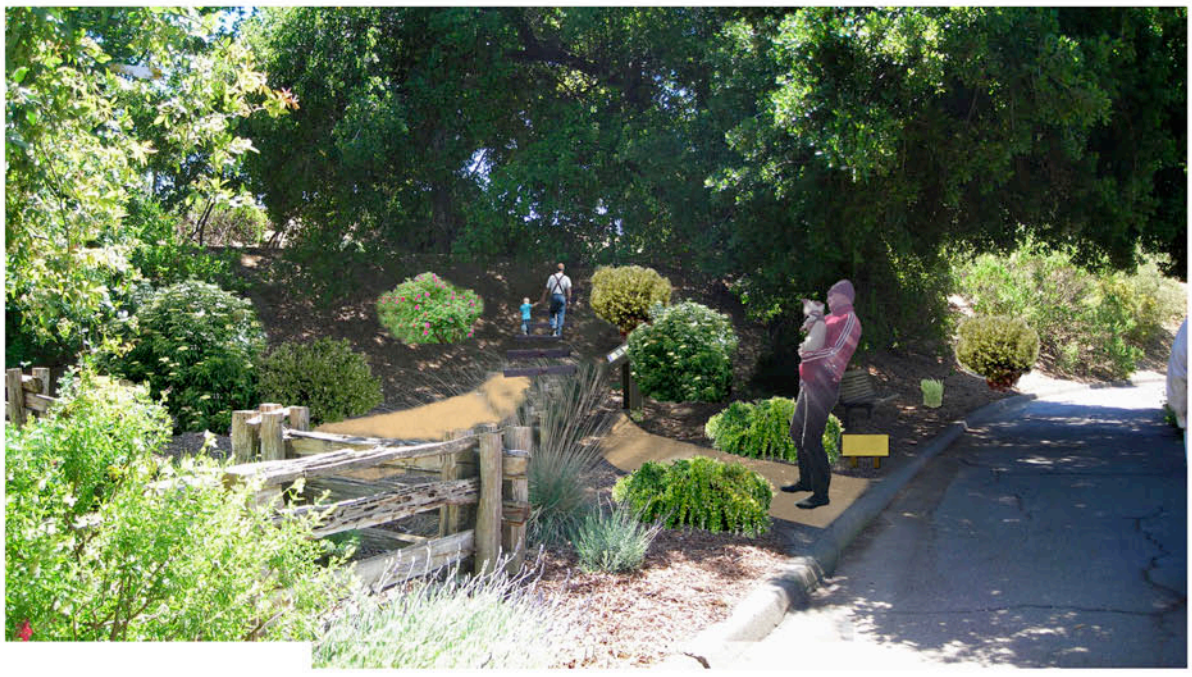
REVISIONS:

SHEET #: L3 3 OF 5

EAST ENTRANCE

BEFORE

AFTER



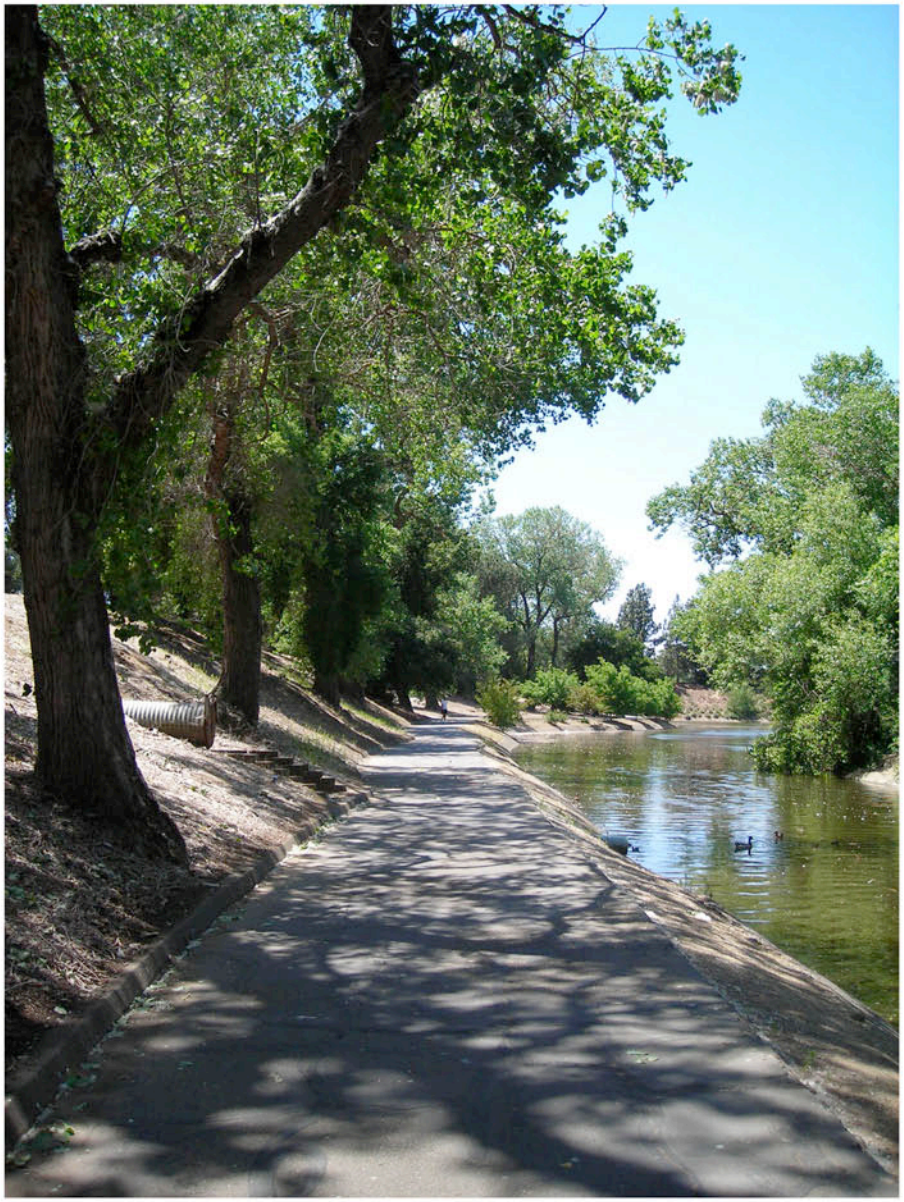
UPPER TERRACE

BEFORE

AFTER

STREAM BANK

BEFORE



AFTER

DESIGN PROCESS – ERICACEAE SECTION

The Ericaceae section is an area where not a lot of design was necessary. Most of the work in this area is going to be the addition of native grasses and plants to improve soil structure and to control soil erosion; although, the area in the far southeast corner of the site has little vegetation and is eligible for a creative design. After talking with Emily Griswold, horticulturalist for the Arboretum, a design for a stage area was thought of. This stage area will provide the Arboretum with a much needed venue for entertainment.

To start the design, I had to find the perfect location for a stage. If you look at the site, as you move from east to west, the width of site gets smaller and more vegetation exist. With these aspects in mind, I decided that the best location for the stage would be in the southeast corner, placed into the existing sloping bank. This was the best spot since it provides the largest space for the addition of the stage. Any other location would not allow enough room for seating or parts of the stage would be blocked to oncoming pedestrians. Since the stage will be cutting into the existing slope of the site, the back of the stage will have to act as a retaining wall.

The next factor in the design was the shape of the stage itself. Due to the location of the stage and the decreasing width of the site, the design of the stage could not be the typical half-circular pattern. The stage had to be designed in such a way that people looking from any angle would be able to see any performance on the stage and the typical circular stage might block some angles and just did not fit. Subsequently, to create a more viewable stage, I designed a stage that had more of a geometric look to it. This shape would also allow me to design pathways that would more suitably fit the site. I also added a shade element that would provide shade to anyone performing on the stage. The structure would be broken into wooden beams that would come out of the top of the back of the stage and make a 25 to 30° angle. The beams will be spaced evenly and small strips will run across all of them, creating sort of a spider web look. This will allow for vines to be hung from the structure giving it a “green” look.

At this moment, with the stage in place the rest of the site could now be designed. I

wanted to keep the site simple but have an aesthetic value to it. I started by adding three cypress trees to the left and right of the stage to frame the stage within the site. From there I started to layout the path system and planting beds throughout the site. I had to leave some space between the stage and any planting beds for a place for seating during performances. I first designed the new boundary of the proposed stage area. Since there was not a lot of existing vegetation in this section, the existing mature valley oak tree to the west, existing asphalt path to the north and northeast and sloping bank along the southern side will now act as the boundary to this area. There was not much room between the edge of the seating area and existing plantings so I started by adding plantings along the edge of the existing asphalt pathway. This was done to create somewhat of a wall, giving the new staging area a separate feeling from the rest of the existing area. These beds will be planted with manzanitas, native grasses, and a couple of trees from the Ericaceae family. This planting wall was split into two sections, each being outlined with pathways that will act as the three ways to enter the stage area. I also added two more planting beds that will cover most of the open space along the west end. These planting beds will have a circular area between them, with benches and a small water fountain. The bed nearest to the stage will only have small native shrubs and grasses that will be picked from a list of California natives and Arboretum All-Stars, which is a collection of plants that do extremely well at the Arboretum. Smaller plantings will allow any users seated within the middle of the beds to see the stage without having any plantings blocking their view. The other bed will have the same planting pallet but the shrubs will range in size and a tree from the Ericaceae family will be added. These planting beds and fountain should add to the aesthetics of the area giving a peaceful background sound to whatever and whoever is performing on stage.

For the rest of the Ericaceae section, grasses native to California and plants of the Ericaceae family will be added to improve soil structure and improve aesthetics. Rushes will be added along the bank of the creek since the Arboretum staff has used rushes along the banks of the creek in other parts of the arboretum, it has seems to increase bank stability.

The addition of a stage area, fountain, and new plantings should increase the overall aesthetic value of the Ericaceae section and hopefully increases the number of visitors to this unused area.

CONCEPT PLAN

ERICACEAE SECTION

NTS

RESTORATION AND BEAUTIFICATION
OF THE UC DAVIS ARBORETUM

SCALE:1"= 10'–0"

PLANT LIST

SYMBOL	BOTANICAL NAME	COMMON NAME	QTY
TREES			
AC	ALNUS CORDATA	ITALIAN ALDER	1
CO	CERCIS OCCIDENTALIS	WESTERN REDBUD	6
AM	ARBUTUS MENZIESII	PACIFIC MADRONE	4
FD	FRAXINUS DIPETALA	CALIFORNIA ASH	1
BP	BETULA PENDULA 'LACINIATA'	CUTLEAF WEEPING BIRCH	2
SG	SEQUOIADENDRON GIGANTEUM	GIANT SEQUOIA	2
AA	ARBUTUS ANDRACHNE	GREEK STRAWBERRY TREE	4
AU	ARBUTUS UNEDO	STRAWBERRY TREE	1
CG	CUPRESSUS GUADALUPENSIS 'GREENLEE'S BLUE ROCKET'	GREENLEE'S BLUE ROCKET CYPRESS	6
QL	QUERCUS LOBATA	VALLEY OAK	2
FL	FRAXINUS LATIFOLIA	OREGON ASH	1
CB	CERCOCARPUS BETULOIDES VAR. BLANCHEAE	ISLAND MOUNTAIN MAHOGANY	2
SHRUBS/ PERENNIALS			
AH	ARCTOSTAPHYLOS HOOKERI	MONTEREY PINE MANZANITA	4
ADH	ARCTOSTAPHYLOS DENSIFLORA 'HOWARD McMINN'	HOWARD McMINN MANZANITA	4
AH	ARCTOSTAPHYLOS HOOKERI	MONTEREY PINE MANZANITA	4
ADJ	ARCTOSTAPHYLOS DENSIFLORA 'JAMES WEST'	JAMES WEST MANZANITA	2
ALP	ARCTOSTAPHYLOS 'LUTSKOS PINK'	LUTSKO'S PINK MANZANITA	4
ASL	ARCTOSTAPHYLOS STANFORDIANA 'LOUIS EDMUNDS'	LOUIS EDMUNDS MANZANITA	2
AP	ARCTOSTAPHYLOS PAJAROENSIS 'WARREN ROBERTS'	WARREN ROBERTS MANZANITA	5
AR	ARCTOSTAPHYLOS RUDIS	SHAGBARK MANZANITA	5
AMA	ARCTOSTAPHYLOS MANZANITA	MANZANITA TREE	7
AV	ARCTOSTAPHYLOS VISCIDA ssp. MARIPOSA	MARIPOSA MANZANITA	5
ASL	ARCTOSTAPHYLOS STANFORDIANA 'LOUIS EDMUNDS'	LOUIS EDMUNDS MANZANITA	2
CRH	CEANOTHUS 'RAY HARTMAN'	RAY HARTMAN CALIFORNIA LILAC	6
CM	CEANOTHUS MARITIUMS	MARITIME CEANOTHUS	6
AS	ARTEMISIA SP.	WORMWOOD	3
EC	EPILOBIUM CANUM 'EL TIGRE'	CALIFORNIA FUCHSIA	7
PH	PENSTEMON HETEROPHYLLUS 'MARGARITA B.O.P.'	SANTA MARGARITA FOOTHILL PENSTEMON	7
RV	RIBES VIBURNIFOLIUM	EVERGREEN CURRENT	1
RA	RIBES AUREUM	GOLDEN CURRENT	2
RC	ROSA CALIFORNICA	CALIFORNIA WILD ROSE	2
SA	SALVIA APIANA	CALIFORNIA WHITE SAGE	3
SJ	SALVIA X JAMENSIS	AUTUMN SAGE	2
SS	SALVIA SPATHACEA	HUMMINGBIRD SAGE	2
HM	HEUCHERA MAXIMA	ISLAND ALUMROOT	3

TREE/SHRUB SYMBOLS

SYMBOL	DESCRIPTION
	PROPOSED PLANTINGS
	EXISTING PLANTINGS

GROUND COVERS / GRASSES

JE	JUNCUS EFFUSUS	COMMON RUSH	flats
BG	BOUTELOUA GRACILIS	BLUE GRAMA GRASS	flats
EC	ESCHSCHOLZIA CALIFORNICA	CALIFORNIA POPPY	flats
NP	NASSELLA PULCHRA	PURPLE NEEDLE GRASS	flats
FC	FESTUCA CALIFORNICA	CALIFORNIA FUSCUE	flats
APM	ARCTOSTAPHYLOS 'PACIFIC MIST'	PACIFIC MIST MANZANITA	2
MR	MUHLENBERGIA	DEER GRASS	27

PROJECT:
ARBORETUM BEAUTIFICATION AND RESTORATION

CLIENT:
UC DAVIS ARBORETUM

DESIGNERS:
EDG
Eden Design Group

CONSULTANTS:

LICENSED LANDSCAPE ARCHITECT (Name & License No.) Signature Renewal Date Date STATE OF CALIFORNIA

PLANTING PLAN
ERICACEAE

DRAWN BY: W.D. CHECKED BY: W.D.
DATE: 5/28/08
REVISIONS:
SHEET #: L1
1 OF 5

STAGE AREA

BEFORE

AFTER

STREAM BANK

BEFORE

AFTER

CONCLUSION

The University of California, Davis's Arboretum is a beautiful place to visit and has become one of the largest and unique plant collections in the interior United States. Even with the majority of the Arboretum's acquired land being developed, there are still sections that have been decreasing in aesthetic and environmental valve throughout the years. These sections in their own ways take way from the overall beauty of the whole Arboretum.

Two sections that stood out the most were the Ericaceae and Cottonwood sections. In the past years, invasive grasses and weeds have taken over the floor of the Cottonwood sections. Management practices have eliminated a majority of the invasive species but have left the soils in this section bare. This has in turn has diminished the aesthetic and environmental values of the site. The Ericaceae section is also suffering from bare soils and a decrease in aesthetic and environmental value.

My goals were to increase the aesthetic and environmental values of both sites by adding native plants and grasses that would increase the overall beauty of each site and also improve any and all native ecosystem functions. For the Cottonwood section, restoring the native Putah Creek riparian ecosystem would increase aesthetic and environmental values but also educate visitors of the Arboretum about its native ecosystem. The addition of native grasses to the Ericaceae section would increase the environmental value of the site, furthermore the addition of a stage area and color native plants to a mostly undeveloped section would help improve the aesthetic value. With help from the staff at the UC Davis Arboretum, faculty members in both the Landscape Design and Ecology departments, and resources that I gathered from a plethora of sources, I was able to get the information needed to produce plans that will reach my goals.

With the addition of the new native riparian section and the improvements and stage area addition to the Ericaceae section, these two sections are now at the level of the rest of the Arboretum. The Arboretum is already a special place to visit and is know by many

national institutions but hopefully with the improvements of the Ericaceae and cottonwoods sections, it will take the next steps in becoming a place where people all around the world will want to experience.

BIBLIOGRAPHY

1. 1980. Riparian Forest in California: Their Ecology and Conservation 122. Davis: University of California Davis.

2. Anderson, S. & R. Masters. 2007. Riparian Forest Buffers. In *Water Quality*, 7. Oklahoma: Oklahoma State University.

3. University of California, Davis. 2006. UC Davis Arboretum. Davis. http://arboretum.ucdavis.edu/

4. Tennessee Valley Authority. 2006. Benefits of Riparian Zones. Knoxville: Tennessee Valley Authority. http://www.tva.gov/river/landandshore/stabilization/benefits.htm

5. Bennett, M. & G. Ahrens. 2007. A Guide to Riparian Tree Planting in Southwest Oregon 32. Oregon State University

6. Boucher, V. 2005. Human History- The Patwin. In *Quail Ridge Reserve*. Davis: University of California, Davis. http://nrs.ucdavis.edu/quail/Natural/Human_Patwin.htm

7. Putah Creek Council. 2005. Putah Creek Overview. Winters: Putah Creek Council. http://www.putahcreekcouncil.org/nodes/aboutus/index.htm

8. Goard, D. 2007. Riparian Forest Buffers: Benefits of Ttrees Along Streams and Rivers in Kansas. 4. Manhattan, KS: Kansas State University.

9. Keefe, B. 2002. The Riparian Forest: A commitment to Stewardship. 3. Alabama: Alabama Forestry Commission

10. Klapproth, J. 2001. Understanding the Science Behind Riparian Forest Buffers: Benefits to Communities and Landowners. Virginia: Virginia State University. http://www.ext.vt.edu/pubs/forestry/420-153/420-153.html#L1

11. Llewellyn, J. 2006. The Importance of Riparian Forests. Pocono Lake: Tobyhanna Creek/Tunkhannock Creek Watershed Association. http://www.tctcwa.org/html/body_riparian_forests.html

12. MacArthur, M. J. 2000. *A History of the Unversity Aroboretum at the University of California Davis*. Davis.

13. Moyle, P. 1999. Putah Creek: Four Versions at UCD. Davis: University of California. http://bioregion.ucdavis.edu/where/putahft.html

14. United States Fish and Wildlife Service. 2004. Riparian Restoration and Management In *Stream Habitat Restoration Guidelines*, 61. Washington U.S. Fish and Wildlife Service.

15. Matteson, G. A. 1997. A History of the Site of the Davis Arboretum. 118. Davis: University of California, Davis.