Arcade Creek Watershed Plan

Prepared for:

Department of Parks and Recreation

City of Sacramento

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2.0 EXECUTIVE SUMMARY

The focus of the Arcade Creek Watershed Plan (the Plan) is to support enhancement in four major areas: flood control, habitat, recreation and water quality. These target goals were identified by the Arcade Creek Watershed Group in August, 2002 as being the most significant within the watershed and providing the greatest opportunity for overall enhancement of watershed value.

The Plan provides background on the resources and management challenges of the Arcade Creek watershed located in Sacramento and Placer Counties, California. This small, urbanized watershed contains one of the most heavily impacted stream systems in the region. This degraded ecosystem has severe water quality problems, is subject to moderate flood damage, and has significantly compromised habitat conditions. At the same time, the juxtaposition of the creek corridors next to extensive residential development provides important opportunities for passive recreation and local stewardship. The urbanized nature of the landscape causes high loadings of toxicants and the hot, dry summer climate create high ambient temperatures in the creek and its tributaries. Related problems include high peak flows that damage property and habitat, excessive erosion, loss of riparian habitat, low dissolved oxygen levels, low flows, and the negative impacts of invasive fish and plant species. These and other problems have virtually eliminated salmonids in the Arcade Creek watershed. Nevertheless, the watershed still provides meaningful opportunities for habitat preservation and enhancement, flood management, and recreational uses.

Protection and enhancement of this ecosystem will require the concerted efforts of many individuals, organizations, government agencies, and land managers. Although the challenges are large, the Arcade Creek watershed has tremendous potential for enhancement.

The approach selected for this watershed management plan is based on the premise that the most likely route to successfully enhancing the Arcade Creek watershed will be one that:

- Is based on an understanding of watershed processes, including hydrology, hydraulic connectivity, plant community ecology, stream channel morphology, and the importance of water quality to all aquatic life;
- Is consistent with local, state and federal regulations;
- Includes the concerns of all stakeholders in the planning and management process;
- Recognizes the potential for a healthy ecosystem to enhance the quality of life for the watershed residents;
- Provides significant opportunities for citizen involvement; and
- Utilizes adaptive management, through which information generated from ongoing monitoring provides the basis to modify restoration techniques, enhancement priorities and land use practices.

This watershed plan describes the status of the watershed and outlines the policy framework and planning process required to support enhancement of the four primary issue areas. The current assessment of watershed conditions is derived largely from the compilation of existing resource information and the professional expertise of the many representatives of local jurisdictions and agencies participating in the Arcade Creek Watershed Group. Detailed analysis of channel conditions has been conducted in only a small portion of the watershed. Expanding this analysis to other discrete segments of the creek system would help to identify additional specific restoration project opportunities.

Based on the analysis of existing conditions and issues within the watershed, the Plan recommends a number of remedial actions and enhancement tasks under each of the four goal areas: flood control, habitat preservation/restoration, recreation, and water quality. These recommendations provide specific actions that may be pursued to implement protection and restoration of the Arcade Creek watershed.

The recommended projects address a variety of priorities, including: a non-point source identification monitoring program, creation of additional detention capacity in the watershed, a recreational trail system integrated with on-street bikeways and access points, land use policies for the protection of property and habitat, monitoring and removal of invasive plant species, riparian enhancement, and environmental education.

3.0 INTRODUCTION

The purpose of the Arcade Creek Watershed Management Plan is to document present conditions in the watershed, to provide a coordinated approach to resource management, and to identify specific actions and policies to enhance and preserve the natural resources in the Arcade Creek Watershed. The plan is based on an adaptive management approach, with the expectation that data from future and ongoing monitoring activities will be used to revise and improve the resource management techniques and priorities articulated in this initial version of the Plan.

Development of the Arcade Creek Watershed Management Plan was coordinated by the City of Sacramento Department of Parks and Recreation with funding secured from the EPA. The Parks and Recreation Department manages Del Paso Regional Park and the Ueda Parkway, two significant recreation, habitat, and open space resources within the watershed. The City Utilities Department also has critical interests in the watershed include stormwater management, flood control, and water quality. As a major civic stakeholder in the watershed, the City of Sacramento facilitated development of this watershed plan to enable effective collaboration among all of the public and private stakeholders in the watershed for the implementation of beneficial projects and policies.

3.1 Watershed Area

The Arcade Creek watershed drains approximately 24,484 acres or 38 square miles. Most of the watershed is composed of commercial and residential neighborhoods, with the majority of the land use being residential. The watershed includes portions of the cities of Sacramento, Citrus Heights and Roseville, with the majority falling within Citrus Heights and unincorporated areas of Sacramento County. The main stem of Arcade Creek is about 16.2 miles long. Its major tributaries are Cripple Creek, Mariposa Creek, South Branch Arcade Creek, San Juan Creek, Brooktree Creek, Coyle Creek, Kohler Creek, and Verde Cruz Creek

This planning effort encompasses the entire watershed, from the headwaters of Arcade Creek to its confluence with Steelhead Creek (Natomas East Main Drainage Canal). The watershed includes all of the landscape that drains into Arcade Creek. Although the riparian zone and stream channel have a critical role to play in watershed functions, all land use activities within the watershed can and do affect the functioning of the stream system. Watershed functions, such as flood flow attenuation, directly affect beneficial uses in the watershed, such as mitigation of flood-related damages. This plan has been developed with the understanding that enhancement of watershed functions will enhance beneficial uses throughout the watershed.

Encroachments in the Arcade Creek system floodplain and channel are both transverse (i.e., bridges and culverts) and longitudinal (i.e., residential and commercial development). Riparian woodlands are generally narrow and frequently bisected into short segments. These encroachments constrain the lateral meanderings of the stream channel, reduce flood storage potential, and limit the extent of riparian habitat, including native trees and shrubs. Other adverse impacts include water quality degradation and proliferation of invasive non-native plant species. Urbanization of the watershed has also radically altered the hydrology of the system, increasing peak flows and scour and decreasing stream bank stability.

3.2 Watershed Planning Approach

The approach selected for this watershed management plan is based on the premise that the most likely route to successfully enhancing the Arcade Creek watershed will be one that:

- Is based on an understanding of watershed processes, including hydrology, hydraulic connectivity, plant community ecology, stream channel morphology, and the importance of water quality to all aquatic life;
- Is consistent with local, state and federal regulations;
- Includes the concerns of all stakeholders in the planning and management process; and
- Utilizes the method of adaptive management, in which new information is generated from monitoring, and modifications to restoration techniques and land use practices are based on this new information.

3.3 Stakeholders

The stakeholders in the watershed that have been identified to date are representatives of local government, state and federal agencies, non-profit and educational organizations, businesses, and private individuals. These stakeholders have had a key role in establishing the direction of this plan and identifying implementation priorities.

The residents of the watershed are essential to plan implementation. They are both renters and homeowners, and many are organized into neighborhood associations. There are eleven neighborhood associations in Citrus Heights, nine in Sacramento, and also a countywide neighborhood association alliance.

A list of stakeholders is maintained based on participation and attendance at the regular meetings of the Arcade Creek Watershed Group. The Group began meeting in April, 2002 and convenes approximately every six weeks are various public locations in the watershed. Facilitation responsibilities are shared by the member organizations, including circulating minutes, setting agendas, and maintaining the stakeholder database (**Appendix F**.)

3.4 Goals

The Arcade Creek Watershed Group developed ten draft goals for the Arcade Creek Watershed Plan on July 1st, 2002. Highest priority was given to the first four goals, with the understanding that by addressing these key issues, ancillary benefits and opportunities to improve the remaining six areas would also occur. The goals are as follows:

1. CONTROL OF FLOOD RELATED DAMAGES

   Provide additional floodplain management measures to minimize flood damage to both community and private property. Floodplain management is defined as "A comprehensive process that uses a variety of techniques and programs to help reduce flood losses and protect and enhance the natural and beneficial functions of floodplains".[1]

2. WATER QUALITY

   Develop and implement a plan to improve and monitor water quality of Arcade Creek and its tributaries, with special emphasis on pesticide levels and other toxicants in stormwater runoff.

3. RECREATION

   Ensure continued recreational access to the resources of the Arcade Creek Watershed and provide new recreational options to its residents.

4. WILDLIFE AND AQUATIC HABITAT

   Preserve and restore sustainable wildlife and aquatic habitat throughout the watershed.

5. LAND USE

   Provide a framework of recommendations to integrate future development and land use planning across the watershed.

6. PUBLIC SAFETY

   Improve public safety throughout the watershed through planning, facility improvements, oversight, and community action.

7. SCENIC RESOURCES

   Restore and maintain the scenic values of the watershed.

8. PUBLIC STEWARDSHIP AND EDUCATION

   Raise the public's awareness, appreciation, and protection of their local watershed through education and stewardship opportunities.

9. FIRE MANAGEMENT

   Identify strategies and opportunities in the watershed to reduce the risk of fire and to promote fuel load control. The fire risks are both to structures within the watershed and to native vegetation and wildlife.

10. STAKEHOLDER COLLABORATION

    Encourage multi-agency and broad based stakeholder participation in the planning and management of the Arcade Creek Watershed.

[1] Association of State Floodplain Managers website, www.floods.org

4.0 WATERSHED RESOURCE ASSESSMENT

This chapter provides a description and summary of the physical resources of the watershed based on a review of existing data and studies. Data have been compiled from a variety of sources including some field studies, literature review, and information provided by key stakeholder resource agencies. Ideally, additional field studies will be conducted in the future to expand the extent of the creek system for which detailed corridor assessments are available. The information provided by such studies is critical to identifying specific project opportunities and high quality resources to protect.

The resources considered in this initial assessment are both biotic, or living, and abiotic, or non-living. The abiotic resources that are relevant to the watershed assessment are topography, geology and soils, land use, climate, hydrology, and water quality. The chapter also includes a discussion of flora, fauna, and the existing recreational resources of the watershed.

4.1 Location and Description

The Arcade Creek watershed is a small urbanized watershed covering about 38 square miles and located primarily in northeastern Sacramento County with a minor portion in southern Placer County (**Figure 1, Arcade Creek Watershed)**. This area originally included a diverse range of native plant communities, but has largely been supplanted by commercial and residential land uses, recreational facilities, and extensive transportation infrastructure. Threads of open space remain along the major creek corridors, but the quality of these areas is heavily influenced by the adjacent land uses.

4.2 Topography

Topography in the watershed is relatively flat. The elevation at the headwaters is approximately 270 feet, and 20 feet at the mouth of Arcade Creek where it joins Steelhead Creek. Local streets and the storm drainage system often control the watershed boundary, with major influences along its northwest boundary at Highway 80 and the Union Pacific Railroad, which crosses the main stem of Arcade creek just west of the Roseville Road Bridge. A low ridge between Arcade Creek and the American River forms much of the southern watershed boundary, and the boundary extends east to just beyond Hazel Boulevard.

While watershed boundaries are typically described solely in terms of topography, this convention is only partially useful for the highly urbanized Arcade Creek watershed. It is believed that the network of subsurface stormwater conveyance infrastructure carries surface flow from areas outside of the topographic boundary into the creek channels within the watershed. Thus, the actual boundaries of the watershed most probably extend out to include these areas. Conversely, there may be some areas within the watershed where surface drainage is being conveyed out of the watershed by this same mechanism. A detailed study of this exchange needs to be conducted to accurately identify the areas that are actually draining into the Arcade Creek system.

4.3 Soil Units

There are approximately 25 soil units that have been mapped in the Arcade Creek watershed. [2] These soils are predominantly Fiddyment, San Joaquin, Urban Land, and Xerarents, or combinations of these soils types (**Figure 2, Generalized Soil Groups of the Arcade Creek Watershed)**. Smaller areas of the watershed have Bruella, Cosumnes, Dierssen, Jacktone, Kaseberg, Liveoak, Orangevale, Ramona, Redding, or Reiff soils.

An understanding of soils is important to assessing the watershed because the relative permeability of soils is a determining factor in the watershed's hydrologic response to precipitation events. Along with climate and soils, other factors determining the hydrologic response are land use, vegetation, and topography.

In addition to determining the runoff potential, soil attributes also greatly affect erosion patterns, stream channel morphology, the occurrence of wetlands, and the potential feasibility of watershed enhancement and protection measures such as infiltration basins. Finally, soils are an important factor in determining the types and patterns of vegetation that live in the watershed.

Hydric soils are soils that are saturated all or part of the time. This saturation limits the presence of oxygen. Hydric soils usually support plant species that are adapted to these conditions, such as reeds, rushes, sedges, and willows. This presence of hydric soils, hydrophytic vegetation, and water defines a wetland.

In the Arcade Creek watershed, there are relatively few wetlands beyond the creek channels. There are some small remnant vernal pools located in the Del Paso Regional Park area on the San Joaquin soil complex and several other types of wetland features in the undeveloped areas of the watershed. However, many of the wetlands that originally existed in the watershed have been lost, including in the area of Dierssen soils in the lower watershed and the riparian wetlands on Liveoak soils and Ramona soils associated with the creek that have been drained as the channel has been incised. The National Wetland Inventory (**Figure 3**) provides a limited view of wetland features within the watershed since it was developed using high altitude satellite imagery and mapped at a fairly coarse scale (1:24,000). It is likely that there are other small seasonal wetland features that have developed over time in association with urban runoff and swales.

For the purposes of this watershed assessment, the soil units found in the Arcade Creek watershed have been placed into 10 groups of one or more units. The general hydrologic attributes and erosion potential of the soil groups are presented below in **Table 1**. The attributes described in this table refer to the innate nature of the soils, not the occurrences of flooding or erosion that are primarily anthropogenic in origin.

Urban Land and Xerarents are areas that have been modified by human activities and no longer posses the attributes of the underlying soil units. Therefore, they are not given the same representation in the Table below.

Urban land consists of areas covered by impervious surfaces or structures, such as roads, driveways, sidewalks, buildings, and parking lots. Xerarents consist of moderately deep to very deep, well drained, altered soils that commonly have a buried soil. These soils are

[2] USDA, SCS, 1993. *Soil Survey of Sacramento County, California.*
USDA, SCS, 1980. *Soil Survey of Placer County, California, Western Part.*

in filled areas on hills, low terraces, and high terraces. They formed in fill material mixed by grading, excavation, and leveling activities.

As a practical matter, urban land has a very low infiltration rate, may flood where urban development has encroached on the floodplain, does not have hydric soils, and has a very low rate of erosion. Xerarents have a moderate to very slow infiltration rate, are unlikely to flood, generally lack hydric soils, and have a slight erosion hazard.

In the City of Citrus Heights, the soils are generally defined as urban land or the Fiddyment/Kaseberg/urban land group. These soils all have very slow infiltration rates. As urbanization occurs in Citrus Heights, infiltration rates are not reduced as much as they would be in other soils units. Therefore, the volume of runoff is not increasing as dramatically as it would when urbanization occurs in areas of soils with high infiltration rates. However, the process of urbanization also entails the construction of paved surfaces, gutters, downspouts, and storm drains that convey stormwater at a faster rate. Therefore, downstream hydrologic impacts may still occur due to the development of areas with Group D soils, such as those found in Citrus Heights.

The hydrologic groups are defined as:

A – High infiltration rates, deep soils, well to excessively drained.

B – Moderate infiltration rates.

C – Slow infiltration rates.

D – Very slow infiltration rates.

Table 1 — Hydrologic and Erosional Characteristics of Soils

Soil Group	Hydrologic Group	Flooding Frequency	Hydric Soils	Erosion Potential
Bruella	B	None	No	Slight or none
Cosumnes	C	Rare	Yes	Slight
Dierssen	D	Rare	Yes	Slight or none
Fiddyment/Kaseberg/Urban Land	D	None	No	Slight or moderate
Jacktone	D	Rare	Yes	Slight or none
Liveoak	B	Occasional/Rare	Inclusions	Slight
Orangevale	B	None	No	Moderate
Ramona	B	None	Inclusions	Slight
Redding	D	None	Inclusions	Slight or moderate
Reiff	B	Occasional	No	Slight
San Joaquin/Urban Land	D	None	Inclusions	Slight
Urban Land	N/A	N/A	N/A	N/A
Xerarents	N/A	N/A	N/A	N/A

4.4 Channel Morphology

Unchannelized streams are dynamic systems. Erosion is a natural process that is a function of soil type, topography, hydrology, and other factors. In most stream systems, the high flows determine the changes in channel morphology, or shape. These changes include scour (deepening of the channel) and meander.

In many locations along Arcade Creek, downcutting has occurred because of land use practices and the soils that exist. It is not unusual to find a channel 10 feet deep in Citrus Heights or 14 feet deep in the vicinity of the American River College campus. This process will often incur the loss of streamside vegetation due to a dropping water table or due to stream bank instability, which may encourage armoring of the banks in an attempt to stabilize them. Unlike channelized reaches, these reaches may still have meanders and a natural substrate of cobbles and boulders as the smaller substrate is scoured away.

When land use changes create higher volumes and greater velocities of runoff, the hydrologic regime and channel morphology are out of balance. Greater flows with higher velocities and longer duration not only contribute to downcutting but also scour the channel and destabilize stream banks. This eroded material is added to the bedload, which may be deposited in the channel further downstream, decreasing channel capacity, and thereby exacerbating flooding. Because the high flow events that form channel morphology are infrequent, it may take many decades if not centuries for the channel morphology to achieve balance with the hydrologic regime after it has been altered by large-scale land use changes.

In the lower reaches of Arcade Creek between Marysville Blvd. and Roseville Rd., sections of the banks have been armored with gunnite and riprap. This area is immediately upstream of the levees that were installed to protect the property in the lower part of the watershed from flooding. The need for the constructed bank protection is a response to both the increased velocity of flows due to urban runoff, the narrowing of the floodplain which constrains the ability of the creek to meander, and the subsequent downcutting. The armoring is an attempt to stabilize the oversteepened banks but precludes the development of riparian vegetation and thus adversely impacts habitat value, aesthetics, and water quality.

The potential to restore the channels in the Arcade Creek system to a more natural configuration is limited mainly by the encroachment in to the floodplain by adjacent developed land uses. There are relatively few locations in the watershed where adequate undeveloped floodplain remains to allow widening of the channel or establishment of side channels and meanders. In some areas, it may is possible to lay back the creek banks to establish secondary terraces or shelves that would increase channel capacity while also improving vegetative structural diversity and habitat opportunities. The Arcade Creek Feasibility Study identified several such locations in the section of the creek through Del Paso Regional Park. Further study should be undertaken in the rest of the system to determine other locations that would be appropriate for this restoration method. Following re-contouring, these reaches could be enhanced through the planting of vegetation to provide habitat value and bank stabilization. However, the success of these enhancement measures is entirely dependent upon designs and installations that give due consideration to the peak flows that will inevitably occur.

4.5 Land Use

Land use in the Arcade Creek watershed is predominantly residential, commercial, and transportation infrastructure such as roads, parking lots, and railroads. Several large paved and/or roofed areas exist in the watershed, including American River College and the Sunrise-Birdcage shopping malls. The area near the intersection of Interstate 80 and Watt Avenue has very extensive impervious land use, including commercial, industrial, the light rail station, roads and parking lots. A general land use map is shown in **Figure 4**.

The area of impervious surfaces and the generation of pollutants are directly related to land uses within the watershed. **Table 2** shows the average percent impervious surface by land use type. Over 56% of the watershed is in residential land use, and 65% of the residential lots are smaller than ¼ acre. Using the estimated for impervious area shown in table 2, this single category of land use accounts for an estimated area of impervious surface of almost 4,300 acres. Another 2,000 acres of impervious surface is associated with residential development on lots ¼ acre or larger. Roads constitute another approximately 3,500 acres of impervious area in the watershed and commercial and industrial areas combined include about 1,270 impervious acres. In total, nearly half (45%) of the Arcade Creek Watershed appears to be covered with impervious surfaces that prevent infiltration of stormwater, exacerbate urban runoff, and preclude habitat opportunities.

A review of numerous watershed studies that was conducted in 1994 by the University of Connecticut determined that the percentage of impervious surface in a watershed could be used to accurately estimate the existing non-point source related water quality conditions.[3] According to this research, watersheds with more than 25% impervious area are very likely to have significantly degraded water quality. The water quality issues in the Arcade Creek system are consistent with this observation. It is significant to note that about 57% of all the impervious area in the watershed is associated with residential development. This fact points strongly to the need to include homeowner education on proper land use practices in any strategy to address water quality issues in the watershed.

Table 2 — Urban Areas: Average Percent Impervious Surface by Type of Land Use

Land Use Type	Percent
Commercial and business districts	85
Industrial areas	72
Residential districts by average lot size	
1/8 acre or less (townhouses)	65
1/4 acre	38
1/3 acre	30
1/2 acre	25
2 acres	25

From: USDA, Soil Conservation Service, June 1986[4]

4.6 Climate

Sacramento County experiences cool wet winters and hot dry summers, with precipitation averaging 17 to 22 inches annually.[5] This Mediterranean climate determines to a great extent the vegetation found in the Arcade Creek watershed.

Because of the low elevations and Mediterranean climate, there is no snow pack in the Arcade Creek watershed to augment base flows. The rainfall that dos occur tends to be

[3] Schueler, T.R., 1994. The Importance of Imperviousness. Watershed Protection Techniques, vol. 1(3): pp. 100-11.

[4] U.S. Department of Agriculture, Soil Conservation Service, 1986. *Urban Hydrology for Small Watersheds.* Technical Release 55, Engineering Division, SCS, USDA, Washington, D.C.

[5] USDA, SCS, 1993. *Soil Survey of Sacramento County, California.*

concentrated in the winter months and often associated with short, intense storm events. There are several ecosystem implications associated with these climate conditions.

First, flows historically tended to be small in volume and high in temperature during most of the year. Portions of the creek system were even dry during the summer in some years. It is probable that any salmonids that originally existed in the creek system were near the limits of their range. Over time, the naturally high ambient stream temperatures have been exacerbated by loss of vegetation associated with development encroachment and other land use practices, thereby precluding the likely use of the stream in the future by salmonids.

Second, the long months of high air temperatures and low humidity may further stress riparian vegetation that is already compromised by loss of ground water related to channel incision. If channel incision causes the creek water surface elevation to be below the top of the ground water column, water flows out of the ground and into the channel and is not available to the root zone of the riparian species. Ironically, summer flows in the Arcade Creek system now exceed historical summer flows mainly due to year round urban runoff. However, these flows are not adequate to compensate for the degree in channel downcutting with respect to providing adequate soil moisture to sustain riparian species on the second and sometimes even the first terrace.

Third, the high degree of impervious area in the watershed combined with the short, but intense winter rains causes stormwater to concentrate and discharge quickly into the creek system. The velocity and flow of such events further contributes to a variety of adverse water quality and habitat impacts including erosion, sedimentation, channel degradation, and flooding.

4.7 Hydrology and Flooding

4.7.1 Surface Water

Urbanization of the Arcade Creek watershed has changed the hydrology dramatically over the past 150 years. No policies requiring surface water detention were in place when most of the watershed was developed. As impervious surfaces, such as roads, buildings, and parking lots were constructed, peak flows increased in volume. The creation of storm drainage systems, including paved gutters, drop inlets and systems of culverts and outfalls, has resulted in a decrease in the time it takes for flows to reach the channel. Grading, paving, and the loss of wetlands and other land use practices have decreased the volume of depressional storage in the watershed. This combination of increased flow volumes and an increase in the rate of flows has resulted in higher peak flows and higher scour capacity.

Historically, Arcade Creek was a seasonal stream that conveyed flows during the winter and spring. Sections of the creek and it's tributaries were even known to be completely dry during the summer in some years. Urbanization caused the stream to flow perennially, perhaps beginning about 45 years ago. Under current conditions, landscape irrigation runoff, car washing, industrial and other non-stormwater discharges augment low flows, and Arcade Creek is now a perennial stream. The interception of shallow groundwater may also augment low flows.

Under current conditions, low flows during the drier summer months may be as little as 2 cubic feet per second (cfs). Between 1964 and 2000, the mean annual flows ranged widely, from 5.96 cfs to 37.3 cfs.[6] Typical flows (i.e., base flows) are in the range of 15 to 20 cfs. Peak flows during intense but infrequent storm events range as high as 2,800 cfs or higher.[7] The ratio of peak flows to base flows is in the range of 150:1 or higher, and indicates a very "flashy" system in terms of its hydrology. This is a reasonable conclusion, given the high rate of runoff generated by the soils in the watershed, the large amount of impervious surfaces, the small size of the watershed, and the Mediterranean climate.

Currently there are several flood management concerns in the Arcade Creek watershed. Levees on both sides of the channel contain flooding between Marysville Blvd. and the confluence with Steelhead Creek. However, upstream at Roseville Road the channel is constrained by the road structure. Consequently, during some storm events, the elevated flows back up and causes flooding in the golf course to the northeast and into the residential area to the southeast. The 100-year floodplain is shown in **Figure 5**. The shape of the floodplain shows where the Roseville Road and Union Pacific Railroad crossings of Arcade Creek function as partial hydraulic controls. Site inspections of these crossings revealed that the bridge abutments are armored with rock, which encroaches in the channel and limits the development of riparian vegetation. SAFCA has contracted for a complete hydrologic analysis of the watershed to be completed sometime in mid-2003. The results of this study will be critical to understanding specific problem areas and developing appropriate solutions.

Within the City of Citrus Heights, private properties back onto the main channel and tributaries throughout the city and in some cases encroach into the floodplain. This circumstance is problematic from a flood management perspective for two reasons. First, homeowners' property and structures are threatened during high water events and subject to erosion or bank failure. Second, the practices used by some homeowners to maintain their yards may adversely impact the channels' flood function by either stripping away vegetation that stabilizes the banks, or by encouraging invasive non-native species that choke the channel and reduce conveyance capacity.

While Citrus Heights is for the most part a fully developed community, there are still a number of neighborhoods served by class C roadways that do not have curbs and gutters to direct surface runoff. In these areas, open vegetated roadside swales function to intercept and convey surface runoff. These swales are actually providing a type of off-channel detention that helps to hold a certain amount of stormwater and allows for gradual infiltration over time. However, in some neighborhoods homeowners are asking to have the open swales replaced with buried pipes so they can use the filled areas for additional parking or other uses. The City is discouraging such requests due to the complexity of trying to provide adequate inlets and connections for these pipes to the existing storm sewer system. Another concern is the potential for this approach to deliver storm flows in greater quantity and more quickly and putting additional stress on the City's storm sewer capacity.

The City's efforts to effectively control and mitigate for development in the floodplain have been constrained by the quality of available base mapping. Two initiatives are

[6] USGS, 2002. *Surface Water Data for USA*, published on website http://waterdata.usgs.gov/nwis/annual

[7] Stopher, 1992. *Management Plan and Grant Implementation Report, American River College Nature Area*. Urban Creeks Council, Sacramento Chapter.

USGS National Water Quality Assessment website. http://ca.water.usgs.gov/sac_nawqa/arcf.html underway to address this problem. The City of Citrus Heights is currently participating in an agreement with FEMA and Sacramento County to secure funding to update the mapping of the 100 year floodway and floodplain in the Arcade Creek Watershed. A separate project involving the Sacramento Area Council of Governments (SCAOG) is focused on correcting the parcel base and creek centerline data. These are currently off by as much as 30' – 40' in some locations and prevent accurate determination of and planning to avoid floodplain impacts.

The City is very aware of the CEQA-mandated need to prevent adverse flood impacts downstream outside of the city limits related to development within the City. The City of Citrus Heights has recently approved a development plan for the Stock Ranch project that will include significant on-site detention capacity. Three basins will provide a total of 20 acres of detention area and are designed to receive stormwater that will spill from the creek channel beginning at the 25-year event and up through the 100-year event. The basins will intercept the flow and increase the time it takes for the water to join the channel. However, Stock Ranch represents the last major new development project in the City since most of the City is already developed. Most proposed projects represent relatively small infill or redevelopment effort with limited opportunity to create onsite stormwater detention or storage.

Management of the American River, particularly Folsom Dam, heavily influences the hydrology of lower Arcade Creek. Improvements to Folsom Dam have reduced the peak flow during a 100-year event from 180,000 cfs to 145,000 cfs; the flow may be reduced further to about 115,000 cfs if proposed future improvements to Folsom Dam are implemented. However, these improvements will probably not alter the extent of the floodplain.[8]

The changing hydrologic regime of the Arcade Creek watershed has implications for channel morphology, flood damage, native vegetation, aesthetics, and fish and wildlife habitat. The Arcade system reaches flood stage and overtops its banks more quickly and more frequently than it did prior to development. Water surface elevations rise and fall more rapidly since a high percentage of the watershed has been urbanized. Flooding occurs in the vicinity of Interstate 80 and Greenback and also where Watt Avenue crosses over Arcade creek.

Flood-related damage occurs from scour and erosion in addition to inundation. This damage may be in the form of streambank instability, habitat loss, damage to bridges and roads, damage to the storm drain system, water quality impacts, damage to residential and recreational structures, and other infrastructure in the watershed, such as utilities. The cost of flood-related damages tends to increase over time along with the trend towards increasing property values.[9]

The response to flood-related damage by public and private entities includes attempts to control floods, avoid flood related damage, study flooding processes, insure the costs of flood-related damage, and repair or absorb the flood-related damages after they occur. For example, Sacramento County Department of Water Resources is preparing a Master Drainage Study, which will be completed in 2004. Each of these strategies has associated costs and benefits, and these costs and benefits may accrue to different

[8] John Bassett, SAFCA, pers. comm.

[9] Dunne and Leopold, 1978. *Water in Environmental Planning*.

parties. A discussion of floodplain management and mitigation of flood-related damages follows in Section 7.1.

4.7.2 Ground Water

In many reaches of the main stem of Arcade Creek the channel has become deeply incised due to high flows. This lower creek bed may intercept shallow groundwater, which would also augment low flows. In those areas of Liveoak soils, the shallow groundwater would be expected to be at 6 or 7 feet in depth. Typically, the channel has incised to a depth of 8 to 15 feet, more than deep enough to intercept these flows. This loss of shallow groundwater in riparian zones may negatively affect vegetation, as noted in Section 4.4.

4.8 Water Quality

4.8.1 Surface Water

The surface water that flows into Arcade Creek is largely urban runoff. Urban runoff typically contains a wide range of conventional and toxic pollutants, including nutrients from fertilizers and manure, bacteria and other microbes from a variety of sources, heavy metals from industrial and vehicular sources, and pesticides from residential yards, recreational areas, and road right-of-ways. Soap, grease, fats, oil, and other hydrocarbons flow into the creek from vehicles, gas stations, car washing, and incidental spills. The surface water in Arcade Creek is also likely impacted by the presence of litter and other solid wastes and by atmospheric deposition. Rainfall in urban environments will typically contain higher levels of phosphorus and mercury and have a lower pH than precipitation in a pristine environment.

This Plan is concerned with the assessment and amelioration of all sources of water quality impacts in the watershed, including both "point sources" and "non-point sources." Point sources are discharges from a discrete location or facility such as an outfall, pipe, or similar structure. Non-point sources are diffuse by nature, and include atmospheric deposition, runoff from mining, construction and agriculture, and urban runoff from roads and parking lots. When urban runoff is collected in a storm drain system and discharged through an outfall into the receiving body, it is still considered a non-point source because the pollutants are generated from the landscape or other diffuse sources. Non-point source water pollution is a very significant issue in the Arcade Creek Watershed because over half of the watershed is in residential use, and nearly half of the watershed is covered by impervious surfaces.

4.8.2 Surface Water Quality Monitoring

Within the past 10 years a number of agencies have monitored various aspects of water quality in Arcade Creek. These include the monitoring conducted by the USGS and by the Sacramento River Watershed Program.

The most far-reaching monitoring has been done by the USGS, which selected Arcade Creek as a trend-tracking site as part of its National Water Quality Assessment Program (NAWQA). Continuous monthly data are available for 1996-1998 for a variety of water quality parameters including major element chemistry, nutrients, dissolved organic carbon, pH, alkalinity, dissolved oxygen, pesticides, and volatile organic chemicals.

Beginning in 2000, the monitoring protocol was revised to include only pesticides, nutrients, major inorganic constituents, and some basic ecological assessments in order to develop trend data. Beginning in October, 2004 the NAWQA program is planning to initiate intensive sampling at a number of sites throughout the Sacramento River basin for a three-year period. It is not yet known what this program will focus on or if Arcade Creek will be included in the study.[10]

Dow AgroSciences also sponsored a study of Arcade Creek conducted by the University of Maryland and California Department of Fish and Game. This study examined physical habitat and benthic communities to determine the impact, if any, of organophosphate pesticides. It compared a representative creek in an agricultural watershed with Arcade Creek, a representative urban creek. Both creeks were chosen because they are listed on the 303(d) list as impaired due to diazinon and chlorpyrifos, two organophosphate pesticides. This study established ten sampling sites along the creek and examined the physical environment of each. The results of sampling for benthic invertebrates generally indicate that more tolerant taxa were common downstream. A group of organisms dominant in stressed environments were most prevalent throughout the area sampled. Compared to the creek in the agricultural watershed, Arcade Creek had lower quality physical habitat as well as lower taxonomic richness.[11] This result was confirmed in the SRWP 2001 report that found that Arcade Creek was the only waterway dominated by a single stress tolerant taxon.[12]

The Sacramento River Watershed Program (SRWP) conducted regularly scheduled monitoring between 1998 and 2000. In 2000-2002 monitoring focused on specific episodic events, such as agricultural dormant spray season, runoff events, and high flow and storm events, to address questions regarding periodic toxicity in the Sacramento River system. Monitoring for *Giardia* and *Cryptosporidium* pathogens was suspended in 2001 due to funding difficulties. Monitoring for PCB's and organochlorides was continued through 2002. Macroinvertebrate sampling took place between 1997 and 2000. The SRWP monitoring site on Arcade Creek is at Norwood Avenue.

The SRWP produces an annual monitoring report on a number of creeks and rivers in the Sacramento Valley. This report compares data from different waterways characterized by a variety of land uses. Arcade Creek is the designated representative urban creek site. The SRWP report incorporates data from many sources including the USGS NAWQA monitoring, pesticide studies from the Department of Pesticide Regulation, and the Sacramento Stormwater Program's annual report. For the 2000-2001 report the SRWP focused on specific episodic events such as high flow events and agricultural spray seasons. The only waterway which showed increased frequency and severity of toxicity under this plan was Arcade Creek.[13]

The contaminant levels in Arcade Creek were found to be among the highest concentrations in almost all of the water bodies that were tested. The dissolved oxygen levels were the lowest. Water quality parameters in Arcade Creek were often similar to those found in two agricultural drainages, the Sacramento Slough and Colusa Basin

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[10] Russick, Kathleen, November 2001. Notes of personal interview of Joe Domagalski on USGS NAWQA Program Plans for Arcade Creek.

[11] Russick, Kathleen, December 2001. *Review of Spring 2000 Arcade Creek Bioassessment/Habitat Assessment Monitoring Report.*

[12] Sacramento River Watershed Program, 2002. *Annual Monitoring Report: 2000-2001*.

[13] ibid.

Drain. All numbers reported are the 50th percentile results.[14] Arcade Creek was not monitored for PCBs and organochlorides.

Mercury and Methylmercury

In 2001 Arcade Creek had the 7th highest concentrations of mercury.[15] According to the 1998 SRWP report the average mercury concentration was below the EPA standard of 12 ng/L, but this level is exceeded in peak concentrations after storm events. In 67% of the samples methylmercury exceeded the Great Lakes human health criterion of .24 ng/L. Total mercury concentrations were substantially higher in Arcade Creek than in the mainstream Sacramento River.[16]

Dissolved Metals

Arcade Creek had the highest levels of dissolved copper at 4.0 ug/L, compared to the next highest measurement of 2.4 ug/L. At 7.7 ug/L, the concentration of zinc was also highest in Arcade Creek compared to the second highest value of 2.8 ug/L. It had the fourth highest levels of total copper (4.29ug/L). It ranked third in arsenic concentrations with 2.0 ug/L versus 4.0 ug/L as the highest concentrations.[17]

Pesticides

Arcade Creek had the largest number of pesticides and the greatest concentrations of any water body according to both the 2000 and 2001 SRWP reports. Diazinon, chloropyrifos, prometon, and prowl were all detected at least once in Arcade Creek, but in many creeks they were not detected at all. Arcade Creek is 303(d) listed for diazinon and chlorpyrifos.[18] However, diazinon is currently being phased out for residential use.[19]

Three carbamate pesticides were detected in Arcade Creek: carbaryl, diuron, and tebuthiuron. Propazine and prometron were the only triazine pesticides found in Arcade Creek in 2000 and 2001. Tebuthiuron, propazine, and prometron are primarily used in public right-of-way and landscape maintenance.[20] Diuron is also commonly used for weed control.[21]

Water quality criteria for chloropyrifos, DCPA, malathion and diuron were exceeded between 10% and 30% of the time in sampling conducted between February 1996 and June 1997. However, carbaryl and diazinon exceeded water quality criteria in 100% of the samples. It should be noted that many other organic compounds that were detected have no water quality standards.[22]

Diazinon was detected at levels exceeding the DFG's Continuous Concentration Criterion (CCC) of .05 ug/L in 67% of the samples taken in 2000-2001. Arcade Creek receives diazinon contamination in runoff from landscaping application and aerial deposition from agricultural applications. Chlorpyrifos was not detected at greater that CCC levels in 2001; however it was recorded twice in Arcade Creek. Diuron was not

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[14] Russick, Kathleen, October 2001. *Review of SRWP Annual Monitoring Report: 1999-2000.*

[15] ibid.

[16] Sacramento River Watershed Program, 2002. *Annual Monitoring Report: 2000-2001*.

[17] ibid.

[18] California Regional Water Quality Control Board, Central Valley Region, 2002. NPDES No. CAS082597

[19] Lori Webber, Central Valley Regional Water Quality Control Board, pers. comm., 2003.

[20] Russick, October 2001.

[21] op. cit.

[22] Cooke, J., and Connor, V., et al, 1998. *Toxicants in Surface Waters of the Sacramento Watershed*.

detected at levels exceeding EPA toxicity standards in 2000-2001, although the level did exceed standard levels in 1999-2000.[23]

There was a significant drop in the detection of herbicides used in rice production, such as carbofuran and malathion. In 1994, these herbicides were detected in 85% of the samples, and not at all in 2000. This is attributed to a change in rice cultivation practices.[24]

Drinking Water Parameters of Concern

The Sacramento River and its tributaries, including Arcade Creek, are the primary source of flow to the Sacramento-San Joaquin Delta and the source of drinking water for 20 million people in the Bay Area, Central Coast, and Southern California. Drinking water parameters of concern included in the SRWP monitoring program include organic carbon, total dissolved solids, pathogens, turbidity, and nutrients.

Arcade Creek was one of three waterways with the highest amount of Total Dissolved Solids. Arcade Creek had the lowest dissolved oxygen content (4.6 mg/L, #2=7.6, high=11.1). Arcade Creek had the highest levels of TOC at 7.8 mg/L (#2=6.9 mg/L, low=1.2) and DOC at 7.0 mg/L (#2=5.2, low=1.0). The threshold level for treating TOC is 2.0 mg/L. High peak concentrations of suspended sediment were also found in Arcade Creek according to the 1998 SRWP report.

Minerals

Arcade Creek had elevated levels of almost all minerals sampled. In the USGS sampling from February 1996 to April 1998 most minerals were measured at higher concentrations in the summer and lower concentration during winter months. This was a general trend that did not always apply. According to the 2000 SRWP report mineral concentrations in Arcade Creek were all higher than the Sacramento River, when data was available for both waterways. Sodium concentrations were not one of the highest sampled, but chloride concentrations were the second highest of any studied at 24.0 mg/L. Calcium was also found in elevated concentrations with a median of 20.5 mg/L. Median concentrations of potassium are two to three times those of other waterways sampled (3.6 mg/L). Dissolved manganese concentration was significantly higher that of the Sacramento River (25.5 mg/L vs. 2.4 mg/L). Dissolved iron concentration in Arcade Creek is much higher (81mg/L) than any other sampled water body. Cadmium was also present in Arcade Creek at elevated levels (.65ug/g).[25]

Nutrients

According to the 2000 SRWP report Arcade Creek had among the highest nutrient concentrations of any sampled waterway. Arcade Creek had the highest levels of nitrite (.51 mg/L). Two separate surveys recorded Arcade Creek as having the highest nitrate level at .04 mg/L, while most other waters had <.01 mg/L. The Sacramento River had a higher concentration of ammonia nitrogen (.11 mg/L) but Arcade Creek had the highest concentration of any of its tributaries at .07 mg/L, compared to most others with <.01

[23] Sacramento River Watershed Program, 2002. *Annual Monitoring Report: 2000-2001*.

[24] Russick, October 2001

[25] Russick, October, 2001.

mg/L. Arcade Creek also had the highest organic nitrogen concentration (.76 mg/L) and dissolved orthophosphate, .123 mg/L, compared to the next highest at .09 mg/L. Analyses of samples for total phosphorous revealed one other sample equaled the concentrations found in Arcade Creek at .24 mg/L, while the lowest concentration recorded was .01 mg/L.

Disease-causing Organisms

There are not enough data to form conclusions about coliform bacteria levels in Arcade Creek, but monitoring programs are being developed and started. Similarly, data are being collected on Giardia and Cryptosporidium levels but there were not enough data at the time of the report to make reliable conclusions.

Bioassays

There have been a number of biotoxicity assays on various taxa in Arcade Creek. In Fall 1995 the USGS sampled tissue and sediment from Asian clam, *Corbicula fluminea*. In the sediment samples, lead, zinc, and DDT were between the threshold effect level (TEL) and probable effect level (PEL). These high levels were attributed to street runoff. Mercury was elevated but below TEL, as were other organochlorines, chlordanes, nonachlors, and dieldrin. In the clam tissue DDT's were elevated but still below FDA human health guidelines.

The Sacramento River Watershed Program sampled water from August 1996 to July 1997 and conducted three-species bioassays. In all but one sample the water was found to be toxic to *Ceriodaphnia,* an invertebrate species, due to high diazinon and chlorpyrifonos, both of which are organophosphate pesticides. In four of the twelve samples the water was toxic to *Selenastrum*, an algae species, due in part to diuron and possibly glyphosate. Two of these collections followed rain events. No toxicity to fathead minnows was recorded. Additional water samples were taken between October and December 1997 and from January to May 1998. These samples all had similar results to the previously described study. One especially noteworthy aspect of these studies is that Arcade Creek is toxic year-round during both low and high flows and toxicity is not restricted to storm events.

According to the 2001 SRWP report samples collected from Arcade Creek are consistently much more toxic than samples from any other water body. This was true of samples taken from a number of points along the Arcade Creek watershed. Out of 97 samples taken, 21 were toxic to *Ceriodaphnia*. Sixteen of these 21 were from Arcade Creek. In comparison, samples from the Natomas East Main Drain, which receives more agricultural runoff, did not cause significant mortality. When treated with peperonyl butoxide, which prevents activation of organophosphate pesticides, the samples did not cause significant mortality, indicating that organophosphate pesticides are the primary toxins.

4.8.3 Ground Water

There are no known groundwater contamination problems in the Arcade Creek watershed. Monitoring conducted by the USGS did not reveal any toxicants at elevated levels.[26] This may be due to both the depth of groundwater and the aquifer may be

[26] USGS, 2002. *National Water Quality Assessment, Groundwater Data: Sacramento Urban Land-Use Study.*

partially confined. Shallow groundwater, found above the impermeable or slowly permeable layers in the subsoils, is at a greater risk of contamination.

4.8.4 Sources of Hazardous Wastes

The U.S. Environmental Protection Agency (EPA) maintains data on potential water contamination sources in the Resource Conservation and Recovery Information System (RCRIS). The RCRIS is a national computerized management information system in support of the Resource Conservation and Recovery Act (RCRA). RCRA requires that entities that generate, transport, treat, store, and/or dispose of hazardous waste provide information concerning their activities to state environmental agencies. The RCRIS sites within the Arcade Creek Watershed are shown in **Figure 6**. The RCRIS database is used by the EPA to support its implementation of RCRA, as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA). The system is used primarily used to track handler permit or closure status, compliance with Federal and State regulations, and cleanup activities.[27]

4.9 Flora

4.9.1 Plant Communities

Prior to the discovery of gold in 1848, the Arcade Creek watershed was characterized by a diverse and complex matrix of habitat types including native perennial grasslands, oak savannahs dominated by blue and valley oaks, seasonal wetlands, and riparian forest consisting primarily of interior live oak and valley oak. With settlement came the gradual conversion of these lands to a variety of agricultural uses, such as grazing, row crops, and orchards, and eventually to urban development. These land uses and the associated changes to surface hydrology have nearly eliminated the naturally occurring plant communities with the exception of a few remnant patches scattered throughout the watershed.

Even these remnant patches reflect the impacts of urbanization and agricultural land uses to some extent. Non-native annual grasses first introduced as pasture grasses have largely replaced the perennial native grass species. The vernal pools and seasonal marshes have been dewatered as a result of the floodplain constriction and grading associated with development. Many of the native oaks were removed to make way for development or were inadvertently killed by subsequent land use practices associated with development such as over watering, soil compaction, and root zone disturbance. The riparian forests now are constrained to a narrow corridor and probably include a greater number of cottonwood, willow and Oregon ash because of the changing dynamics of the creek ecosystem associated with perennial flows and channel incision.[28] Channelization has resulted in the fragmentation of the riparian habitat by creating very narrow, poorly vegetated reaches that interrupt the opportunities for cover, nesting and foraging provided in the more intact sections of riparian vegetation. The riparian plant communities now include many non-native species introduced by ornamental horticultural practices in the adjacent residential and commercial areas.

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[27] U.S. EPA, 1998. *EPA/OSW Resource Conservation and Recovery Information System (RCRIS) for the United States*.

[28] Stopher, 1992.

The current plant communities in the watershed include numerous native and non-native species. While the focus of restoration efforts is on native plant species, it is important to acknowledge that the non-native ornamental landscapes in private residential yards and parks have now become an integral part of the overall habitat characterization in the watershed. Homeowners should be encouraged both to consider including more native species in their landscapes and to make plant choices that provide functional habitat values such as nesting, cover, and foraging opportunities since the native habitat matrix is no longer intact.

The primary native plant community fragments that remain are either oak woodland or riparian forest. Native oak woodland occurs in only a few places such as the Longview Oaks Nature Preserve and a few other locations in the Del Paso Regional Park, the American River College Nature Area, the Stock Ranch property in Citrus Heights, the Sunrise Oaks Park Site in Citrus Heights, and in some of the unimproved sections of other park properties owned by the Sunrise Recreation and Park District. There are also a few privately owned parcels located in the 100-yr floodplain in Citrus Heights that have not been developed and which still sustain stands of native oaks, such the creekside property behind the Sayonnara mobile home park, and the undeveloped land on the Arcade Creek tributary at Fair Oaks Boulevard and Greenback Lane. Primary species include the interior live oak (*Quercus wislizenii*), valley oak (*Q. lobata*), and blue oak (*Q. douglasii*), with occasional intermediary species such as oracle oak (*Q. x morehus*). The overall condition of the oak woodland throughout the watershed is compromised in part by the extreme amount of fragmentation. The vestigial oak woodlands really function as small islands of habitat and are thus severely constrained as to the wildlife species they will support. However, there are many heritage status oaks in the remaining woodlands because grazing has been eliminated and fire suppressed for many years. No comprehensive study of age class structure within the oaks woodland in the watershed has been done. This information would be valuable in determining the mortality and regeneration rate and thus the potential for these woodlands to persist. A 1992 assessment of native oaks at the 22-acre American River College Nature Area showed a healthy amount of regeneration with a large number of young trees interspersed with fewer numbers of successively larger size classes.[29] Conditions at this site are a reflection of its relatively protected status.

The remnant riparian forest represents the most significant native plant resource in the watershed. In some locations the canopy layer is actually dominated by oak species rather than the willows, cottonwoods and box elders that are often found as the dominant canopy species in Central Valley riparian forests. In other locations, these species are more abundant. The differences are probably attributable to variations in ground water, seasonal flows, and channel morphology. It is not clear whether one canopy condition is significantly replacing the other at this time. Field surveys conducted in 2002 along 4.5 miles of the main stem of Arcade Creek between Marysville Boulevard and the City of Sacramento city limits identified eleven native tree species in the riparian canopy and eighteen non-native species (**Appendix C**). However, many of the non-natives were young and did not form a well-established canopy. While the non-natives accounted for more species diversity, the native species accounted for greater abundance so that overall the canopy is dominated by native species.

The field study also identified nine native species occupying the mid-story and seventeen non-native species in the mid-story. However, in this position, the non-natives accounted

[29] Stopher, 1992.

for both greater diversity and abundance. Similar findings were made with respect to the herbaceous layer. Native herbaceous plants that still survive in riparian areas include Barbara sedge, creeping wild rye, and deer grass.[30] The 1992 study at the American River College Nature Area shows comparable trends with respect to the relative native vs. non-native composition of the overstory, midstory, and herbaceous understory. The high degree of non-native species in the midstory and understory is possibly attributed to the fact that non-native species introduced into the watershed are more aggressive and generally more abundant than the native species that would naturally have occupied these positions in the vegetative structure. This may also be an indication of a future trend toward fewer natives in the overstory. As individual native trees in the overstory age and decline, the non-native tree species in the midstory may become more dominant and supplant the natives in the canopy.

4.9.2 Priority Species

The only known priority plant species in the watershed is Sanford's arrowhead (*Sagittaria sanfordii*).[31] Its habitat requirements are perennial marshes and low velocity streams. This plant has been found in Sacramento County, and is on the California Native Plant Society 1B list. Plants on this list are judged to be both rare and vulnerable and must be considered under any California Environmental Quality Act process. This species is threatened by grazing, development, and channel alteration.[32] Known locations of priority species in the vicinity of the Arcade Creek watershed are shown in **Figure 7**. In addition, elderberries (*Sambucus spp.*) are periodically found throughout the riparian woodland. These shrubs provide habitat for the Valley Elderberry Longhorn Beetle which is a threatened species. Consequently, the U.S. Fish and Wildlife Service typically requires measures to protect or mitigate for impacts to the elderberry shrubs.

4.9.3 Non-native Invasive Species

In general, upland areas of the watershed have lost native species as dominants. In most cases, vegetation has been lost to the construction of roads and buildings or to landscaping or non-native invasive plants such as annual grasses and forbs. In those riparian areas where the native forest canopy is still relatively intact, the understory vegetation has been subject to substantial disturbance and is largely dominated by non-native species.[33]

The predominantly non-native composition of the majority of plant communities is a reflection of land use practices. Grazing of livestock and grading for construction projects allows both the introduction and establishment of annual grasses and agricultural weeds, including Hardinggrass and yellow star thistle. As land use in the watershed became more suburban, ornamentals such as ivy, periwinkle, acacia, and European olive became established in the riparian corridors. Flood events can disturb soils, providing microhabitats for non-native propagules, including giant reed (Arundo) and Jerusalem artichoke.[34] Other invasive non-natives include tamarisk, Chinese tallow, red sesbania, black locust, honey locust, Scotch broom, and Himalayan blackberry.

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[30] ibid.

[31] California Natural Diversity Database, 2002.

[32] California Native Plant Society, 2001. *Inventory of Rare and Endangered Plants of California.*

[33] Stopher, 1992.

[34] ibid.

These species are highly competitive with the native flora and, in the absence of effective management, will continue to proliferate throughout the creek corridors in the watershed.

4.10 Fauna

4.10.1 Wildlife

In spite of its urbanized character, the Arcade Creek Watershed is home to a variety of small mammals, birds, amphibians, fish, and reptiles. Species found within the watershed are those that are tolerant of urban conditions, and/or able to exist within the small remnant areas of relatively natural habitat in the creek corridors or undeveloped lands. Urban conditions that have reduced the numbers and diversity of wildlife species include destruction and fragmentation of habitat, lack of upland refugium during flood events, and in the case of birds and small mammals, predation by domestic species such as cats and dogs.

Avian species are the most abundant of the vertebrates within the watershed. This is because they are able to successfully use the creek corridors (and the residential landscape to some limited extent) for the full range of habitat function, including migration, shelter, forage, and nesting. A six-year field study of birds compiled by the American River College lists a total of 115 species of birds observed in the section of the watershed from the Winding Way bridge upstream to Garfield Park (**Appendix A**). Many of these are occasional or rare visitors, and the remainder resident or migrants. Species observed infrequently that indicated important habitat functions include mallard, wood duck, red-shouldered hawk, Cooper's hawk, great egret, belted kingfisher, California quail, and acorn woodpeckers. Ground nesting birds such as California quail and the introduced ring-necked pheasant, along with wood ducks and mallards, generally have poor success in rearing nestlings due to uncontrolled cats and dogs.[35]

The mammal species that presently exist in the Arcade Creek watershed are far fewer than were found in historic conditions. Locally extinct species include grizzly bear, tule elk, black-tailed deer, pronghorn antelope, coyote, ringtail, cottontail, and badger. Native species still extant include California ground squirrel, western gray squirrel, Botta's pocket gopher, beaver, river otter, raccoon, and striped skunk. Other non-native mammals observed include fox squirrel, black rat, Norway rat, house mouse, Virginia Opossum, domestic cat.[36]

Of all the mammals in the watershed, beaver have the most potential to affect watershed functions. This is because they feed on trees and shrubs in the riparian zone and construct dams that can significantly alter the hydrology in those areas immediately upstream and downstream of the dams. Beaver activity has been observed on the main stem of Arcade Creek at and below the Norwood Boulevard bridge, just above the Marysville Boulevard bridge, and just downstream of the Sacramento Northern bike trail crossing. Established beaver dams in these areas have periodically resulted in the creation of emergent and year-round wetlands, which in turn enhance habitat and species diversity. In recent years, river otters have been observed in the lower reaches of Arcade Creek and in the receiving waters of Steelhead Creek inhabiting ponded areas

[35] Stopher, Mark, 1992.

[36] ibid.

created by beaver activity. However, the beavers can also decimate riparian vegetation and severely impede establishment of restoration plantings.

While there are certain wildlife advantages to having beaver in the Arcade Creek system, their continued presence will necessarily be limited by the need to control the impact of their activities on private property and public infrastructure. Where dams impair essential flood conveyance or pose a threat to the levees, they are generally removed by channel maintenance crews to reestablish flow.

Due to the relatively small areas of suitable habitat in the Arcade Creek watershed, it is uncertain to what extent a permanent beaver population can be supported without engendering conflicts with floodwater conveyance and riparian habitat. SAFCA has had considerable experience with beaver management at restoration and levee construction sites using the Progressive Beaver Management (PBM) philosophy. The focus of this approach is to use all management methods that are sub-lethal, reasonable, economically practical, and safe to the public before resorting to depredation. Methods may be used in combination to achieve the best result, and some may be implemented by volunteers or for relatively little cost. Where depredation does have to occur, populations at restoration sites should be reduced first.[37]

Amphibians and reptiles, or herpetofauna, are found in the watershed, but in limited numbers. These populations suffer from predation by dogs, cats, raccoons, skunks, and raptors. They are also displaced or drowned during flood events. Those species known to have recently occurred include southern alligator lizard, sharp-tailed snake, gopher snake, pond turtle, western toad, and bullfrog.[38]

4.10.2 Priority Species

The priority wildlife species known to occur in the vicinity of the Arcade Creek watershed are vernal pool tadpole shrimp, vernal pool fairy shrimp, valley elderberry longhorn beetle, western spadefoot toad, northwestern pond turtle, western pond turtle, bank swallow, Swainson's hawk, Cooper's hawk, and white-tailed kite. All of these species except the latter two are found in wetlands or riparian areas. Known locations of priority species in the vicinity of the Arcade Creek watershed are shown in **Figure 7**.

4.10.3 Fish

Priority Species

Chinook salmon and steelhead trout have not been reported in Arcade Creek in over 20 years. Due to the lack of suitable rearing and spawning habitat and summer low flows, it is not likely that these species would return in the foreseeable future[39]. However, these species do occur in the Sacramento River system and could potentially be affected by the water quality of Arcade Creek. Both of these species have been documented in recent years in Miner's Ravine and Secret Ravine, tributaries of the Dry Creek watershed immediately to the north. While the Dry Creek watershed is not as heavily urbanized as the Arcade Creek watershed, the potential does exist for these species to return to the

[37] Mary Tappel, pers. comm., 2003.

[38] Stopher, Mark, 1992.

[39] Mike Healy, CA Dept. of Fish and Game, pers. comm., 2002.

Arcade Creek system if habitat conditions were to improve. Steelhead in the Central Valley are listed as threatened under the federal Endangered Species Act.

Other native fish species that are likely to occur in the Arcade Creek include tule perch, Sacramento sucker, and several minnow species.[40]

Other Species

Introduced fish species expected to occur in Arcade Creek are similar to those that are found in nearby Dry Creek. These include catfish, bluegill, and mosquito fish.[41] Green sunfish may also be present, and both carp and largemouth bass were reported in 1977.[42]

4.11 Recreational Resources

A wide variety of passive and active recreational opportunities are available to residents of the Arcade Creek Watershed. These include over sixty public parks ranging in size from a few acres to several hundred acres (**Figure 8**). Del Paso Regional Park, operated by the City of Sacramento, is the largest public open space within the watershed and is located along the lower reaches of the main stem of Arcade Creek. The Sacramento Horseman's Association leases facilities from the City of Sacramento within the Del Paso Regional Park which include a network of equestrian trails that are also commonly used by pedestrians and mountain bikers. Other major park facilities located along the creek system include Rusch Community Park on Cripple Creek, and Tempo Community Park and Crosswoods Community Park on Arcade Creek. All three of these parks are located in Citrus Heights and are owned and managed by the Sunrise Recreation and Park District (SRPD). The SRPD will also manage a 4.6-acre neighborhood park and large 20-acre conjunctive use basin on Arcade Creek included in the Stock Ranch property development.

In addition, the SRPD owns four undeveloped properties within the creek corridor that are designated as Natural Park Land in the District's 2000 Master Plan. These include the Cripple Creek Park Site on Edgecliff Court and the Woodside Oaks Park Site on Olivine Drive, which are both on Cripple Creek, the Matheny Way Park Site on Arcade Creek, and the Indian River Drive Park Site located at the Arcade/Cripple Creek confluence. As designated Natural Park Land, these sites are intended to support only passive recreation activities that would not adversely impact the oaks, creek corridor, and other natural resources at the sites.

There are forty-six elementary schools, nineteen middle/high schools, the American River College, and three golf courses within the watershed (**Appendix E**). These facilities are important to include in any consideration of recreational opportunities because they often provide amenities that supplement the public parks. Like parks, they also have large areas of open space that can provide limited habitat benefits.

The recreational opportunities in the watershed include the various sports and activities associated with developed facilities such as soccer, baseball, swimming, golf, tennis and skeet shooting. Passive activities are also available in certain areas such as walking,

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[40] Dennis McEwan, CA Dept. of Fish and Game, pers. comm., 2003.

[41] Mike Healy, CA Dept. of Fish and Game, pers. comm., 2002.

[42] Stopher, 1992.

cycling, horseback riding, bird watching and nature study. While all of these activities occur within the Arcade Creek watershed, most of the passive activities are inherently related to watershed function and generally occur in or near the riparian zone. For example, activities such as fishing or bird watching are only available to the extent that fish and wildlife habitat are present in the watershed.

Currently there are several major issues associated with recreation in the Arcade Creek Watershed. Residents of the watershed are drawn to the remaining natural areas for passive recreation as an antidote to the largely urbanized landscape surrounding them. However, there is a lack of formally designated trails and access points. Within Citrus Heights, there is approximately ¼ mile of improved trail along Arcade Creek from Sunrise Boulevard through Tempo Community Park. In the City of Sacramento, improved trails include approximately 2 miles of the Sacramento Northern Bike Trail alignment which intersects Arcade Creek just downstream of Rio Linda Boulevard. Within the next few years, the City of Sacramento also anticipates completing approximately 4.5 miles of trail along the top of the north Arcade Creek levee from the mouth of Arcade Creek to Marysville Boulevard as part of the Ueda Parkway project. There is an extensive informal network of unpaved trails associated with the Del Paso Regional Park, and approximately 1 mile of trail upstream through the American River campus and Nature Area ending in Arcade Creek Park.

Over time, residents have tended to create informal trails and creek crossings in locations that are poorly suited to repeated foot or equestrian traffic leading to erosion, destruction of vegetation, and stream bank destabilization. In some places, this network of trails is nearly impossible to police because it is complex, difficult to access, not visible from the road, and has poor lines of sight. The lack of formal, well-used trails can thus make an area attractive to homeless encampments and other illegal activities which in turn create safety and public health concerns. The problem is especially evident at Del Paso Regional Park, where the combination of mountain bike, pedestrian and equestrian uses along both the north and south banks of Arcade Creek has resulted in a very complex network of trails and crossings with the attendant bank erosion and water quality impacts.

Access to the creek corridors for recreational use is a second issue. Private properties back on to most of the creek corridors, with the exception of the public sites listed above. The City of Citrus Heights General Plan Open Space element calls for the eventual establishment of a system of public creekside trails using both acquisitions and easements over time as a means to address this problem. However, local residents have expressed concerns about personal safety and protection of their property should such a system be established. Public access is currently provided to the creek corridor at a few key locations such as the schools and park sites mentioned above.

5.0 KEY WATERSHED MANAGEMENT ISSUES

As in most urban watersheds, the Arcade Creek basin has undergone enormous changes in the past 60 years. Land that was once predominantly agricultural has been developed into residential, commercial, and industrial uses and transportation corridors including roads and railroads. Stormwater runoff that previously soaked into the ground or slowly filtered to the creek now flows quickly into storm drains and then into the stream channel. Peak flows in the creek have increased dramatically in volume and the creek channel has become incised, resulting in unstable stream banks, reduction in water quality and the increased probability of downstream flood damage. During major storm events, water backs up behind undersized structures and overflows onto private and public lands. Related problems include erosion and sedimentation.

Arcade Creek watershed is characterized by a very high percentage of residential land and related water quality degradation. Homeowner practices such as the improper use of household chemicals, fertilizers, herbicides, pesticides, vehicle use, and unmanaged animal wastes are a well-documented source of water pollution. These non-point sources clearly have a cumulative impact but are difficult to monitor or quantify. Diazinon and malathion are two of the most important toxicants found in Arcade Creek that exceed water quality standards. Direct and indirect impacts of poor water quality include decreased fish and wildlife in and near the creek, potential human exposure to toxicants, decreased water quality in the Sacramento River, and decreased desire by the public to recreate along the creek corridor. Municipal water supplies for millions of Californians are diverted from the Sacramento Basin downstream of Arcade Creek. Drinking water supply is the most important watershed function, because it has the potential to directly affect human health.

As the greater Sacramento area becomes more urbanized, suitable habitat for many native species is rapidly disappearing. This is particularly true along Arcade Creek, due to the urban nature of the entire watershed. Improving the remaining habitat will be the critical factor in retaining many species in the area. A related consequence of development in the watershed is the loss of wetlands. Wetlands detain stormwater and filter pollutants and provide high-quality habitat for migratory waterfowl and other wildlife, so loss of these resources results in a lower level of the watershed functions that are important to the community.

Throughout the watershed, the riparian forest is severely degraded and in some places non-existent. Restoration of riparian vegetation would improve both habitat quality and recreation opportunities. It can also help stabilize banks and improve water quality. In addition, there are many exotic plant species in the riparian corridor. While not all exotic plants spread aggressively, some species such as yellow star thistle, giant reed, tree of heaven, red sesbania, Himalayan blackberry, vinca, English ivy, and common fig are notorious for crowding out native plants. Uncontrolled cats and dogs are free to prey on wildlife and diminish the value of potential breeding habitat.

Recreation in the watershed is somewhat constrained by a limited connectivity in the trail system, the lack of a designated, improved trail system, lack of access, and concerns about personal safety. Other significant problems found in the watershed include the lack of a designated trail system and limited public access to the creek corridor. The homeless population along the creek, primarily under the bridges, leads to reduced water quality due to the presence of bodily wastes and washing and cleaning in the creek. This also is likely to diminish the recreational use of the nearby trails.

The connection between recreational opportunities and watershed health occurs on many levels. By providing designated trails through natural areas, adverse impacts associated with trail use such as erosion, destruction of vegetation, and habitat intrusion can be limited. There is a direct connection between the availability and quality of beneficial passive recreational uses in the Arcade Creek watershed and watershed functions. When watershed functions are enhanced, recreational uses are also often enhanced.

Keeping habitat intact, and thus keeping wildlife visible and audible, is an important part of creating a positive recreation experience on the creek. Recreational opportunities would be increased and improved by providing additional access and by educating the general public on these opportunities and the resources that exist in the watershed.

6.0 POLICY FRAMEWORK

Various federal, state and local regulations require mitigation measures and other controls on proposed habitat, water quality, flood control, and recreation projects. This chapter provides a brief overview of some of the main regulatory agencies and processes that will be relevant to the eventual implementation of Arcade Creek watershed enhancement measures. Although these and other similar policies may provide some protection for stream channels, they should not be relied upon exclusively to address all impacts. For example, historic encroachment into the floodplain, non-point source pollution, and alterations to riparian habitats, including the introduction of non-native plants and animals, have incurred and to some extent continue to occur in spite of the regulatory programs that are in place today. It is also important to recognize that regulations change over time, and watershed protection efforts may evolve to meet the changing regulatory environment.

6.1 Federal Regulation

Section 404 of the federal Clean Water Act (CWA) prohibits the discharge of fill into "waters of the United States" without a permit form the Corps of Engineers. This includes the ephemeral and perennial drainages in the Arcade Creek watershed, and wetlands that are not isolated. Section 401 requires a water quality certification, which is administered by the Regional Water Quality Board, to be issued for any project that may affect water quality by discharge to a water of the United States.

The CWA also requires, through the National Pollutant Discharge Elimination System (NPDES), that communities and local districts reduce the discharge of pollutants in municipal stormwater to the maximum extent practicable. Sacramento County and the cities of Sacramento and Citrus Heights are all regulated under the same municipal NPDES agreement and the Regional Water Quality Control Board manages the NPDES permit. The permitees are required to monitor both receiving waters and discharges and to develop a target pollutant reduction strategy that systematically implements measures to control those sources.[43] Details of the integration of the NPDES program with the watershed planning process are found in Section 8.2, below.

The National Flood Insurance Program was developed to provide federally subsidized insurance policies to the owners of flood plain properties, and to provide incentives to local government to plan and regulate land use and building design in flood hazard areas.[44] The federal government began floodplain mapping in the late 1960's. In California, it is estimated that the Federal Emergency Management Agency (FEMA) has now mapped approximately 15,000 miles of stream systems by both detailed and approximate study methods, or less than 10% of all streams. Even those areas that have been mapped need to be updated, and FEMA mapping support is diminishing, with the burden shifting to the State of California to support future mapping needs.[45]

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[43] California Regional Water Quality Control Board, Central Valley Region, 2002. NPDES No. CAS082597

[44] Placer County Flood Control and Water Conservation District, 1990. *Stormwater Management Manual.*

[45] Dept. of Water Resources, 2002. Existing Floodplain Mapping website. http://www.fpm.water.ca.gov/mapping/existing_mapping.html

6.2 State Regulation

The California Environmental Quality Act (CEQA) requires that local agencies disclose potential impacts and consider mitigation measures, including potential impacts to water quality, flooding, and fish and wildlife. Mitigation requirements may be identified in a regional plan or in master drainage plans.

The Porter-Cologne Water Quality Control Act gives the state primary responsibility for water quality. This authority is promulgated through the State Water Resources Control Board and the various Regional Water Quality Control Boards.

The California Department of Fish and Game regulates alterations to stream channels under Section 1600. An agreement with Fish and Game is required for all such alterations, and the agreement may be conditioned to protect fish and wildlife.

The State Department of Water Resources (DWR) conducts tree and debris removal from riparian areas. DWR also has a Division of Flood Management that assists with floodplain mapping and the dissemination of floodplain maps.

The potential impacts to beneficial uses from diazinon and chorpyrifos are being examined through the Water Quality Management Strategy developed by the Organophosphate Pesticide Focus Group, and by the Total Maximum Daily Load (TMDL) strategy being developed by the Central Valley Regional Water Quality Control Board. The parameters of greatest concern for drinking water quality (TOC, TDS, nutrients, and pathogens) are still largely unregulated by the Regional Water Quality Control Board (RWQCB) and the Water Quality Control Plan (Basin Plan). The RWQCB is currently implementing a work plan for the development of an effective drinking water policy. This policy is expected to specifically address these parameters of concern and to establish water quality objectives for eventual inclusion in the Basin Plan. Future drinking water regulations may require agencies treating Delta water to implement additional treatment at increased costs.[46] Moreover, as the general public becomes more educated on their drinking water supply and the potential for contamination with metals, pesticides, and other toxicants, they may demand increased monitoring, source controls, and/or treatment.

6.3 Local

General Plans are used by local governments to define goals and policies regarding land use and development, and are the basis of many ordinances and Specific Plans. General Plans also grant discretionary powers to local planning commissions to impose mitigation measures and other conditions on projects. Sacramento County and the cities of Citrus Heights and Sacramento each have adopted General Plans that pertain to portions of the Arcade Creek Watershed. Proposed watershed enhancement projects will need to be evaluated for consistency with these plans as well as the local ordinances that implement the General Plans.

In 1980, the Sacramento County Board of Supervisors adopted resolution 80-531, establishing a policy that wherever possible, naturally occurring streams in the unincorporated part of the County "shall be retained in their natural condition and shall not be channelized, realigned or otherwise modified to accommodate the use of

[46] Sacramento River Watershed Program, 2002.

adjoining land". The Citrus Height General Plan includes a Resource Conservation element with specific goals and policies to provide for the preservation and enhancement of natural areas, including creeks, woodlands and wetlands. The City of Sacramento's General Plan contains comparable goals and policies in the Conservation and Open Space Element.

7.0 WATERSHED ENHANCEMENT STRATEGIES

This chapter outlines strategies for making enhancements in the four goal areas defined by the watershed group: flood control, water quality, habitat, and recreation. In addition, several integrated project opportunities are identified based on the recommendations from the Arcade Creek Feasibility Study (2002). These project recommendations are included in order to provide some specific suggestions for enhancement that may be implemented immediately.

These watershed management strategies are designed to be realistic, of high priority, and to address multiple goals in an integrated manner. It is also anticipated that these strategies will be periodically evaluated and revised as the need arises. Several guiding principles were used to arrive at these recommendations. These are:

- Use an ecosystem approach. This includes the recognition that all actions in the watershed, including restoration and enhancement, affect other watershed functions. Other important concepts include the awareness that stream channel morphology is a response to the hydrologic regime, riparian forests proceed through a natural succession, including the generation of snags and LWD, fish and wildlife populations are largely a response to the habitat available to them, and that building long-term sustainability into the landscape is the most effective strategy for preserving and expanding wildlife populations.

- Work with the landscape. This means working in harmony with the naturally occurring conditions and characteristics of the landscape rather than against them. For example, naturally occurring depressional areas should be considered first for constructing detention storage to minimize excavation costs and impacts.

- To the extent possible, develop projects that provide benefits in meeting at least two of the four goals, as opposed to narrowly focused projects. For example, projects to minimize flood damage should be designed to enhance habitat.

- Recognize that both flooding and erosion are natural processes that have been exacerbated by human activities. The goal should be to minimize the negative aspects (i.e., flood damage), rather than control the natural process of flooding itself.

- Maximize cost-effectiveness and minimize maintenance requirements.

7.1 Flood Protection

Mitigation of damage to properties from flooding must be addressed at the watershed level to effectively decrease the potential for damage when major storm events occur. High flows are the primary force that determines stream channel morphology. Compared to non-urban streams, some reaches of Arcade Creek are deeply incised by greatly increased volumes and velocities of peak flow. The desire to control flooding results in armoring of stream banks, constructing levees, straightening of channels, removal of woody vegetation and debris, and other techniques that significantly degrade the quality of the habitat and water quality in the stream corridor. The increase in floodwaters and correspondingly greater impacts to the stream system arise from the decreased permeability of the landscape in an urban environment and the stormwater conveyance system itself, which increases the rate of runoff and decreases the time for floodwater to enter the creek channel.

The overall goal is to provide additional measures to minimize flood damage to both public and private property. Decreasing floodwater damage is important to home and business owners along the creek, as well as the overall economy of the region. With questionable funding for floodplain management for the foreseeable future, it is crucially important that all preventative measures be implemented.

The best solution to flooding and other problems in small urban catchments like the Arcade Creek Watershed is to detain stormwater in small volumes as near to its source as possible, and then to release the flows slowly to natural stream channels or to groundwater. Since most urban runoff is originates on impervious surfaces, such as rooftops and parking lots, one obvious method of runoff control is the storage of the water in these very areas.[47]

There may also be opportunities to increase the natural flood storage capacity of the landscape.[48] This strategy may include widening the floodplain or installing partial hydraulic controls in the main channel. Another strategy would be to detain stormwater in small quantities close to where it is generated, allowing sediments to settle out, and then diverting the flows to natural topographic depressions with permeable soils and maintaining native vegetation and natural channels as much as possible.

The specific objectives are to attenuate flows in the upper watershed and to provide flood damage prevention in the middle and lower watershed by maximizing the size of and access to the floodplain.

The following projects and practices should be considered to better mitigate the impacts of flooding within the Arcade Creek Watershed:

- FP1 - Encourage local jurisdictions to continue prohibitions on the development of property within the 100-year floodplain.

- FP2 - Encourage local jurisdictions to require all new development projects within the watershed to fully detain stormwater runoff on site. This would include clearing, grading, parks, schools, remodels, and expansions. Fees could be paid in lieu of detention on-site.

- FP3 - Encourage property owners to implement measures to detain stormwater on site and to eliminate dry season runoff from their properties. Conduct a study to evaluate the feasibility of retrofitting rooftops, parking lots, and recreational areas for use as detention facilities, and the feasibility of taking advantage of using the potential for flood storage within the natural landscape.

- FP4 - Encourage local jurisdictions to purchase or retrofit properties within the 100-year floodplain to prevent flood related damage. There are 40 to 60 such structures between Roseville and Marysville Roads. Units can be raised above the probable high water level, but this method is costly and may decrease capacity

[47] Dunne and Leopold, 1978.
[48] City of Sacramento, Dept. of Parks and Recreation, 2002. *Arcade Creek Feasibility Study.*

of the floodplain. Flood proofing by rendering buildings or other infrastructure less vulnerable to flood-related damage is another strategy.

- FP5 - Improve detention of storm water away from the creek to decrease the depth and velocity of flood flows, using a variety of scales from on site detention ponds to regional detention facilities. Since much of the watershed is developed, property may need to be acquired and converted for this purpose.

- FP6 - Allow flooding to occur on sections of the creek to lower peak flood levels and benefit riparian vegetation. Identify vacant sites and public open space along the creeks to be considered for prescriptive flooding, particularly in those areas where flooding is compatible with an existing or proposed conjunctive use, such as sports fields that are not utilized during the rainy season. Look for locations where minor topographic modifications can be used to reintroduce flooding into disconnected backwater channels or sloughs.

- FP7 - A small benefit may be achieved by reducing flood damage with good land use. This would include planting trees and erosion control, but they are only incrementally effective.[49]

- FP8 - Maintain the channels by removing the trash and excess woody debris in a manner that does not compromise habitat functions.

- FP9 - Conduct specific studies as follows: stream channel topographic survey for the entire watershed, an impervious surfaces inventory, and a sediment budget. These data will be critical to specific plans for detention facility location, retention facility location, and wetland restoration or construction.

7.2 Water Quality

Improving water quality is important for its own sake and a necessary first step towards improving habitat and recreational opportunities. The water quality of Arcade Creek does not meet current standards, and therefore may be the most important goal for Arcade Creek because water quality affects so many other aspects of the stream system. Improving water quality also improves habitat quality for aquatic species and thus the terrestrial species that prey upon them. This in turn increases the recreational value to people. Aside from increasing the presence and diversity of wildlife, clean water in and of itself is more appealing to recreational users. Additionally, poor water quality may be detrimental to the health of the users of the creek system, whether human or wildlife. It is possible that there currently exists a real danger from eating fish or waterfowl taken from the stream.

The overall goal is to develop and implement a plan to improve and monitor water quality of Arcade Creek and its tributaries, with special emphasis on pesticide levels and other toxicants in stormwater runoff. The specific objectives are to implement source controls for toxicants and to control erosion and sedimentation in the watershed.

Point sources are readily identified, since they are discharges from factories, wastewater treatment plants or other facilities. Non-point sources, as noted above, are diffuse in nature, and their identification typically requires additional effort.

[49] Dunne and Leopold, 1978.

For example, there is a large storm drain outfall approximately 84” in diameter located just east of the Sacramento Horseman’s Association facility adjacent to Arcade Creek on Longview Road. Even during dry weather, a turbid discharge was observed at this site. The stormwater system map indicates that this discharge could be from Interstate 80, the light rail stations, discharge from washing construction equipment, runoff from areas with livestock, or all the above.

The overall approach in abatement of water quality problems is to identify sources of pollutants and then develop strategies for reducing the loading to Arcade Creek. These strategies will include replacing toxic materials with less toxic substitutes, education, and the design and construction of non-point pollution control facilities, such as grassed swales and detention facilities. Source controls are likely to be the most effective and least costly means for improving the water quality on Arcade Creek.

The projects and practices that should be implemented to improve water quality in the watershed include:

- WQ1 - Develop a comprehensive map of the subsurface stormwater infrastructure and associated conveyance into and out of watershed.

- WQ2 - Expand the existing City of Sacramento Department of Utilities’ program for homeowner education and outreach to include other jurisdictions in the watershed and to emphasize a comprehensive approach to reduction of household water quality impacts.

- WQ3 - Identify opportunities for retrofitting large parking lots such as those found at American River College and Sunrise and Birdcage Malls with oil/water separation vaults or, if space is available, above ground vegetated filtration swales.

- WQ4 - Identify locations to filter runoff from roads and parking lots using detention ponds, grassed swales, filter strips, constructed wetlands, or water quality basins,

- WQ5 - NPDES program implementation, including monitoring, source identification and reduction of pollutants to the “maximum extent practicable” are a priority for the cities of Sacramento and Citrus Heights and for Sacramento County. The target pollutants of concern are, among others, diazinon, chlorpyrifos, copper, lead, mercury, and coliform/pathogens. The permit requires the evaluation and reduction of toxicity, and the use of treatment controls for new and significant redevelopment projects.

- WQ6 - Develop an on going and comprehensive water quality monitoring plan for the watershed specifying number and location of sampling sites and desired assays. The plan should incorporate required NPDES monitoring and should be coordinated with the USGS NAWQA program, which will begin formulating high intensity monitoring plans for the Sacramento River basin in the winter of 2003/2004. Monitoring requirements under the NPDES permit include monitoring of conventional parameters, toxicants, and bioassays. These bioassays are used to identify toxicity and to provide the basis for Toxicity Reduction Evaluations (TRE).

- WQ7 - Provide ready access to the water quality monitoring data to watershed stakeholders to support multiple efforts for water quality enhancement.

- WQ8 - Enhance public awareness of water quality issues and impacts. The NPDES permitees are required to maintain a "hotline" for members of the public to report stormwater problems, as per the SQIP.

- WQ9 - Identify major users of pesticides in the watershed, what is being used, how its use is being regulated, and recommend alternatives.

- WQ10 - Encourage the practice of Integrated Pest Management (IPM) through incentive programs, education and/or regulation,

- WQ11 - Continue to prohibit development adjacent to the creek to prevent direct runoff of potential pollutants and encourage the planting of vegetative buffers for development already adjacent to the creek,

- WQ12 - Ensure that Storm Water Pollution Prevention Plans are followed,

- WQ13 - Establish regulations for new and re-development that require the capture and filtering of the initial runoff from a storm, which typically carries the majority of the water pollution. This is a requirement of the NPDES permit.

7.3 Habitat

Due to the urbanized nature of the Arcade Creek Watershed, much of the suitable habitat for many native species has disappeared. Preserving and improving what habitat remains may be the only hope for retaining the species that are extant in the area.

Almost all remaining natural habitat is constrained or adjacent to the creek corridors. These areas are thus a high priority for preservation and enhancement. The habitat value of the creek corridors is variable throughout the watershed. In some areas, the width of the riparian forest is severely constrained by the encroachment of development into the flood plain. The proliferation of invasiv e non-native species, bank erosion, water quality impairment, and human intrusion also compromise habitat quality. All of these impacts contribute to the high degree of habitat fragmentation, which further exacerbates wildlife viability since species must be free to move and disperse between habitats in order to retain diversity and healthy populations. Poor water quality is a wildlife habitat limitation because it contributes to reduced aquatic food sources.

Two major issues that need to be addressed to improve fish habitat specifically are poor water quality and excessive stream temperatures. Of these, water quality is probably the current limiting factor and the more difficult to address. The recommendations below do not address water quality issues directly since these are already called out in the prior plan section. It is expected that implementation of the recommended water quality enhancement measures will provide synergistic benefits for habitat as well. Other fisheries habitat issues include eroding stream-banks, lack of structure in the channel, and lack of shelter.

Specific recommendations for preserving and enhancing habitat within the watershed include:

- H1- Conduct additional inventories and assessments using the comprehensive methodology from the Marysville Blvd. to Sacramento City limit Feasibility Study in other priority areas in the creek system to better identify constraints to habitat, the location of high quality habitat that should be preserved, and opportunities for enhancement. The results of this assessment will provide specific information about the location of barriers to passage, outfalls, erosion 'hot spots', and infestations of exotics in order to implement the following recommended remediation actions.

- H2 - At locations where stream passage is compromised by culverts, weirs, and other structures, redesign structures to improve passage as feasible without adversely impacting flood control objectives.

- H3 - Removal of all exotic plants from riparian areas would require a high level of funding and ongoing maintenance as they re-colonize the watershed. Given that the removal of all exotic plants is not feasible, a more realistic goal would be to selectively remove the most invasive exotic trees and shrubs and the most problematic riparian plants, such as giant arundo and red sesbania. Native trees and shrubs should be planted to replace removed exotics.

- H4 - Provide additional canopy closure and channel shading, and increase riparian habitat width through revegetation with native species in areas that are sparsely vegetated.

- H5 - Improve bank stability, reduce erosion and protect mature oaks at the top of bank through a combination of techniques including re-contouring of steep banks, revegetation, and bioengineering.

- H6 - Snags serve an important habitat function by providing sites for roosting, refuge and food supply. However, they may also be considered hazardous if they can fall on trails or other areas where people are likely to be present on an excessive fuel load in some situations. Identify snags to be preserved in areas where they do not present these problems and communicate the preservation plan to local jurisdictions that maintain creek channel vegetation.

- H7 - Encourage local jurisdictions to retain large woody debris in the channel in locations where it can be secured in a lateral alignment with the bank or otherwise positioned to prevent obstruction of flow and increased flood hazard.

- H8 - Provide landowners with information and assistance in implementing effective approaches to erosion control and bank stabilization;

- H9 - Educate the public on the need for controls on pets and livestock to prevent impacts to wildlife and water quality.

- H10 - Conduct a watershed beaver census and evaluation of vegetation impacts as the basis to formulate a policy for stakeholder agency endorsement addressing beaver management strategies including circumstances in which beaver dams do not need to be removed, relocation, and controls. The policy should incorporate the Progressive Beaver Management or 'PBM' approach for situations when beaver damage restoration plantings, or threaten mature native riparian trees with girdling and/or felling at or near restoration and/or mitigation sites.

- H11 - Encourage homeowners to consider including more native species in their landscapes and to make plant choices that provide functional habitat values such as nesting, cover, and foraging opportunities since the native habitat matrix is no longer intact.

- H12 - Conduct an assessment of the current condition of oaks in key locations in the watershed such as the American River College Nature Area to evaluate mortality, regeneration, and model future succession.

7.4 Recreation

Properly managed recreation within the Arcade Creek Watershed will not only enhance the quality of life for local residents but can also help to foster greater awareness and stewardship of watershed resources. Preservation and enhancement of habitat is an important part of creating a positive recreation experience on the creek because it keeps wildlife visible and audible. The overall goal is to ensure continued recreational access to the resources of the Arcade Creek Watershed and provide new recreational options to its residents.

The recommended strategies and projects for enhancing recreation in the watershed are:

- R1 - Conduct a comprehensive review of informal trail use in the creek corridor and identify those areas with heaviest use and greatest actual or potential adverse impact on habitat, water quality or public safety. Prioritize which trail sections need closure, relocation, renovation, and/or additional patrol.

- R2 - As informal trails are closed, provide for revegetation of trail, public notification, and signage to direct users to alternate routes.

- R3 - Develop a conceptual plan for a multi-jurisdictional Arcade Creek Watershed trail system. This plan should describe a continuous system of off- and on-street multi-use trails that will provide controlled access to the creek corridor and connections to parks and schools. Incorporate information from the study of existing informal trail use, and identify key locations for access points, bridges, constraints to access to protect private property interests, and areas for staging, parking, restrooms, and picnic areas. Potential connections to other planned or existing regional trail systems should also be indicated including the Ueda Parkway, the American River Parkway, and the Dry Creek Greenway.

- R4 - Include the public and watershed recreation providers in development of trail plan and decisions regarding modifications to existing trails.

- R5 - As long as habitat and water quality are not compromised, encourage the placement of off-street bicycle, pedestrian and equestrian trails following the creek corridors.

- R6 - Review design standards currently in place with local jurisdictions for trails, staging areas, rest stops, and picnic sites and make recommendations for modifications to limit impacts to habitat such as the use of elevated boardwalks, access control measures (bollards, post and cable fencing, etc.)and pervious surfaces.

- R7 - Develop an interpretive signage program for the trail system including information about natural resources, history, directions, and stewardship.

- R8 - Erect barriers as needed to limit motorized vehicle access to the riparian zone to emergency and maintenance vehicles only.

- R9 - Develop a public education and involvement strategy with the recreation districts, Sacramento County, Citrus Heights and Sacramento to encourage trail use that is sensitive to habitat and water quality issues and encourages stewardship of the trail system.

- R10 - Identify which entities have patrolling, enforcement, and maintenance responsibility for the various sections of trail within the watershed and post this information to assist the public in reporting unsafe conditions or environmental issues.

7.5 Integrated Project Opportunities

Several key projects have been identified as part of the Arcade Creek Feasibility Study completed in 2002 for the portion of the creek between Marysville Blvd. and the City of Sacramento city limits. These projects are further described in **Appendix D** of this report and include the Auburn Park Detention Basin northeast of Renfree Park, the Softball Complex Wetlands adjacent to the Sacramento Softball Complex, and the Arcade Creek Trail Corridor between Marysville Boulevard and Del Paso Boulevard. These projects were chosen for their integration of multiple restoration or improvement goals. They are presented in the report at a conceptual level and should be studied in greater detail to determine the full feasibility of the recommendations, including costs and benefits.

The **Auburn Park Detention Basin** combines a settling basin, a filtration wetland, a detention basin, and bicycle and equestrian trails with interpretive signage and a trailhead at Renfree Park. The settling basin and filtration wetland function to polish the stormwater first-flushes from an outfall emptying into the site from south of Auburn Boulevard. These initial stormwater flows are often the most toxic and the most important to treat. The detention basin, designed for the 100 year storm, catches the highest flows from the outfall, mitigating the contribution of this drainage to Arcade Creek flooding. Recreation trails connect the site to the proposed regional system along Arcade Creek, and a trailhead and information kiosk at Renfree Park provide access and educational opportunities to visitors.

The **Softball Complex Wetlands** project includes creation of wetlands on a site where they were likely to have been before the region was developed. Additionally, it may be feasible, depending upon site topography, to connect these wetlands back to Arcade Creek via a high water flow channel that would replenish the water in this system during flood events. Even if this is not possible, a perennial pond might be established northeast of the softball fields that would provide high-quality habitat to migratory birds and local wildlife. Such an amenity, in proximity to the softball complex, would offer educational and recreational benefits to visitors via interpretive signs and a system of trails that connect to the regional system. One of the challenges to improving this site that is also an asset to the proposed program elements is the need to protect the existing vernal pools and mature oak trees.

The **Trail Corridor improvements** between Marysville and Del Paso Boulevards include two main concepts: developing a regional trail system and laying back the creek banks. The component pieces of this comprehensive project are the **Hagginwood Park, Pilgrim Court**, and **Del Paso Boulevard Staging Area** projects identified in **Appendix D**. The benefits of connecting a trail along Arcade Creek with the Ueda Parkway have already been discussed. Two important linkages that would be made by this trail are connecting the Ueda Parkway to Del Paso Park and to the light rail station. Widening the stream channel by laying back the banks would allow replacement of the existing bank armoring with bioengineered solutions that reduce erosion while providing wildlife habitat. This would help reintroduce woody vegetation to shade the stream and reduce summertime water temperatures. The increased flood capacity would also allow the introduction of in-channel structures such as boulders to redirect the low-channel flow and provide shelter and diversity to fish and other aquatic wildlife. Improving the natural aesthetics of this segment of the creek would also promote additional recreational users of the trail.

These projects, if implemented will make significant contributions to the wildlife habitat and recreational opportunities within the study area. While they may not result in major improvements to the water quality or flood capacity by themselves, combined with concerted efforts in the watershed targeted at pollution source control and floodwater detention, they will help to return this stream system to a healthier and more stable regime.

7.6 Plan Revision

The Arcade Creek Watershed Management Group should update this watershed plan every two years, with a brief summary report of progress and challenges, including a summary of the results of the SQIP and the results of the NPDES monitoring. The plan should be revised to reflect changing conditions and priorities.

8.0 GLOSSARY

Abiotic: The non-living components of an ecosystem, such as soil, climate, and hydrology.

Adaptive Management: A systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. It is designed to experimentally compare selected policies or practices, by evaluating alternative hypotheses about the system being managed.

Alluvial: Composed of sediment deposited by flowing water.

Ambient: Surrounding.

Anthropogenic: Human induced.

Aspect: A particular direction, such as south.

Attenuation: The reduction in strength, force, or amount.

Bedload: The material moved by a river, exclusive of water, e.g., silt, sand, gravel, cobbles, and boulders.

Beheaded drainages: A drainage that has been separated from the headwaters by a shift in the earth's surface.

Biodiversity: Biological diversity, such as the number and types of species in an ecosystem.

Biogeography: The study of the spatial distribution of life forms.

Channelization: The excavation, deepening, and straightening of channels to convey flows at a greater rate.

Chaparral: Shrubs and small trees.

Checkdam: A small dam designed to retard the flow of water and sediment in a channel, used especially for controlling soil erosion. Also used in channels to divert intragravel water toward surface water for interchange of dissolved gases.

Desiccation: The process of thoroughly drying out.

Endemism: The property of being confined to a particular region.

Fry: The early stage of life of salmon and trout after the yolk sac has been absorbed.

Herptiles: Reptiles and amphibians.

Hydraulics: The science and technology of the behavior of fluids.

Hydrology: The science of the behavior of water from the atmosphere into the soil.

Incision: The downcutting of a channel; also known as degradation.

Instream Cover: Areas of shelter in a stream channel that provide aquatic organisms protection from predators or competitors and/or a place in which to rest and conserve energy due to a reduction in the force of the current.

Montane: Growing in mountain areas.

Morphology: The biological study of the form and structure of living organisms.

Niche: The set of functional relationships of an organisms or population to the environment it occupies.

Non-Point Source Pollution: Variable, unpredictable, and dispersed pollution sources from agriculture, silviculture, mining, construction, saltwater intrusion, waste deposition and disposal, and pollution from urban-industrial development areas.

Palustrine: A type of wetland that is a shallow freshwater system, such as a marsh or pond.

Point Source Pollution: Steady, predictable, and concentrated through "end of pipe" discharges from manufacturing and water treatment plants.

Propagules: Reproductive structures in plants, such as seeds, tubers, and spores.

Rhizomatous: Sending subsurface spreading roots.

Riparian: Pertaining to anything connected with or immediately adjacent to the banks of a stream or other body of water.

Riverine: Associated with a river system, e.g., a riverine wetland,

Sag ponds: A pond that has formed where the surface of the soil has subsided.

Salmonids: Fish of the family Salmonidae, including salmon, trout, char, whitefish, ciscoes, and grayling. Generally, the term refers to most salmon, trout, and char.

Savanna: Grassland with dispersed trees.

Scour: The process by which a channel is deepened through the action of moving water.

Sediment: Fragmental material that originates from the weathering of rocks and decomposition of organic material that is transported by, suspended in, and eventually deposited by water or air, or is accumulated in beds by other natural phenomena.

Serpentine: A type of soil and rock substrate that typically supports specialized plant communities because of its chemical properties.

Sinuosity: The ratio of channel length between two points on a channel to the straight-line distance between the same two points.

Substrate: The mineral and/or organic material that forms the bed of the stream.

Taxa: Plural for groups and kinds of organisms, e.g., families of plants.

Total Maximum Daily Load (TMDL): Maximum amount of pollutant or sediment a water body can receive and still satisfy water quality standards.

Trophic: Of or pertaining to nutrition, or the level of feeding in an ecosystem.

Turbidity: a) Relative water clarity; b) A measurement of the extent to which light passing through water is reduced due to suspended materials.

Watershed: Total land area draining to any point in a stream, as measured on a map, aerial photo or other horizontal plane. Also called catchment area, drainage area, and basin.

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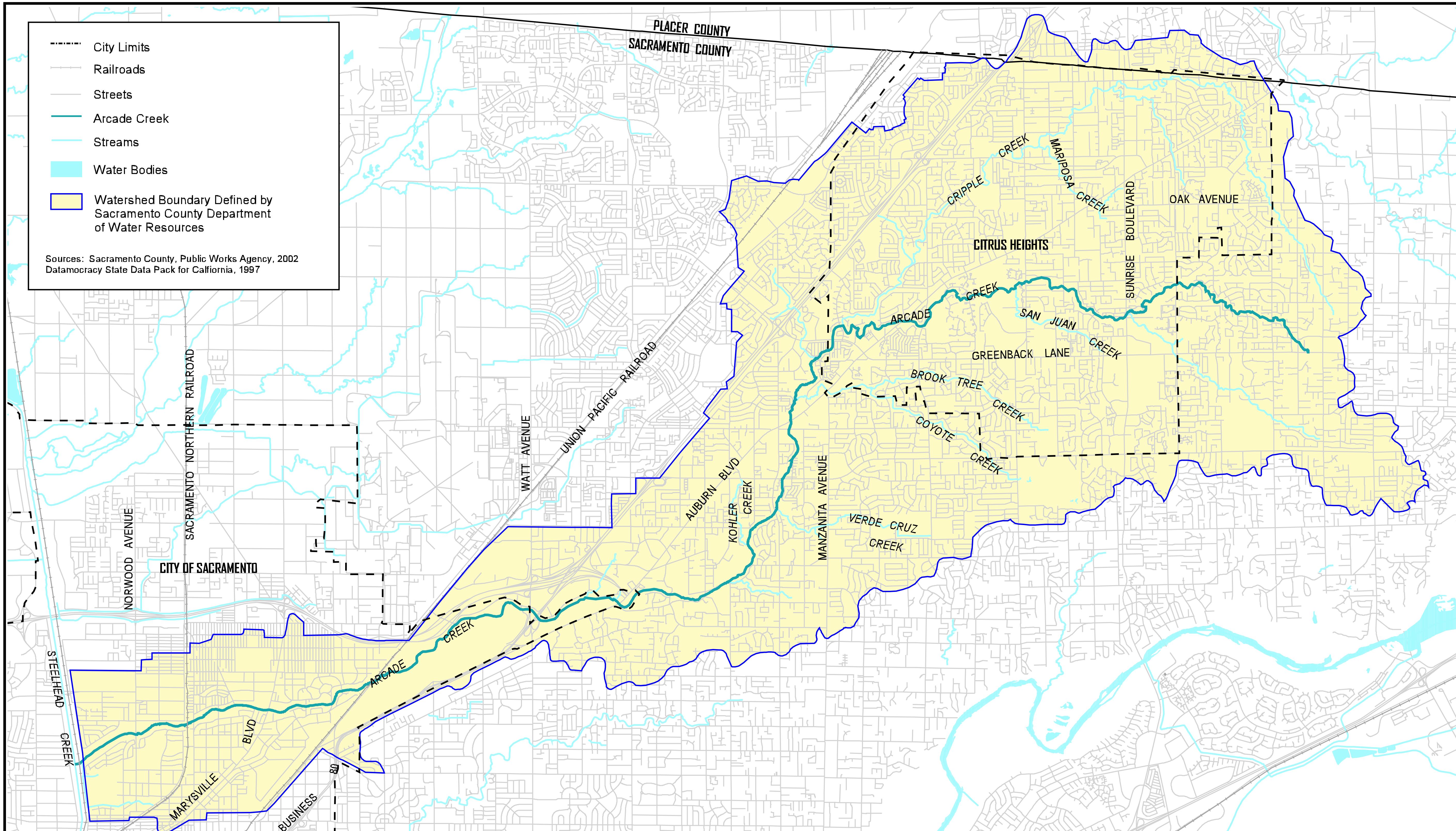

ARCADE CREEK WATERSHED

FOOTHILL ASSOCIATES
ENVIRONMENTAL CONSULTANTS
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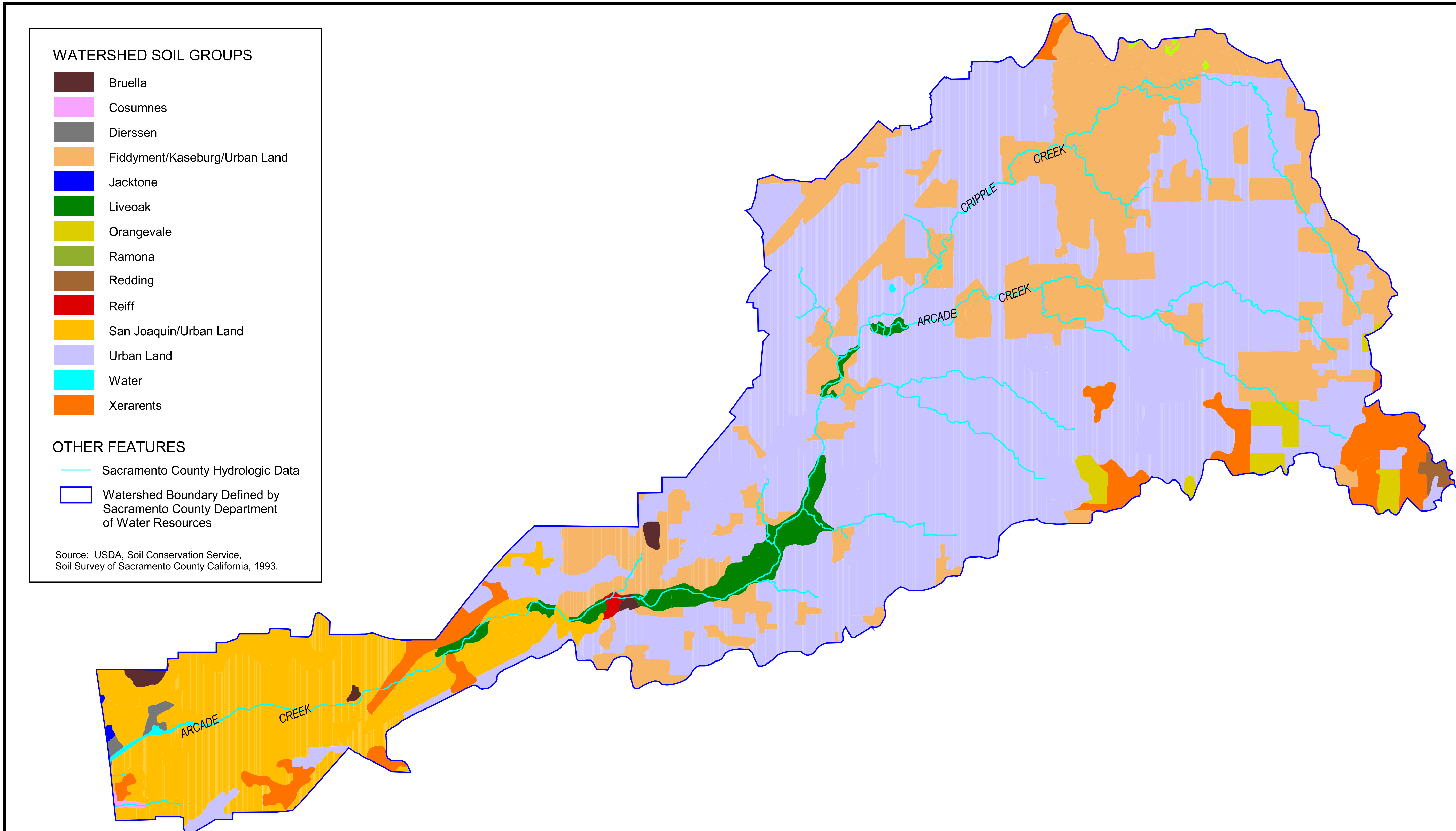
SCALE IN MILES 0 0.5 1.0

FIGURE 1



GENERALIZED SOIL UNITS IN ARCADE CREEK WATERSHED

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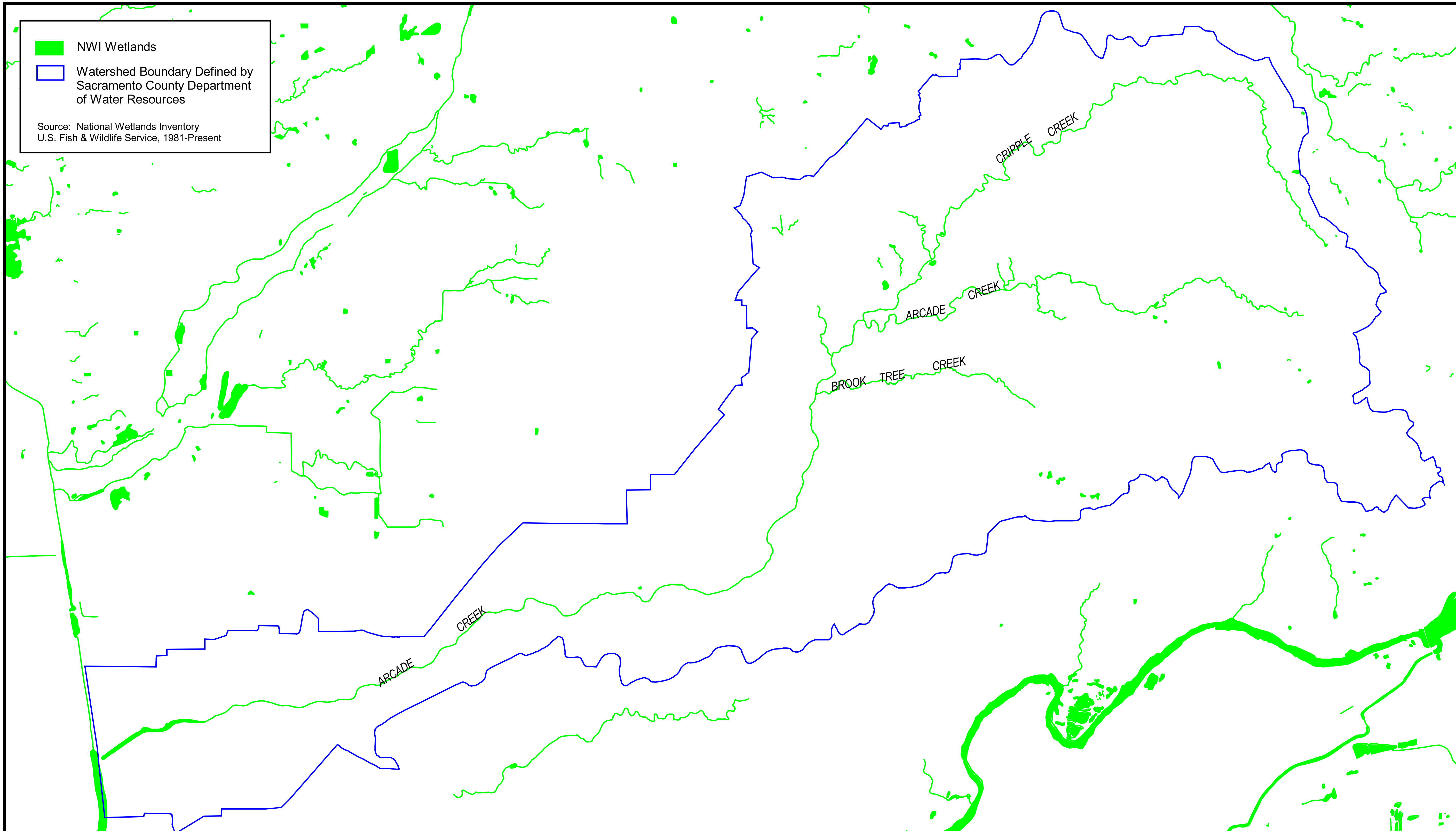
FIGURE 2



NATIONAL WETLAND INVENTORY FOR ARCADE CREEK WATERSHED

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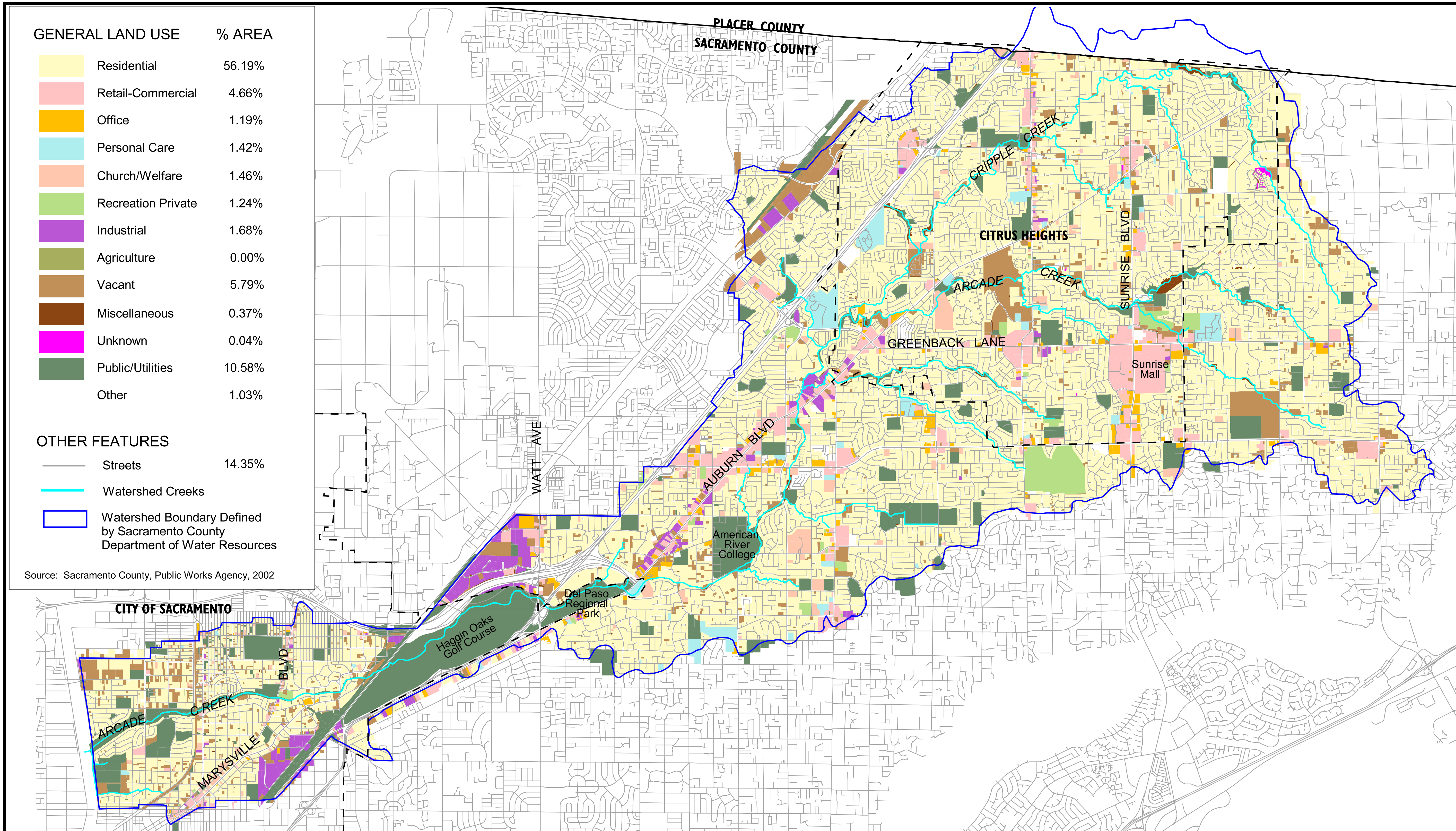
SCALE IN MILES 0 0.5 1.0

FIGURE 3



GENERAL LAND USE IN THE ARCADE CREEK WATERSHED

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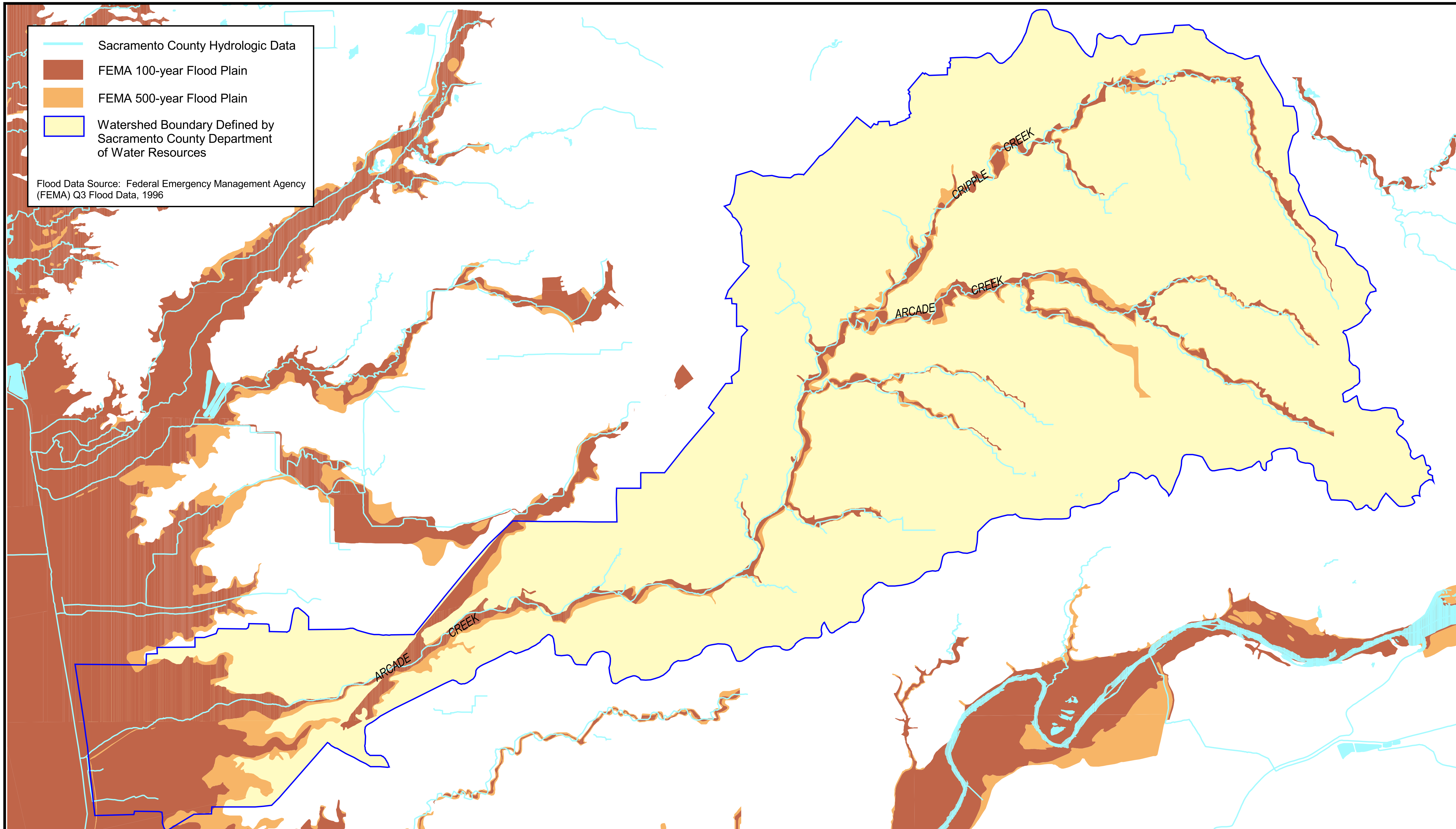
SCALE IN MILES 0 0.5 1.0

FIGURE 4



FEMA FLOOD PLAIN FOR ARCADE CREEK WATERSHED

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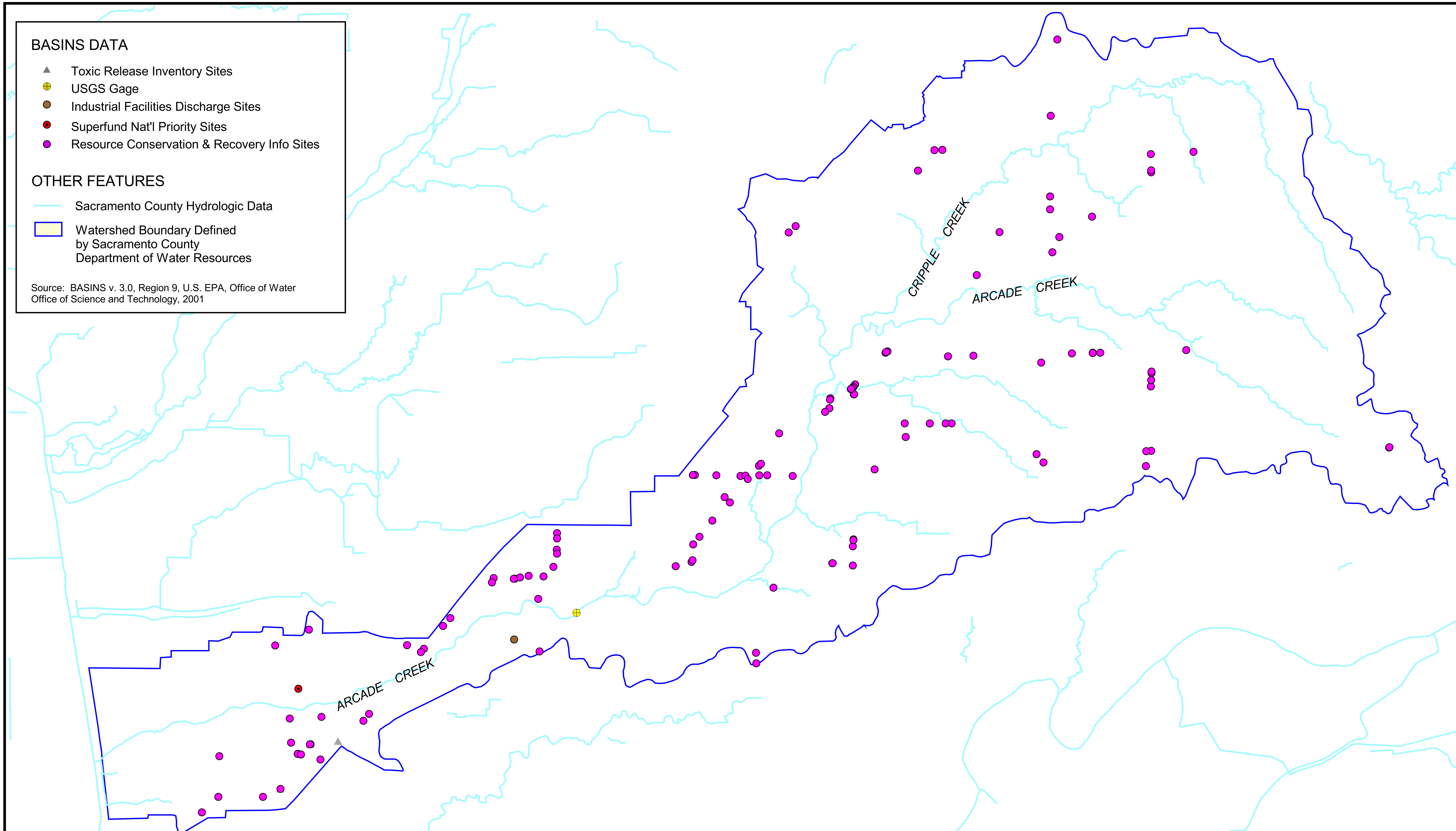
FIGURE 5



SOURCES OF TOXICANTS IN THE ARCADE CREEK WATERSHED

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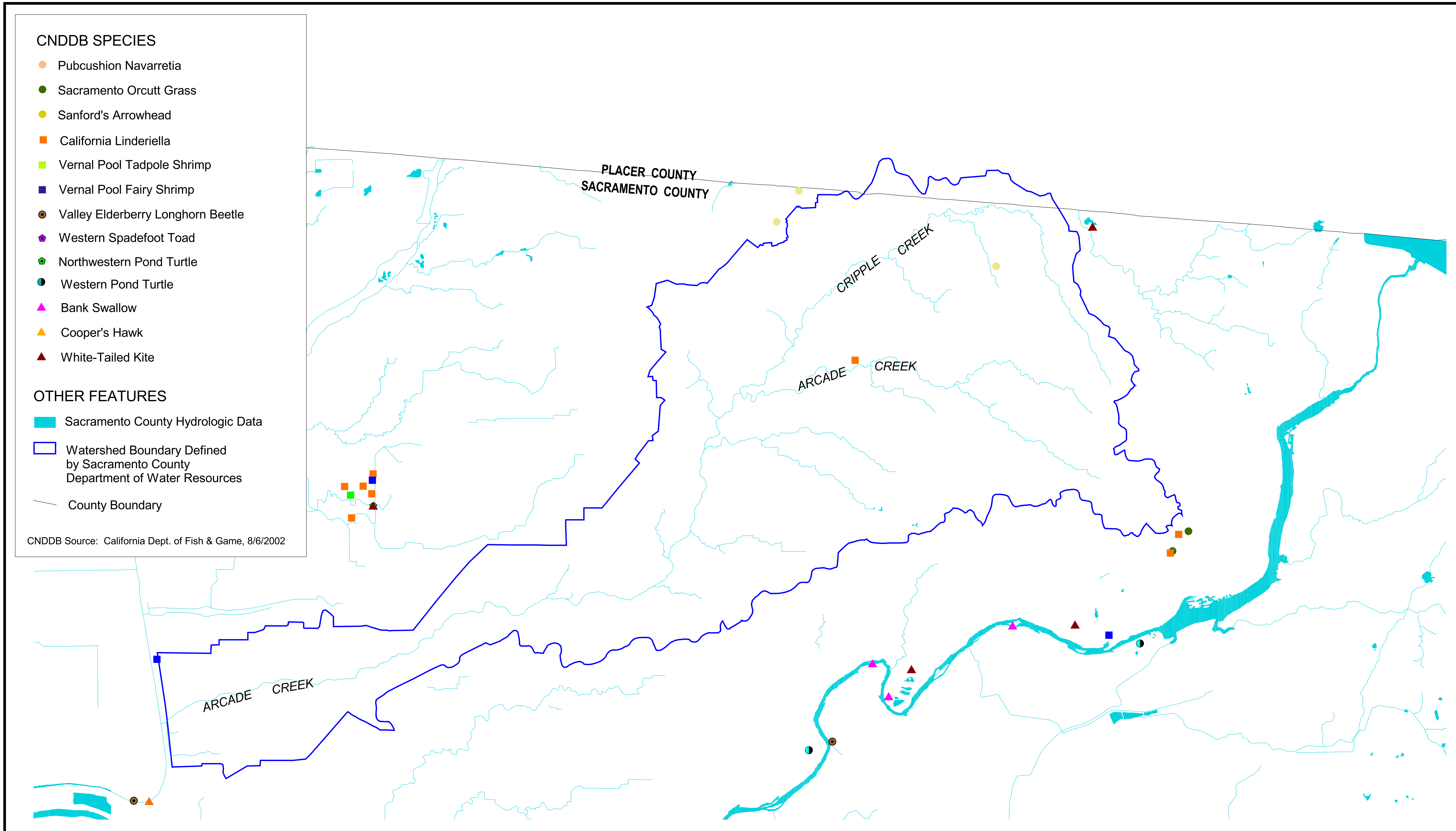
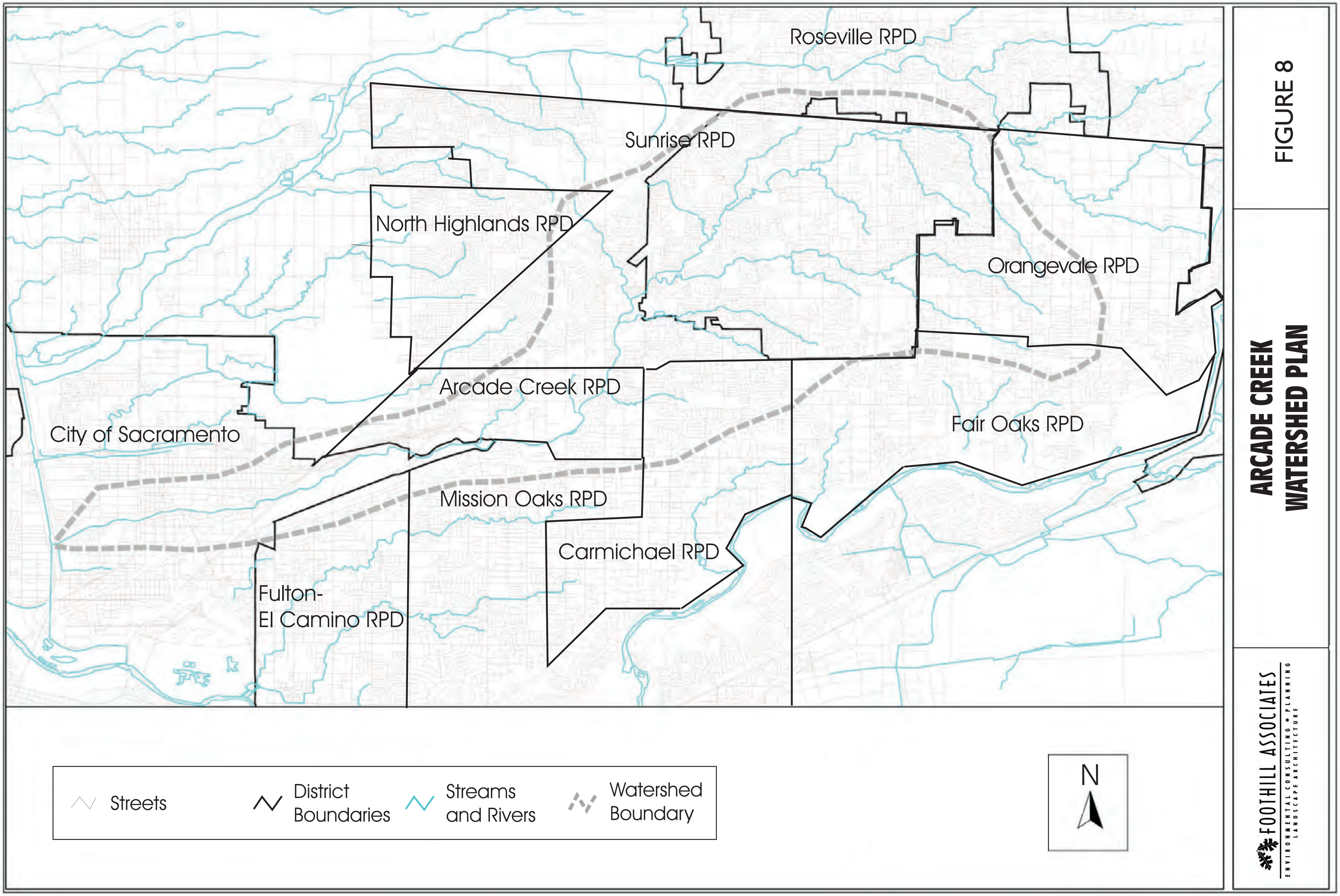
SCALE IN MILES 0 0.5 1.0

FIGURE 6



CNDDB FOR THE ARCADE CREEK WATERSHED AND SURROUNDING AREA

FOOTHILL ASSOCIATES ENVIRONMENTAL CONSULTANTS ©2003	N	SCALE IN FEET 0 3500 7000	FIGURE 7



Park and Recreation Districts in the Arcade Creek Watershed

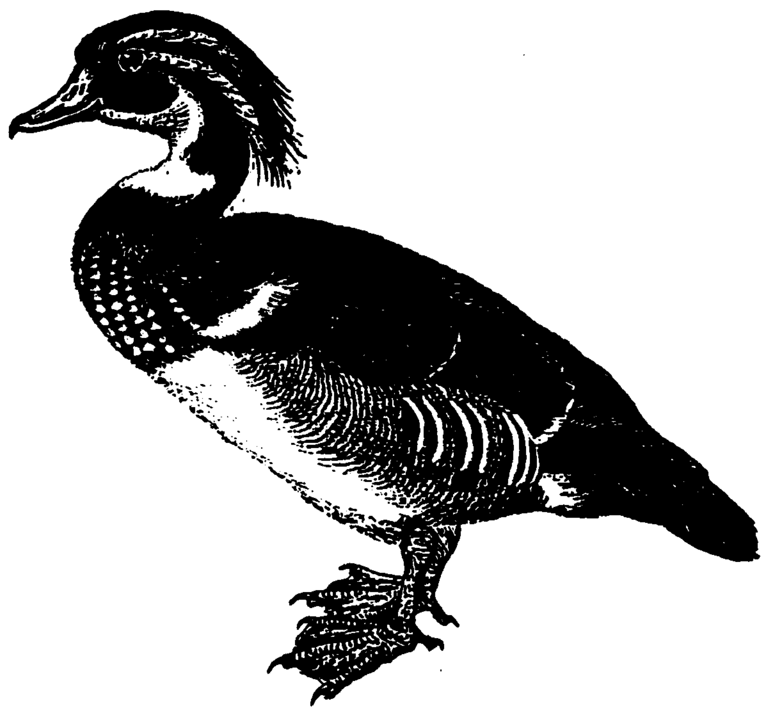
Appendix A: An Annotated List of the Birds of Arcade Creek

APPENDIX A

AN ANNOTATED LIST OF THE BIRDS OF ARCADE CREEK

Garfield - American River College Section

FIRST DRAFT



Compiled by
W. Edward Harper
Mathematics Department
American River College
4700 College Oak Drive
Sacramento, CA 95841

AN ANNOTATED LIST OF
THE BIRDS OF ARCADE CREEK
Garfield - American River College Section

The following is a compilation of bird records spanning a period from March 1986 to March 1992. This annotated account lists 115 species of birds that have been recorded during the course of 440 visits. For each visit, data on bird species and the numbers of each species were recorded. The area of coverage extends along the length of Arcade Creek from Winding Way Bridge upstream to Garfield Park. The American River College (ARC) campus is included along with portions of two tributaries of Arcade Creek. Kohler Creek is one tributary which was covered from its confluence with Arcade Creek on the ARC campus north to Hemlock Avenue. The other tributary is Verde Cruz Creek. This creek, which joins Arcade Creek at Garfield Park, was covered upstream to Hackberry Lane. Because of its proximity to Verde Cruz Creek, the large field south of Verde Cruz Creek and west of Hackberry Lane is also included. This is the last large remaining field in the census area and is indicative of the type of habitat formerly widespread along Arcade Creek. The field is private property belonging to the Sacramento Adventist Academy. Birds were observed from Hackberry Lane.

The major significance of this publication is that it calls attention to important components of our Sacramento experience: the urban creeks. This report on the birds of Arcade Creek is one way of quantifying some measure of the creek's environmental quality. Although birds are implemented to underscore both the importance and significance of this area, it is people that enjoy a better quality of life as they, too, utilize the area. The existence of the Arcade Creek Park Corridor makes the region a better place to live and profoundly enhances the quality of life for its people. Preserving, protecting, and enhancing the environmental quality of Arcade Creek is a wise investment, not only in the enriched quality of life, but in the practical matter of real estate values as well.

Individuals wishing to add their observations to the data base for this area are kindly invited to do so. Lists can be mailed to Ed Harper, Mathematics Dept., American River College, 4700 College Oak Drive, Sacramento, CA 95841 or observations of particular interest can be called in to his office telephone 484-8635.

* * * * *

GREAT BLUE HERON Casual visitor, seen a few times each year. Wary and flushes readily.

GREAT EGRET Rare visitor. Not recorded every year. This handsome wader prefers to forage in a more open environment than what is available along the confines of this section of Arcade Creek.

GREEN-BACKED HERON Rare visitor. Not recorded every year. The paucity of records is somewhat surprising since the species is fairly common along the American River.

BLACK-CROWNED NIGHT-HERON Rare visitor. Not recorded every year. This nocturnal species has sometimes roosted by day along sections of the creek.

TUNDRA SWAN Uncommon aerial visitor only. During the winter months, flights of these magnificent birds are sometimes seen flying high over the area. During the hunting season (Nov. - Jan.) when waterfowl often resort to feeding at night, the species is sometimes heard calling overhead, particularly on foggy nights.

GREATER WHITE-FRONTED GOOSE Uncommon aerial visitor only. Flocks of 50 or more birds can sometimes be noted in winter when the species traverses the Central Valley. Most likely to be observed in the spring migration when vast flocks pass through the area.

SNOW GOOSE Uncommon aerial visitor only. Most records are at night when calling birds can be heard overhead, particularly during foggy conditions.

ROSS' GOOSE Rare aerial visitor only. Usually silent in flight, this small goose is most easily identified when traveling with flocks of Snow Geese by its noticeably smaller size.

WOOD DUCK Uncommon permanent resident. Shy and retiring, this species flushes readily. At home in trees, this species has accepted nest boxes provided for it. A female with six young was observed on Arcade Creek on May 6, 1991.

MALLARD Common permanent resident. Although the species readily interbreeds with domestic ducks, wild mallards have successfully nested in most years along Arcade Creek. A female with nine downy young was observed near the ARC campus on 4 April 1988. Another record consists of a female with five half-grown young on May 6, 1991.

NORTHERN PINTAIL Observed infrequently only as an aerial visitor during winter months. Flights of Northern Pintail are most likely during periods of dense fog when the species strays from the Yolo Bypass area where the species is abundant.

TURKEY VULTURE Uncommon aerial visitor only. Usually solitary birds are seen passing overhead. Largely absent during the winter months.

OSPREY Accidental. One record on March 17, 1991 by W. E. Harper. An Osprey carrying a fish about 12 inches in length was seen flying over Arcade Creek with several California Gulls in aerial pursuit. It is unlikely the fish was taken from Arcade Creek; a residential fish pond is more likely the source.

BLACK-SHOULDERED KITE Occasional visitor. This attractive bird of prey can sometimes can be seen hunting open fields near Arcade Creek, particularly the large field at the Sacramento Adventist Academy off Hackberry Lane.

SHARP-SHINNED HAWK Uncommon in winter. Although a winter resident, the species does not breed in the Sacramento Valley. Typical of the species in the genus ***Accipiter***, these hawks frequently hunt other birds from ambush. The presence of this accipiter is usually first announced by other birds. Listen for their high, thin alarm calls to alert you to its nearness.

COOPER'S HAWK Uncommon permanent resident. Has nested on the ARC campus. Noticeably larger than the similar looking Sharp-shinned Hawk. In flight, with its head and neck extending clearly ahead of the leading edge of the wing, Cooper's Hawk shows a different flight silhouette than the Sharp-shinned Hawk.

NORTHERN GOSHAWK Accidental. One record of an adult bird (April 3-12, 1991). This record was confirmed by D. Bruce Swinehart, instructor of ornithology classes at ARC, who is familiar with the species.

RED-SHOULDERED HAWK Fairly common permanent resident. Has nested on the ARC campus. The cries of this hawk are often heard, particularly from late winter through spring. A species that is particularly dependent upon riparian surroundings, Arcade Creek provides important nesting habitat for this beautiful hawk.

RED-TAILED HAWK Occasional visitor fall through spring. This large, cosmopolitan buteo uses the creek environment more for roosting than for foraging. Unlike Red-shouldered Hawks which hunt primarily from a perch, Red-tailed Hawks do most of their hunting while soaring over open fields.

GOLDEN EAGLE Accidental aerial visitor. One record (Nov. 1, 1987) by W.E. Harper.

AMERICAN KESTREL Occasional visitor fall through spring. Formerly an uncommon permanent resident which possibly nested. This small, attractive falcon has declined sharply in the area in the last decade as open fields have been converted to urban use. This species is attracted to riparian areas with tall dead snags which provide nesting cavities.

RING-NECKED PHEASANT Uncommon permanent resident. Formerly more common, this introduced species needs weedy fields for foraging and thick cover for hiding. One last stronghold for this species is the field at the Sacramento Adventist Academy off Hackberry Lane. Crowing roosters are heard from March to late May.

CALIFORNIA QUAIL Rare permanent resident. Formerly common, California Quail have been severely reduced in numbers by urbanization. Now in marginal and much reduced habitat, quail are very vulnerable to predation. Not only do natural predators like skunks and racoons pose problems for this ground-nesting species, but free-roaming dogs have also limited nesting success. Cats, both domestic and feral, prey heavily upon quail chicks.

SANDHILL CRANE Uncommon aerial visitor only in spring and fall migrations. Flocks of sandhill cranes occasionally pass high overhead during spring migration from mid-February to mid-March. This species could be easily missed at such times except for their far-reaching, bugle-like trumpeting. Most records are from the late morning hours at which times the cranes are utilizing rising thermals of warm air to assist their migration.

KILLDEER Fairly common permanent resident, but declining. The species nests on the ARC campus. Normally the species prefers to nest on the ground, but will also nest on flat, gravel roof tops, possibly to avoid predation by cats. This species is often found at ARC on the large, grassy playing fields adjacent to Arcade Creek. This vociferous species is frequently heard at night as well as by day uttering its distinctive call by which comes its common name.

RING-BILLED GULL Uncommon winter visitor. Although many gulls are seen in the vicinity of Arcade Creek, few are of this species.

CALIFORNIA GULL Common winter resident. Most gulls seen along the creek are of this species. Often seen in large flocks lounging on the playing fields at ARC, the species becomes uncommon by April when adult birds have departed for distant breeding grounds. Nearly all birds seen in the summer are immature birds. Numbers begin to increase in late summer when gulls start returning.

HERRING GULL Uncommon winter visitor. A few individuals, usually immature birds, are sometimes found with flocks of California Gulls during the winter months. Their larger size and pink legs are a good aid in distinguishing them from California Gulls. Adults show a pale yellow iris whereas all California Gulls exhibit a dark iris.

ROCK DOVE Common permanent resident. Nests in nearly every available structure. It has been necessary to discourage these prolific birds from nesting on the ledges of the ARC library building. Cheer for Peregrine Falcons.

MOURNING DOVE Common permanent resident. Widely distributed in our area, doves prefer weedy fields, but the species is attracted to feeders in back yards along the creek and to nesting habitat along the creek. In late summer their numbers, augmented by southbound migrants, tend to reach a maximum.

BARN OWL Uncommon permanent resident. Rarely detected by day when roosting in dense vegetation, this highly nocturnal owl is often overlooked unless one is aware of its vocalizations as it flies about in the cover of darkness.

WESTERN SCREECH-OWL Uncommon permanent resident. Although numbers appear to have declined over the years, the highly nocturnal owl is more often heard than seen. A cavity nester, it may be attracted to back yards by providing appropriate nest boxes. It has nested along Arcade Creek and on the ARC campus.

GREAT HORNED OWL Casual visitor. On a few occasions, this large owl has been found roosting along Arcade Creek. It is not known to have nested.

WHITE-THROATED SWIFT Casual aerial visitor throughout the year. The wide wanderings of this highly mobile swift sometimes brings it over Arcade Creek. Most easy to detect by their distinctive calls, foraging groups of White-throated Swifts usually fly so high they are not readily seen.

ANNA'S HUMMINGBIRD Common permanent resident. This hardy hummingbird species is found along Arcade Creek even in the coldest weather of winter. There are many local nesting records. The species is easy to attract to yards by using a hummingbird feeder containing 1 part sugar to 4 parts water. The solution need not be colored red particularly if the feeder itself contains red plastic parts. Numbers may decline in the spring when many hummingbirds depart to the Sierra foothills where an abundance of flowers and optimum habitat afford favorable nesting conditions.

BLACK-CHINNED HUMMINGBIRD Uncommon spring and summer resident. The species has attempted to nest. A nest on the ARC campus along Kohler Creek in May of 1991 failed to fledge any young because of predation.

RUFOUS HUMMINGBIRD Uncommon migrant. In flight, the pointed primary feathers of the bright orange-red male produce a buzzy trill which is often the first indication of the presence of this colorful hummingbird. With some birds flying as far north as Alaska, this hummingbird lingers only briefly in our area when going north in spring. Males are the first to return, sometimes as early as mid-July but even the best stocked hummingbird feeder will not delay this bird from heading on south to wintering grounds in Mexico.

BELTED KINGFISHER Uncommon permanent resident. This shy species is usually noted by a flash of gray-blue and white accompanied by a rattling call as it flies from its fishing perch. Breeding status along the creek is uncertain. A gap in records during March may indicate the species forsakes the Arcade Creek area to breed elsewhere. The species requires tall vertical clay banks along waterways in which to excavate its deep tubular nest.

ACORN WOODPECKER Fairly common permanent resident. Nests. This highly social species needs tall standing dead snags for constructing its "granary" where it stores acorns in holes carefully excavated for the purpose. Removal of such trees along Arcade Creek diminishes the ability of the handsome bird to survive.

RED-BREASTED SAPSUCKER Uncommon, wintering species. Although numbers tend to vary from year to year, this species is found along Arcade Creek in sparse numbers and, with diligent searching, will be found every year. Due to its bright red head and breast, this handsome member of the woodpecker family is often mistakenly called "Red-headed Woodpecker", a species of only accidental occurrence in California.

NUTTALL'S WOODPECKER Common permanent resident. Nests. Easy to detect by its rattling call, this species nests along Arcade Creek. Since it constructs a new nest cavity each year, this woodpecker provides an essential service for many other species of cavity nesting birds which utilize the old nest holes.

DOWNY WOODPECKER Uncommon permanent resident. This species has not been recorded as nesting along Arcade Creek. Although nesting may yet be shown to occur, the species is quite scarce in the area during summer months.

NORTHERN FLICKER Common winter resident; rare summer resident. Not known to have nested along Arcade Creek, the species is usually absent from late April to mid-September. In winter months the species is hard to miss.

WESTERN WOOD-PEWEE Uncommon spring migrant. The few records for this species are in May. Unrecorded in the fall, but at this time the species is not vocal and has probably passed through the area undetected.

DUSKY FLYCATCHER Uncommon spring migrant. Several records of calling birds have been noted on the ARC campus with all records falling in early May. Birds of the genus ***Empidonax*** are difficult to identify to species when not vocalizing. Some fall records of ***Empidonax*** flycatchers may be of Dusky Flycatcher, but are not included here for lack of firm evidence.

HAMMOND'S FLYCATCHER Uncommon spring migrant. A calling bird on May 8, 1991 clinched what is otherwise a difficult identification. Fall birds may occur, but documentation is lacking.

GRAY FLYCATCHER Rare spring migrant. One record on May 8, 1991 by W. E. Harper from Garfield Park. This species has the distinctive habit of dipping its tail downward in a movement that is slow enough for the eye to easily follow. This is an important behavioral trait that is distinct from that of any other ***Empidonax***.

PACIFIC-SLOPE FLYCATCHER Uncommon spring and fall migrant. Formerly called Western Flycatcher, this is the most likely species of the genus ***Empidonax*** to be found along Arcade Creek. On May 8, 1991 a total of eight different individuals were recorded on a walk. The species is vocal at this time of year, as it moves through the area.

BLACK PHOEBE Common permanent resident. This attractive flycatcher nests along Arcade Creek where it favors bridges and overhanging structures for nesting. In May 1991 a nest under the Garfield Avenue crossing of Arcade Creek successfully fledged four young.

ASH-THROATED FLYCATCHER Uncommon summer resident. Records range from the third week in April to August. There is a remarkable winter record spanning the dates Feb. 4 - 18, 1990. (Ron Storey, Gil Ewing, Mark Cudney, Mike Lippsmeyer.) The species breeds in numerous areas of the county and it is conceivable it could breed along Arcade Creek, but there are no known records. Since it is a cavity nester, nest boxes suited to its use, might attract this bird.

WESTERN KINGBIRD Uncommon summer resident. A bird of open fields, Western Kingbirds arrive in numbers in early April to the Sacramento area. Some pass through the Arcade Creek area, being seen mostly in adjacent fields and flycatching from perches on power poles and light standards around athletic fields. The species has a penchant for nesting in the network of power transformers on utility poles. It May 1991 a nest was observed high up in the power poles at the SMUD substation at Garfield Park.

PURPLE MARTIN Rare aerial visitor. The species has been seen on only two occasions in the past fifteen years flying over Arcade Creek. The species is very local in the Sacramento area, nesting only in a few locations around Old Sacramento and in a few freeway structures.

NORTHERN ROUGH-WINGED SWALLOW Occasional summer resident. This swallow is associated with riparian habitats and has been attracted to Arcade Creek. Records spanning April through May of 1990 for a pair of birds, suggested possible breeding.

CLIFF SWALLOW Rare visitor. One record (21 June 1988) is somewhat surprising for this common species. Although large colonies of Cliff Swallows nest in the Sacramento area, none are close to this portion of Arcade Creek.

BARN SWALLOW Uncommon migrant/summer resident. Most records pertain to migrating birds with a high of five being noted on 3 September 1990. Records of spring migrants span March through May.
The continued presence of a pair of birds in May of 1989 suggested the possibility of breeding but no firm evidence of this exists.

SCRUB JAY Abundant permanent resident. Nests. Raucous and conspicuous, this bird needs no introduction.

YELLOW-BILLED MAGPIE Abundant permanent resident. Nests. Birds are often seen carrying nesting material as early as mid-January, but nesting does not begin in earnest until March. Sacramento is the metropolitan center for the population of this spectacular bird which is endemic to California.

AMERICAN CROW Common permanent resident. Nests. This species has adapted well to man and appears to be increasing in our area. When not nesting, crows often fly from the Arcade Creek area to join other crows in a huge roost in downtown Sacramento. This may be a protection strategy to avoid predation at night by Great Horned Owls, the arch enemy of crows.

PLAIN TITMOUSE Common permanent resident. Nests. A bird of many different and distinctive songs, it begins to noisily proclaim a nesting territory as early as mid-January. This cavity nester is dependent upon nest holes excavated by woodpeckers.

BUSHTIT Common permanent resident. Nests. When not nesting, this species travels in troops of six to more than thirty birds. A bird partial to shrubs and oaks, it is rarely seen on the ground.

RED-BREASTED NUTHATCH Irruptive migrant/winter resident. Not recorded every year, this species can sometimes be absent from entire regions. Partial to conifers, the species is unusual along Arcade Creek.

WHITE-BREASTED NUTHATCH Fairly common permanent resident. Nests. Often seen foraging headfirst down the trunks of trees.

BROWN CREEPER Rare winter migrant. Not recorded every year. Climbs up tree trunks when foraging. Its cryptic pattern makes it difficult to be seen against a tree trunk.

BEWICK'S WREN Common permanent resident and thought to nest. A wonderful songster, it gives loud, ringing notes that are often confused with those sometimes given by Plain Titmouse.

HOUSE WREN Uncommon migrant in area. Not known to nest along Arcade Creek. Its scarcity along the creek is somewhat surprising since the species is common nester along the American River Parkway.

WINTER WREN Very rare with only two records (Feb. 13, 1989 and Nov. 23, 1989) This secretive wren is rare in the winter to the Central Valley. Look for it around dense thickets of blackberry brambles.

GOLDEN-CROWNED KINGLET Uncommon winter visitor. An irruptive species, in many winters it is not recorded. Since the species usually forages fairly high in the canopy, this tiny bird is often first detected by its high, thin call.

RUBY-CROWNED KINGLET Common winter visitor. Usually arrives in early October and is present through early April. Although usually concealed, the bright ruby-red crown patch is sometimes exhibited by the male when agitated.

BLUE-GRAY GNATCATCHER Rare fall migrant along creek; one record Sept. 23, 1990 by W. E. Harper.

SWAINSON'S THRUSH Uncommon spring migrant, chiefly during the month of May. Fall records are few since the species tends to migrate more along the coast. In spring, its northward migration includes the Central Valley.

HERMIT THRUSH Uncommon winter resident from October through April. Secretive and solitary, the bird feeds on or near the ground and seems particularly vulnerable to predation by cats.

AMERICAN ROBIN Common permanent resident. Although numbers diminish during our summers some individuals remain to nest. Numbers fluctuate from year to year depending upon available berry crops.

VARIED THRUSH Irruptive winter visiter. Although not seen every winter, a few birds seem to show up most winters. Probably the wetter the winter months, the more likely the species will appear, particularly in years with good berry crops.

NORTHERN MOCKINGBIRD Common permanent resident. Nests in yards along Arcade Creek. This is one species that has prospered because of man. Ornamental plantings, particularly trees and shrubs that provide berries, have been a boon to this song bird which has greatly extended its former range.

AMERICAN PIPIT Common winter visitor to open fields. A good place to usually find this species from late October through the middle of April is at American River College. The open playing fields adjacent to Arcade Creek often provide a foraging area for this terrestrial bird. Easily overlooked, the species is often heard before being seen.

CEDAR WAXWING Common winter visitor. Although numbers vary from year to year, the species is present from October through early June in most years. It is one of the last winter visitors to migrate out of the Sacramento area.

EUROPEAN STARLING Abundant resident. This introduced species competes vigorously with native species for cavity nesting sites. It is also an early nester, taking over nest holes and nest boxes before native species start to nest.

SOLITARY VIREO Uncommon spring migrant. Easiest to find in late April and early May. Hard to find in fall migration when the species is not singing. The western form *cassinii* is quite distinct from the forms found in the eastern USA or in the Rocky Mountains.

HUTTON'S VIREO Rare visitor. The few records are primarily from September when there is some local movement of this species which is a permanent, but uncommon resident, of the foothills east of Sacramento.

WARBLING VIREO Common spring migrant, less common in fall. This species is conspicuous by its incessant singing during April and May when the species moves through our area. The species is not as detectible in the fall when singing has stopped.

ORANGE-CROWNED WARBLER Common migrant in spring and fall; uncommon in winter. This ground nesting species nests from the foothills to the lower reaches of the Sierra. The species may have nested along Arcade Creek many years ago. The peak spring migration lasts from late March to early May. During the protracted fall movement, this rather plain appearing warbler does not sing and is less detectible. The species over winters in small numbers.

NASHVILLE WARBLER Fairly common spring migrant; uncommon in fall. The widespread warbler nests in the middle elevations of the Sierra. Peak movement along Arcade Creek is from mid April to mid May.

YELLOW WARBLER Uncommon spring migrant and uncommon fall migrant.

YELLOW-RUMPED WARBLER Common winter visitor. The most common of warblers found along Arcade Creek and in the Sacramento area. Of the two forms occurring, Audubon's decidedly outnumbers the Myrtle form in our area. This species has done well coexisting with man.

BLACK-THROATED GRAY WARBLER Uncommon migrant in spring and fall. Breeds in the lower elevations of the Sierra Nevada. Somewhat difficult to separate by its vocalizations from the similar sounding Townsend's Warbler.

TOWNSEND'S WARBLER Uncommon migrant in spring and fall. The species passes through in highest numbers in early May. This warbler does not breed in California.

HERMIT WARBLER Rare migrant in spring and fall. The paucity of records is somewhat surprising since the species breeds extensively in the Sierra.

MACGILLIVRAY'S WARBLER Uncommon migrant in spring and fall. The species is secretive and is found in dense cover close to the ground.

WILSON'S WARBLER Common migrant in spring and fall. Spring migration peaks between the middle of April to the middle of May. In the spring Wilson's Warblers are often heard singing during migration. Except for chip notes, the species is silent in fall migration which extends from August to early October.

WESTERN TANAGER Common migrant in spring and fall. It is a common nesting species in the Sierra.

BLACK-HEADED GROSBEAK Common migrant in spring; breeds in the county but not known to breed along Arcade Creek. Beginning in July the species become less common and is very difficult to find after the end of August.

LAZULI BUNTING Uncommon spring and fall migrant. Most records are from late April and early May; some fall records exist for August. The species is known to nest in the county, but there are no reported nesting records for Arcade Creek.

RUFOUS-SIDED TOWHEE Fairly common from late September through March. Numbers decline in April and the species becomes rare from May through the summer. Not known to nest. This status of this species along Arcade Creek raises a number of questions. It is a common nesting species in Sacramento County; why is this not the case along this stretch of Arcade Creek? Have cats seriously impacted this terrestrial species?

CALIFORNIA TOWHEE Fairly common resident; very likely a nesting species but this needs confirmation.

CHIPPING SPARROW Uncommon spring migrant, chiefly during April and early May. No records for fall.

LARK SPARROW Occasional visitor. There is a scattering of records for fall, winter, and spring. Although a sparse nesting species in Sacramento County, there is probably a lack of suitable nesting habitat for this species along Arcade Creek.

SAVANNAH SPARROW Accidental. One record on May 6, 1991 by W. E. Harper. A single individual was observed on the ARC campus on an athletic playing field adjacent to the creek. The lack of suitable habitat for this grassland species is the reason for its accidental status. The species is a common wintering species in suitable habitat in the county.

FOX SPARROW Uncommon winter visitor. Most records span the period from November through January. Forms that winter in the Sacramento area are not the same races that nest in the Sierra.

SONG SPARROW Uncommon visitor. Although a resident species in our area, it is surprising that Song Sparrows are not more established along Arcade Creek. Perhaps fluctuating high waters along the creek and/or a high incidence of cats in the area has impeded the success of this species here.

LINCOLN'S SPARROW Occasional winter visitor. This elegant but shy sparrow is always a treat to discover. The species breeds in moist mountain meadows and can only be found infrequently along Arcade Creek from the months of October through April. This species does not sing on its wintering grounds.

GOLDEN-CROWNED SPARROW Common winter visitor. First arrivals occur in late September and last departing birds leave about the middle of May. Sings throughout the period.

WHITE-CROWNED SPARROW Common winter visitor. Present from late September to early May. Sings throughout the period. Not as shy and retiring as Golden-crowned Sparrows with which it sometimes associates.

DARK-EYED JUNCO Common winter visitor. Sociable and approachable, this tame species arrives around the second week of October and remains until early April.

RED-WINGED BLACKBIRD Occasional visitor. Although the Red-winged Blackbird is the most abundant bird in North America, the species is scarce along Arcade Creek. The species prefers open fields and marshes.

WESTERN MEADOWLARK Occasional winter visitor. As open fields have disappeared along Arcade Creek, so have numbers of Meadowlarks. Now the species is only a sporadic flyover along the creek. The best remaining open field that still occasionally harbors Western Meadowlarks is along Hackberry Lane in the fields of the Seventh Day Adventist Academy.

BREWER'S BLACKBIRD Uncommon permanent resident. This widespread blackbird species has nested on the ARC campus. In some years the species has roosted near Hackberry Lane and Verde Cruz Creek. Concentrations of over 100 birds have been recorded in March when many Brewer's Blackbirds move through our area in migration.

BROWN-HEADED COWBIRD Common spring migrant; occasional in other seasons. Peak numbers are reached in April and early May when cowbirds, which practice brood parasitism, are passing through our area with vireos, warblers, and other host species.

NORTHERN ORIOLE Fairly common summer resident. Nests. By the second week of April the first orioles have arrived and numbers increase to a peak in early May when many migrants are passing through. After nesting and rearing young, the species begins its southward migration and, by late August, the species has departed.

PURPLE FINCH Irruptive winter resident and spring migrant. Some care must be taken to separate this species from the abundant and similar appearing House Finch. Fairly common in some years, the species may be nearly absent in others.

HOUSE FINCH Abundant permanent resident. Nests. This species has prospered with man's activities. Readily adaptable to suburban life, the species is easily found along Arcade Creek.

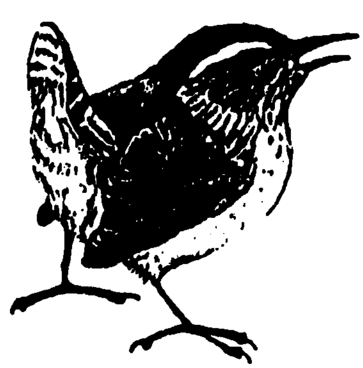
PINE SISKIN Irruptive winter resident and spring migrant. Absent in some years. The species often associates with flocks of goldfinches. The species is very partial to fields with mature seeds of dandelions or thistles.

LESSER GOLDFINCH Common permanent resident. No nest records for Arcade Creek, but nesting may occur. Numbers peak during the winter months and fall off during the summer when many birds have departed to the foothill areas to nest.

AMERICAN GOLDFINCH Fairly common in all seasons but summer. Much drabber in basic winter plumage than the similar Lesser Goldfinches with which the species often associates.

EVENING GROSBEAK Rare winter visitor. Only recorded in a few years, this striking species is attracted to bird feeders with sunflower seeds. This is much more a bird of the high Sierra.

HOUSE SPARROW Common permanent resident in association with man's activities. Nests.



Appendix B: The Vascular Plant Flora of the American River College Nature Area

APPENDIX B

THE VASCULAR PLANT FLORA

OF THE

AMERICAN RIVER COLLEGE NATURE AREA

May 10, 1992

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Personal Service Agreement P-4140

INTRODUCTION

In 1990 the Sacramento Chapter of the Urban Creeks Council in conjunction with American River College obtained a grant under the Urban Streams Restoration Program. The primary goals of the grant are the restoration of Arcade and Kohler Creeks within the American River College Nature Area and the preparation of a management plan for the site. This flora has been prepared to provide baseline documentation of the plant species growing within the study area as of 1991. It is intended to provide a floristic bench mark that can be used as an evaluation tool in the ongoing restoration and management of the Nature Area. An additional goal is the identification of undesirable, invasive plants as well as existing native plant materials that may prove useful in restoring the Nature Area.

THE STUDY AREA

The study area is located on the American River College campus in north-central Sacramento County, California. Known locally as the Nature Area, the 22.4-acre site lies along Arcade Creek approximately 11.5 stream miles above its confluence with the Sacramento River. The study area is bounded on the north by Myrtle Avenue and on the south by Winding Way. Residential development abuts the survey area to the east, with the college's turfed playing fields, parking lots, and arboretum forming the west boundary (Figure 1).

Elevations in the survey area range from approximately 75 to 90 feet above mean sea level. Soils are predominantly Liveoak sandy clay loams. These are very deep, well drained soils that have formed in granitic alluvium on high, narrow flood plains (Tugel 1990). Slopes are gentle, ranging from 0-2 percent.

Arcade and Kohler Creeks are probably the most important features influencing the physical and biological environment of the Nature Area. Much of the site lies within the flood plains of these two creeks. As a result, portions of the study area are subject to occasional flooding following long duration or high intensity winter storm events. With increasing development in the watershed of Arcade Creek, the frequency of flood events along this reach of the creek has increased. However the duration of flooding is normally quite brief, lasting only a few days following major storms. With the exception of the immediate stream channel and lowest flood plain areas, most of the Nature Area is not subject to prolonged inundation. Downcutting of the Arcade Creek channel has probably had the effect of lowering summer water tables in the study area. However this may be somewhat offset by increased summer flows resulting from urban irrigation and runoff.

MATERIALS AND METHODS

The study area was visited at approximate 2-week intervals between February 22, 1991 and October 6, 1991. During each site visit an effort was made to traverse all portions of the site to increase the probability that all plant taxa would be observed. Even with this effort, it is unlikely that all plants growing in the Nature Area have been identified in this study. Given California's annual variability in temperature and precipitation, a single year of observation is rarely adequate to provide a complete enumeration of a local flora. After five years of below average rainfall, it is even less likely that all species normally growing in the Nature Area were in evidence. This flora should therefore be regarded as a starting point, a "snapshot in time" to be supplemented in future years and hopefully under more "normal" rainfall conditions.

During each field visit plants were collected on site and prepared for later identification. Voucher specimens were collected for nearly all taxa reported. Exceptions were made when populations were too small to sustain the removal of individuals for a collection. Specimens are on file at American River College. Nomenclature follows Munz (1968) for native and naturalized species and Bailey (1949) for cultivated species. Where other names are used, authorities are provided and the name used in Munz listed in parentheses.

Plants were assigned to the following abundance classes: very rare, rare, uncommon, common, and abundant. These classes are roughly equivalent to those used by Braun-Blanquet (Shimwell 1971). Non-native taxa were placed in three categories: naturalized, introduced and adventive as defined by Lawrence (1951). These alien plants are marked with an asterisk in the flora. Those taxa with potential or demonstrated invasive tendencies are highlighted in the text.

VEGETATION

The most notable feature of the Nature Area is its mature oak canopy. This well-developed forest contains a diverse assemblage of native oak species. The following generalizations can be made regarding the distributions of oaks within the survey area, although oaks of all species can be found in most parts of the site. Interior live oak (Quercus wislizenii) and valley oak (Q. lobata) generally can be found in the lower areas closer to the stream channels. In these locations they can be found along with scattered Oregon ash (Fraxinus latifolia) and black walnut (Juglans hindsii). Blue oak (Q. douglasii) is more common at the upper margins of the riparian zone. Scattered oracle oaks (Q. x morehus) contribute to the diversity of the oak canopy. These are generally large diameter trees growing in close proximity to Arcade Creek. In addition, trees that appear to be intermediates between blue oak and valley oak are also present in the Nature Area. These are usually sapling or pole size trees growing at the upper edges of the riparian zone.

The Nature Area's assemblage of tree species does not fall conveniently into existing community classifications. While the vegetation contains elements of both the Great Valley Mixed Riparian Forest and Great Valley Valley Oak Riparian Forest, members of these communities are generally poorly represented in the study area (Holland 1986). In fact, cottonwood (Populus fremontii), black willow (Salix goodingii var. variabilis) and box elder (Acer negundo subsp. californicum) which dominate these lower riparian communities, are conspicuous by their near absence from the Nature Area. Alternatively, much of the study area's vegetation appears more closely related to upland, oak-dominated communities and can probably best be viewed as a mesic expression of Valley Oak Woodland and Interior Live Oak Woodland (Holland 1986, Griffin 1977). In this view the Nature Area's vegetation is transitional between the riparian communities of the lower Sacramento Valley and the oak woodlands of the surrounding foothills.

In contrast to the relatively intact, native forest canopy, the understory vegetation has been subject to substantial disturbance. The predominantly non-native composition of the understory reflects both past and present land uses. Annual grasses and agricultural weeds probably date from grazing activity when the area was ranch land. The dense stands of Hardinggrass (Phalaris tuberosa var. stenoptera) in the lower portions of the study area were probably established during this period.

More recently, introduced ornamentals from surrounding residential areas have begun to influence the understory. These include intentional plantings such as ivy (Hedera helix), redbud (Cercis occidentalis) and periwinkle (Vinca major) as well as escapes such as acacia (Acacia spp.), flowering plum (Prunus spp.) and European olive (Olea europa). Disturbance from flood events is an additional source of non-native propagules. Species reproducing by rhizomes, tubers or other vegetative means frequently gain advantage when transported to areas that have been reworked by floods. Giant reed (Arundo donax) and Jerusalem-artichoke (Helianthus tuberosa) are good examples of this mode of establishment in the Nature Area.

FLORISTICS

A total of 177 plant taxa representing 140 genera and 57 families have been recorded from the Nature Area. This is a relatively large number of species for an area of only 22.4 acres. Families that are best represented include Poaceae (27 taxa), Asteraceae (25 taxa), and Fabaceae (14 taxa). The genus Quercus with three species and two hybrids is the best represented genus followed by Polygonum and Bromus with 4 taxa each.

Much of the study area's floristic diversity can be attributed to the influx of introduced species from previous agricultural land uses as well as current residential and urban development. Approximately 36.2 percent of the flora (64 taxa) are California natives compared to 63.8 percent (113 taxa) that have been introduced or naturalized from other areas. If one includes species such as Calocedrus decurrens, Sequoia sempervirens, and Platanus racemosa which are native to California but not to the study area, the percentage of native to introduced taxa drops to 32.8% and 67.2% respectively.

As discussed above, the percentage of native to introduced taxa varies with vegetation strata. The overstory has been the least influenced by exotics, with 52.9% native species compared to 47.1% introduced species. In comparison, the composition of the understory shows considerably more alien plants, with approximately 31.1% native and 68.9% introduced taxa.

Curiously, the midstory has been the most influenced by non-native plants. Over 75% of the species in this layer are introduced, with Acer negundo subsp. californicum, Sambucus caerulea, and Salix lasiolepis the only natives observed. The lack of native taxa in this stratum has apparently left an unoccupied niche that has been aggressively colonized by several exotic shrubs and small trees. These include ornamentals such as Prunus cultivars and Ligustrum lucidum as well as orchard escapes such as Olea europa, Prunus amygdalus, and Ficus carica.

In spite of the compositional changes that have occurred in the understory, valuable examples of the original native vegetation remain. These include remnant stands of herbaceous perennials such as Barbara sedge (Carex barbarae), creeping wildrye (Elymus triticoides) and deer grass (Muhlenbergia rigens). All of these species should be protected and encouraged within the Nature Area, both as examples of the original native vegetation and as potential sources of plant materials for future restoration activities.

ACKNOWLEDGEMENTS

I would like to thank Mark Stopher for his encouragement and support in this project and for his review of the draft checklist. I am also grateful to Jo Smith who gave useful comments and provided much needed information on additional plants that she has recorded from the Nature Area.

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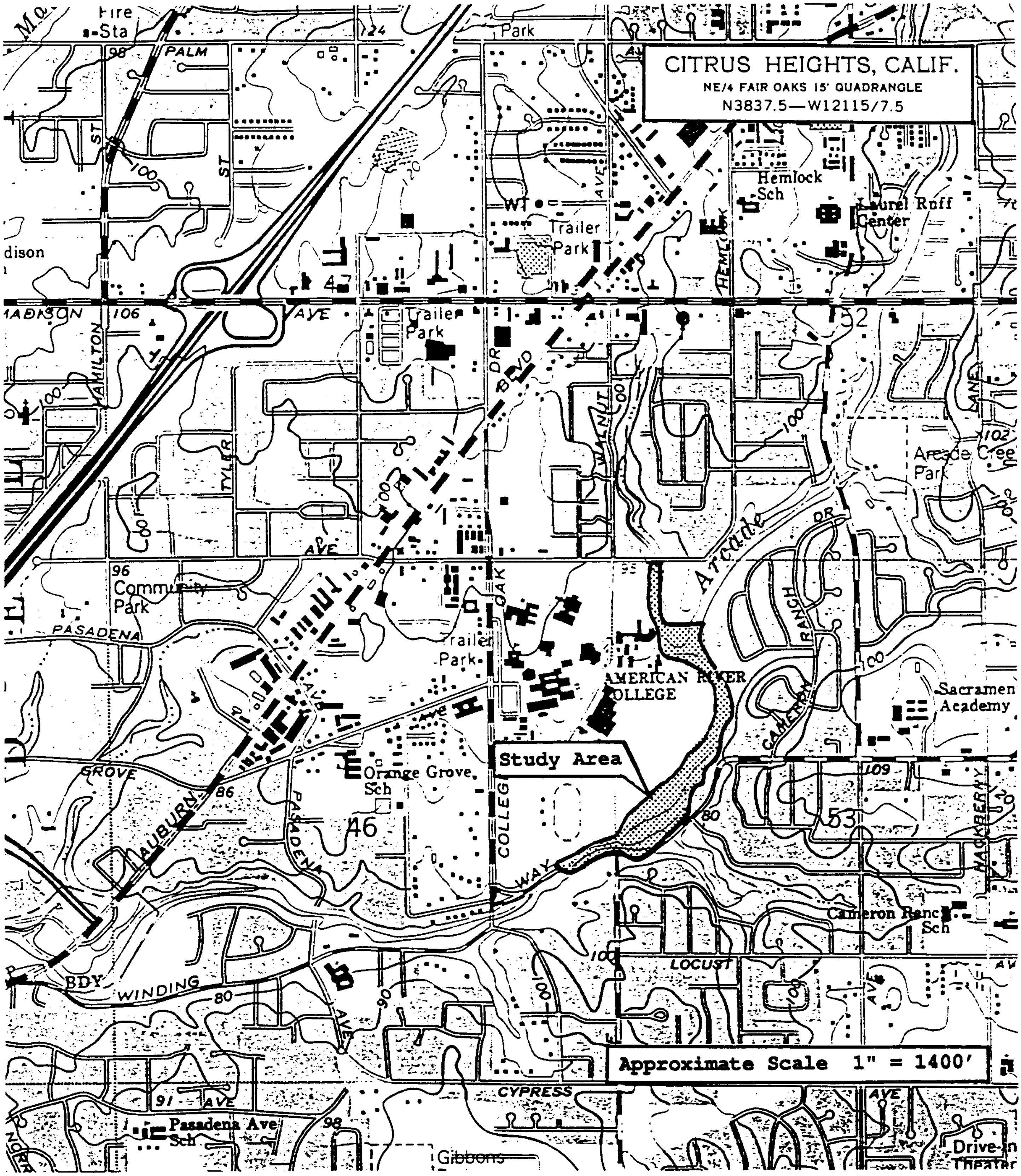


Figure 1. Area Covered by this Flora.

THE VASCULAR PLANT FLORA OF THE AMERICAN RIVER COLLEGE NATURE AREA

PTEROPHYTA

Polypodiaceae

Pityrogramma triangularis Goldenback fern. Rare; along shaded banks in lower riparian zone of Arcade Creek; not collected.

CONIFEROPHYTA

Cupressaceae

Calocedrus decurrens Incense-cedar. Very rare; a single individual has been planted behind a residence on the east side of Arcade Creek. Native to Coast Ranges and Sierra Nevada (Coll. No. 407).

Taxodiaceae

Sequoia sempervirens Coast redwood. Very rare; only one individual noted along Arcade Creek. Several trees are planted in the Vietnam Veterans Memorial Grove adjacent to the arboretum. These trees have been severely stressed by the current 5-year drought and may not persist. Native to coastal California (Coll. No. 408).

ANTHOPHYTA - DICOTYLEDONEAE

Aceraceae

Acer negundo ssp. californicum Box elder. Very rare; only two individuals observed within the Arcade Creek riparian zone (Coll. No. 418).

*Acer saccharinum Silver maple. Very rare; a single sapling was observed adjacent to Winding Way (Coll. No. 391).

Amaranthaceae

*Amaranthus albus Tumbleweed. Very rare; sandy banks along Arcade Creek. This common weed is from tropical America (Coll. No. 370).

*Amaranthus retroflexus Redroot pigweed. Rare; disturbed areas and accumulations of sand along Arcade Creek. Native to New World tropics (Coll. Nos. 424,487).

Anacardiaceae

Toxicodendron diversilobum Poison oak. Abundant; well-distributed in shaded environments throughout the study area, particularly beneath oaks; sometimes climbing into the canopy.
Not collected.

Apiaceae

*Anthriscus scandicina Bur-chervil. Collected by Jo Smith from riparian woodland, 20 April 1979. Naturalized from Europe.

*Conium maculatum Poison-hemlock. Uncommon; in partial shade in floodplain of Arcade Creek. Naturalized from Europe (Coll. No. 411).

*Foeniculum vulgare Sweet fennel. Uncommon; open areas in upper riparian zone of Arcade Creek. Naturalized from Europe (Coll. No. 452).

Sanicula crassicaulis Pacific sanicle. Rare; shaded areas beneath oak canopy along Arcade Creek. Not collected due to small population size within the study area.

*Torilis arvensis Hedge-parsley. Common; shaded environments throughout the study area. Naturalized from Europe (Coll. No. 355).

Apocynaceae

*Vinca major Periwinkle. Uncommon garden escape; shaded areas along Arcade Creek. **POTENTIALLY INVASIVE** in riparian areas. Native of Europe (Coll. No. 451).

Araliaceae

*Hedera helix English ivy. Uncommon garden escape; largely confined to the east bank of Arcade Creek at the north end of the study area where it was undoubtedly planted by residents whose homes back up to Arcade Creek. The species is able to persist in shaded riparian environments, but does not seem particularly invasive. Native of Eurasia (Coll. No. 460).

Asclepiadaceae

Asclepias eriocarpa Indian milkweed. Uncommon; colonial in open grassland areas above the riparian zone of Arcade Creek (Coll. No. 434).

Asteraceae

*Anthemis cotula Mayweed. Very rare; sandy bank above Arcade Creek. Introduced from Europe (Coll. No. 430).

Artemisia douglasiana Mugwort. Common in shaded environments throughout the study area (Coll. No. 426).

Aster chilensis Common California aster. Very rare within the Nature Area. A single colony of plants occurs in sandy soil on the bank of Arcade Creek downstream from the Lower Outdoor Classroom (Coll. No. 472).

Baccharis pilularis ssp. consanguinea Coyote brush. Very rare; a single shrub can be found in the open savanna above the Arcade Creek riparian zone. This is the lone survivor of an earlier planting effort within the Nature Area (Coll. No. 304).

*Bidens frondosa Stick-tight. Common; in low areas adjacent to creeks and overflow channels. This North American native is apparently naturalized in California (Coll. No. 479).

*Carduus pycnocephalus Italian thistle. Uncommon in partial shade along Arcade Creek. Probably became established when area was used for grazing. Naturalized from southern Europe (Coll. No. 346).

*Centaurea solstitialis Yellow star-thistle. Too common; open grassland areas bordering the riparian zone; a painful and troublesome weed. Naturalized from Europe (Coll. No. 441).

*Chrysanthemum parthenium Feverfew. Very rare; adventive on sandy banks above lower reaches of Arcade Creek. Native of Europe (Coll. No. 378).

*Cichorium intybus Common chicory. Common; openings and ruderal areas along Arcade Creek. Naturalized from Europe (Coll. No. 372).

*Conyza bonariensis South American conyza. Rare in disturbed areas such as road and path margins. This species is a common urban weed from South America (Coll. No. 447).

Conyza canadensis Horseweed. Very rare in the Nature Area. A single individual was collected behind the recycling center (Coll. No. 484).

Helianthus annuus Common sunflower. Uncommon on sandy banks near the water along Arcade Creek (Coll. No. 455).

*Helianthus tuberosus L. Jerusalem-artichoke, girasole. Uncommon; sandy soils and bars along Arcade Creek. Introduced from the eastern U. S. and grown locally as a garden vegetable for its edible tubers. Plants within the Nature Area may have washed down from gardens upstream (Coll. No. 483).

*Hypochoeris glabra Smooth cat's ear. Collected by Jo Smith in annual grassland areas, 16 April 1979. Naturalized from Europe.

*Lactuca serriola Prickly-lettuce. Common; annual grassland and ruderal areas above the riparian zone. The var. integrata (with entire leaves) seems to be more common within the Nature Area, although the typical form is also represented. Naturalized from Europe (Coll. Nos. 437, 470).

Matricaria matricarioides Pineapple weed. Uncommon; generally restricted to disturbed soils along trails and access roads (Coll. No. 319).

*Senecio vulgaris Common groundsel. Uncommon; disturbed areas along trails and roads. Naturalized from Europe (Coll No. 316).

*Silybum marianum Milk-thistle. Uncommon; scattered colonies in openings within the oak canopy. Probably established with pastgrazing. Naturalized from southern Europe (Coll No. 385).

Soliva sessilis Common soliva. Collected in disturbed grassland areas by Jo Smith, 22 April 1979.

*Sonchus asper Sow-thistle. Rare; in grassland and ruderal areas. Naturalized from Europe (Coll. No. 412).

*Sonchus oleraceus Sow-thistle. Uncommon; grassland and ruderal areas. Naturalized from Europe (Coll. No. 431).

*Taraxacum officinale Common dandelion. Rare; edges of roads and paths, especially near turf areas. Naturalized from Europe (Coll. No. 308).

*Tragopogon porrifolius Oyster plant. Common; in open grassland areas. Naturalized from Europe (Coll No. 343).

Wyethia angustifolia Narrow-leaf mule ears. Uncommon; small colonies in grassy openings; Arcade Creek, upper riparian zone (Coll. No. 340).

Xanthium strumarium var. canadense Cocklebur. Common; low areas and sandy banks adjacent to Arcade Creek (Coll. No 440).

Bignoniaceae

*Catalpa bignonioides Walt. Common catalpa. Rare; several trees that had become established along Arcade Creek were girdled in 1990. **POTENTIALLY INVASIVE** in riparian environments. Introduced from eastern U.S. (Coll. No. 377).

Boraginaceae

Amsinckia intermedia Fiddleneck. Uncommon; annual grassland areas above Arcade Creek riparian zone.

Brassicaceae

*Brassica campestre Field mustard. Collected by Jo Smith in grassland and riparian woodland, 2 March 1979. Naturalized from Europe.

*<u>Brassica</u> <u>nigra</u> Black mustard. Common; in grassland and openings within the upper riparian zone of Arcade Creek. Naturalized from Europe (Coll. Nos. 350, 351).

*<u>Brassica</u> <u>geniculata</u> Mediterranean mustard. Collected by Jo Smith in grassland and disturbed areas, 20 April 1979. Naturalized from Europe.

*<u>Capsella</u> <u>bursa-pastoris</u> Shepherd's purse. Common; early spring ruderal along trails and in grassland areas. Naturalized from Europe (Coll. No. 309).

<u>Cardamine</u> <u>oligosperma</u> Few-seeded bitter-cress. Common early spring annual in grassland and oak openings (Coll. No. 323).

*<u>Lepidium</u> <u>strictum</u> Wayside peppergrass. Uncommon spring annual in disturbed, compacted soils along paths. Apparently naturalized from South America (Coll. No. 324).

*<u>Raphanus</u> <u>sativus</u> Wild radish. Common; openings within the riparian zone and ruderal areas. Naturalized from Europe (Coll. No. 314).

*<u>Sisymbrium</u> <u>officinale</u> Hedge mustard. Common; openings and disturbed areas. Naturalized from Europe (Coll No. 349).

Caprifoliaceae

*<u>Lonicera</u> <u>japonica</u> Japanese honeysuckle. Very rare; only one individual observed within the riparian zone of Arcade Creek. Introduced from Asia (Coll No. 345).

<u>Sambucus</u> <u>caerulea</u> Blue elderberry. Uncommon; openings along Arcade Creek; this is the host plant of the valley elderberry long-horn beetle (<u>Desmocerus</u> <u>californicus</u> ssp. <u>dimorphus</u>) a federally listed threatened species. Shrubs within the Nature Area have apparently not been colonized by the beetle, but may provide habitat for the species in the future (Coll. No. 416).

Caryophyllaceae

*<u>Cerastium</u> <u>glomeratum</u> Thuill. [=<u>Cerastium</u> <u>viscosum</u> L.] Mouse-ear chickweed. Uncommon; early spring annual along paths and in grassland areas. Naturalized from Europe (Coll. No. 322).

*<u>Spergularia</u> <u>rubra</u> Purple sand spurry. Rare; in compacted soils along access roads. Native of Eurasia (Coll. No. 352).

*<u>Stellaria</u> <u>media</u> Chickweed. Common; early spring annual in grassland areas beneath oaks. Native of Eurasia (Coll. No. 305).

Chenopodiaceae

Atriplex patula ssp. hastata Fat hen. Uncommon; in sandy soil along Arcade Creek (Coll. No. 477).

*Chenopodium album Lamb's quarters. Uncommon; sandy soils along Arcade Creek. Naturalized from Eurasia (Coll. No. 432).

*Chenopodium ambrosioides Mexican tea. Common; sandy soils within the riparian zone of Arcade Creek and in grassland areas above. Naturalized from tropical America (Coll. Nos. 367, 467).

Convolvulaceae

*Convolvulus arvensis Bindweed. Common; in both grassland and open oak woodland; naturalized from Eurasia (Coll. No. 371).

Crassulaceae

Tillaea erecta Pygmy weed. Collected by Jo Smith from grassland areas, 9 March 1979. This inconspicuous species is relatively common in compacted soils along trails and roadways.

Cucurbitaceae

Marah fabaceus Manroot. Very rare; clambering vine in shaded areas; Arcade Creek riparian zone. Not collected due to small population size within the study area.

Euphorbiaceae

*Euphorbia maculata Spotted spurge. Rare; in disturbed areas. Naturalized from eastern North America (Coll. No. 450).

*Euphorbia peplus Petty spurge. Uncommon; growing beneath California buckeye between Arcade Creek and Winding way. Native of Europe (Coll. No. 379).

*Euphorbia supina Prostrate spotted spurge. Rare; openings in oak woodlands. A common weed in urban areas. Native to the eastern United States (Coll. No. 476).

Fabaceae

*Acacia decurrens Green wattle. Formerly abundant, now rare; ornamental tree introduced from Australia; **EXTREMELY INVASIVE** in riparian areas. A major effort to eradicate this species in 1990/1991 has been largely successful. Future individuals should be removed as soon as they are identified (Coll. No. 362).

*Acacia melanoxylon Black acacia. Formerly abundant, now very rare; popular street tree introduced from Australia is **EXTREMELY INVASIVE** in riparian settings. Most individuals have been removed from the study area as of 1991. Remaining large trees have been girdled. This species suffered severe frost damage in many parts of the Sacramento area during the Christmas freeze of 1990. Trees within the study area were affected to a much lesser degree (Coll. No. 338).

*Albizia julibrissin Silk tree. Formerly common, now rare; ornamental tree from Auatralia should be considered **POTENTIALLY INVASIVE** in riparian areas (Coll. No. 435).

Cercis occidentalis Redbud. Very rare; only two individuals observed near residential areas on east side of Arcade Creek. This native shrub is more common in the foothills and Coast Ranges of California, and was planted as an ornamental within the study area (Coll. Nos 307, 414).

*Cytisus monspessulanus French broom. Rare; a few individuals were observed growing along Arcade Creek below the Outdoor Classroom. This species is **EXTREMELY INVASIVE** and has become extensively naturalized in coastal California. It is not well established in the Central Valley and may be less of a threat here. The shrubs within the study area did not produce flowers this year. However, the species should be regarded as an undesirable exotic and removed as soon as possible. Native of the Canary Islands (Coll. No. 421).

*Gleditsia triacanthos var. inermis Honeylocust. Very rare; open areas in lower riparian zone along Arcade Creek; **POTENTIALLY INVASIVE?** ornamental tree introduced from eastern U.S. (Coll. No. 360).

Lathyrus palustris Marsh pea. Uncommon; banks above Arcade Creek channel. Collected by Jo Smith on 29 April 1979.

*Lotus corniculatus Bird's-foot trefoil. Rare; Openings in oak woodland. Introduced from Europe (Coll. No. 445).

Lupinus bicolor Uncommon; grassland openings above riparian zone. This native annual lupine is a common component of the valley grassland flora (Coll. No. 336).

*Medicago arabica Spotted medick. Collected by Jo Smith from annual grassland areas, 20 April 1979. Naturalized from Eurasia.

*Melilotus alba White sweet-clover. Rare; Growing in disturbed areas in sandy soils. Naturalized from Eurasia (Coll. No. 481).

*Robinia pseudoacacia Black locust. Very rare; a single sapling has established in rip-rap along Arcade Creek. This species has become naturalized in riparian environments in northern California and should be considered **POTENTIALLY INVASIVE** within the study area. Native of eastern U.S. (Coll. No. 425).

*Vicia dasycarpa Vetch. Abundant in grassland areas above Arcade Creek. Naturalized from the Mediterranean region (Coll. No. 344).

*Vicia villosa Winter vetch. Abundant; open grassland areas above the riparian zone. Naturalized from Europe (Coll. No. 392).

Fagaceae

Quercus douglasii Blue oak. Common; open grassland areas and upper margins of the riparian zone (Coll. Nos. 405, 458). Many trees within the Nature Area have very deeply lobed leaves whose intermediate size, shape and color suggest possible hybridization with Quercus lobata (Coll. No. 361).

Quercus lobata Valley oak. Abundant; co-dominant of the riparian zone along Arcade Creek (Coll. No. 384).

Quercus X morehus Oracle oak. Very rare; scattered large trees observed along Arcade Creek, one east of the Outdoor Classroom, another just downstream on the east bank of the creek. Oracle oak is thought to be the product of past hybridization betweeen black oak (Quercus kelloggi) and interior live oak (Quercus wislizenii). Leaf morphology is intermediate between the two parents, and the trees are partially deciduous (Coll. Nos. 376, 466).

Quercus wislizenii Interior live oak. Abundant; the dominant tree of the riparian zone along Arcade Creek (Coll. Nos. 404,464).

Geraniaceae

*Erodium botrys Long-beaked filaree. Uncommon; early spring annual in open grassland areas above the riparian zone. Naturalized from the Mediterranean region (Coll. No. 335).

*Erodium cicutarium Red-stemmed filaree. Common; grassland areas. Naturalized from the Mediterranean region (Coll. No. 332).

*Erodium moschatum White-stemmed filaree. Uncommon; ruderal species along trail margins, disturbed areas. Naturalized from the Mediterranean region (Coll. No. 317).

*Geranium dissectum Cutleaf geranium. Common; grassland areas, upper margins of riparian zone. Naturalized from Europe (Coll. No. 353).

Hippocastaneaceae

Aesculus californica California buckeye. Uncommon; scattered trees within the riparian zone of Arcade Creek, mostly in the reach above Winding way (Coll. No. 342).

Juglandaceae

Juglans hindsii Black walnut. Common; scattered trees within the riparian zones of Arcade and Kohler Creeks. This native walnut is used as a root stock for English walnut, with which it freely hybridizes (Coll. Nos. 358, 389).

*Juglans regia English walnut. Adventive along Kohler Creek, now extirpated within the study area; several trees within the Nature Area were girdled in 1990. Native of Eurasia.

Lamiaceae

*Lamium amplexicaule Henbit. Collected by Jo Smith from annual grassland, 15 March 1979. Naturalized from Europe.

*Marrubium vulgare Horehound. Uncommon; grassy openings within the riparian zone, ruderal areas. Naturalized from Europe (Coll. No. 364).

*Melissa officinalis Lemon balm. Common; open shade beneath oak canopy, less commonly in grassland areas. Naturalized from Europe (Coll. No. 413).

Lauraceae

*Laurus nobilis Grecian laurel. Very rare; adventive along Arcade Creek; this is the "bay leaf" used in cooking; the species is also planted locally as a street tree. Native of the Mediterranean region (Coll. No. 402).

Malvaceae

*Malva nicaeensis Cheeseweed. Collected by Jo Smith from disturbed grassland areas, 21 April 1979. Naturalized from Europe.

*Malva parviflora Cheeseweed. Common; grassy areas and disturbed soils along trails and roads. Native of Eurasia (Coll. No. 337).

Moraceae

*Ficus carica Common fig. Rare; a single tree was observed near the confluence of Arcade and Koehler Creeks; others can be found near the Recycling Center. This introduced, Mediterranean tree is able to become established and persist in riparian settings. It should be considered **INVASIVE** within the Nature Area (Coll. No. 410).

Oleaceae

Fraxinus latifolia Oregon ash. Abundant; co-dominant in lower riparian zone of Arcade Creek (Coll. No. 339).

*Ligustrum lucidum Glossy privet. Rare; occurrence within the study area confined to several individuals planted behind residences on the east side of Arcade Creek, and a single individual that has become established in the riparian zone of Kohler Creek. This small tree is widely planted as an ornamental in the Sacramento area. The plants produce abundant berries which are distributed by birds (Coll. No. 457).

*Olea europa European olive. Formerly abundant, now very rare; Prior to 1991, this species was becoming naturalized as an understory shrub in the riparian zone between Arcade Creek and Winding Way. Most of these trees were removed in April 1991. Based on its demonstrated ability to invade and become established beneath an intact oak canopy, this species should be considered **INVASIVE** within the nature area. Native of the Mediterranean region (Coll. No. 341).

Onagraceae

Epilobium adenocaulon var. parishii Northern willow-herb. Uncommon; plants can be found growing at scattered locations near the water along both Arcade and Kohler Creeks (Coll. Nos. 453, 488).

Epilobium paniculatum Panicled willow-herb. Very rare; dry, disturbed areas at upper margins of the Arcade Creek riparian zone (Coll. No. 482).

Ludwigia peploides Yellow water weed. Common in pools and slow moving sections of Arcade Creek (Coll. No. 456).

Papaveraceae

Eschscholzia californica California poppy. Very rare; grassland opening along Koehler Creek. Perhaps not native in the study area (Coll. No. 396).

Phytolaccaceae

*Phytolacca americana Pokeberry. Very rare; a single shrub can be found as an adventive along Arcade Creek in the fenceline separating the Nature Area from the playing fields. The berries, foliage and roots of this species are poisonous. Native of the eastern United States (Coll. No. 438).

Plantaginaceae

*Plantago lanceolata Common; margins of trails, grassy openings within the riparian zone. Naturalized from Europe (Coll. No. 326).

*Plantago major Common plantain. Rare; scattered plants along the banks of Arcade Creek. Naturalized from Europe (Coll. No. 386).

Platanaceae

Platanus racemosa California sycamore. Very rare; only two young trees observed near residential areas on east side of Arcade Creek. This native tree is a more common element of the mixed riparian forests along the Sacramento and lower American Rivers. The trees in the study area were probably planted here by local residents (Coll. No. 403).

Platanus X acerifolia London planetree. Rare; occurence in the study area limited to trees planted at the Winding Way bridge. A popular street tree in the Central Valley (Coll. No. 388).

Polygonaceae

*Polygonum aviculare Common knotweed; Rare; sandy banks along Arcade Creek, compacted soils along access roads. Naturalized from Eurasia (Coll. No. 399).

Polygonum hydropiper Annual smartweed. Rare; Growing at the water's edge along Arcade Creek (Coll. No. 486).

*Polygonum persicaria Lady's thumb. Uncommon; banks of Arcade Creek, near the water. Introduced from Europe (Coll. Nos. 398, 465).

Polygonum punctatum Perennial smartweed. Common near the water along both Arcade and Kohler Creeks. This is the most abundant smartweed in the study area (Coll. Nos. 473, 478, 485).

*Rumex crispus Curly dock. Common; growing throughout the study area, in both shaded and open habitats. Naturalized from Eurasia (Coll. No. 373).

*Rumex pulcher Fiddle dock. Common; distribution within the study area similar to the preceding, but somewhat less abundant. Naturalized from the Mediterranean region (Coll. No. 363).

Portulacaceae

Claytonia perfoliata Donn. ex Willd. [=Montia perfoliata (Donn.) Howell var. perfoliata] Miner's lettuce. Common; a conspicuous spring annual in shaded areas, particularly under oaks (Coll. No. 312).

*Portulaca oleracea Purslane. Very rare; establishing on gravel bars within Arcade Creek channel. Native of Europe (Coll. No. 428).

Primulaceae

*Anagallis arvensis Scarlet pimpernel. Collected by Jo Smith from cultivated areas, 6 April 1979. Naturalized from Europe.

Rosaceae

Heteromeles arbutifolia Toyon. Very rare; growing in open shade on bank above Arcade Creek. This native shrub is more common in chaparral and oak woodland habitats in the Coast Ranges and foothills of the Sierra Nevada. However it is widely planted as an ornamental in the Central Valley (Coll. No. 436).

*Prunus amygdalus Almond. Very rare; adventive along upper margin of Kohler Creek riparian zone below the Recycling Center. Formerly quite common within the Nature Area; most have been removed as of 1991. Native of Eurasia (Coll. Nos. 301, 461).

*<u>Prunus</u> cultivars Flowering plum. Common; Naturalizing in shaded habitats throughout the study area. Most trees have been removed as of June 1991. <u>Prunus</u> cultivars are prolific seeders and should be considered **INVASIVE** within the Nature Area (Coll. Nos. 302, 374, 375, 400, 401).

<u>Rosa</u> <u>californica</u> Wild rose. Rare; shaded banks above Arcade Creek. Plants did not flower in 1991 (Coll. No. 468).

*<u>Rubus</u> <u>procerus</u> Himalaya-berry. Abundant throughout the study area, in both open and wooded settings; forming impenetrable thickets; this **INVASIVE** shrub is naturalized from Europe and has undoubtedly displaced much of the native understory vegetation within the study area (Coll. No. 390).

Ranunculaceae

*<u>Ranunculus</u> <u>repens</u> Creeping crowfoot. Collected by Jo Smith in disturbed grassland, 28 April 1979. Naturalized in lawns and turf areas. Native of the Old World.

Rubiaceae

*<u>Galium</u> <u>aparine</u> Common bedstraw. Abundant; clambering annual in shaded environments throughout the study area. Naturalized from Europe (Coll. No. 327).

<u>Galium</u> <u>nuttallii</u> Climbing bedstraw. Uncommon; collected by Jo Smith from riparian woodland on 28 March 1979.

Salicaceae

<u>Populus</u> <u>fremontii</u> Fremont cottonwood. Very rare; this dominant element of the riparian forests along the Sacramento and lower American Rivers is conspicuous by its near absence from the study area.

*<u>Populus</u> <u>nigra</u> var. <u>italica</u> Lombardy poplar. Extirpated within the study area; adventive along Arcade Creek. A single tree was girdled in 1990. Introduced from Europe.

<u>Salix</u> <u>lasiolepis</u> Arroyo willow. Uncommon; sandy banks along Arcade Creek; additional shrubs behind the Recycling Center along Kohler Creek (Coll. Nos. 306, 406).

<u>Salix</u> <u>goodingii</u> var. <u>variabilis</u> Gooding's willow. Very rare; this co-dominant tree of the Great Valley mixed riparian forest is poorly represented within the study area; when found in the Nature Area, it is usually growing with Fremont cottonwood (Coll. Nos. 347, 419.

Scrophulariaceae

*Veronica anagallis-aquatica Water speedwell. Very rare; On sand and gravel bars along Arcade Creek. Naturalized from Europe (Coll. No. 449).

*Veronica persica Persian speedwell. Rare; growing beneath oaks at margins of turf areas and playing fields. Naturalized from Eurasia (Coll. No. 315).

Simarubaceae

*Ailanthus altissima Tree of heaven. Very rare; a single individual was observed growing beneath the canopy of interior live oak along Arcade Creek. This tree was introduced from Asia during the gold rush and has become extensively naturalized in California, both in urban and rural settings. It should be considered POTENTIALLY INVASIVE in the study area (Coll. No. 359).

Solanaceae

*Solanum nodiflorum Small-flowered nightshade. Rare within the study area; Growing in disturbed areas such as sand bars along Arcade Creek. Naturalized from tropical America (Coll. No. 454).

Urticaceae

*Urtica urens Dwarf nettle. Uncommon; growing in grassy areas, often at edges of oak canopy. Naturalized from Europe (Coll. No. 311).

Verbenaceae

*Verbena bonariensis Argentine vervain. Very rare; a single individual can be found on the sandy bank of Arcade Creek above Winding Way. Native of South America, becoming naturalized in riparian habitats in the Central Valley (Coll. No. 433).

Vitacaeae

Vitis californica Wild grape. Rare; occasional vines on shaded banks along Arcade Creek. Generally not robust and not forming the lianas so typical of the riparian forests along the Sacramento and lower American rivers. An apparent hybrid with V. vinifera can be found along Kohler Creek adjacent to the Recycling Center (Coll. No. 356).

ANTHOPHYTA - MONOCOTYLEDONEAE

Alismataceae

Alisma triviale Water-plantain. Very rare; at immediate water's edge along Arcade Creek above Winding Way (Coll. No. 429).

Sagittaria latifolia Arrowhead. Uncommon; growing in the channel of Kohler Creek above the Outdoor Classroom (Coll. Nos. 443, 459) .

Amaryllidaceae

Brodiaea elegans Harvest brodiaea. Uncommon; open grassland areas generally above the riparian zone, sporadic in openings beneath oaks (Coll. No. 357).

Dichelostemma multiflorum (Benth.) Heller [=Brodiaea multiflora Benth.] Very rare; grassy openings in the upper riparian zone of Arcade Creek. Not collected due to small population size within the study area.

Triteleia laxa Benth. [=Brodiaea laxa (Benth.) Wats.] Grass nut. Common; grassland areas, often with Brodiaea elegans but flowering earlier (Coll. No. 328).

Cyperaceae

Carex barbarae Barbara sedge. Common, upper margins of Arcade Creek riparian zone. This native, rhizomatous sedge is a good bank stabilizer and should be encouraged in the Nature Area (Coll. No. 387).

Carex sp. cf. subbracteata Common; on steep channel banks of Arcade Creek (Coll. Nos. 394, 422).

*Cyperus eragrostis Umbrella-sedge. Common; edges of Arcade Creek channel, overflow areas. Growing near the water's edge (Coll. Nos. 427, 463).

Iridaceae

*Iris foetidissima Scarlet-seeded iris. Very rare; adventive beneath the oak canopy in the upper riparian zone of Arcade Creek. This location is reportedly near the site of Cameron's residence and may represent a remnant of his garden. This species is grown as an ornamental. Its flowers are inconspicuous, but the capsules (which retain brilliant red seeds after opening) are used in dried floral arrangements. Introduced from the Mediterranean region (Coll. No. 313).

Juncaceae

Juncus bufonius Toad rush. Very rare; sand bars along Arcade Creek (Coll. No. 395).

Juncus patens Spreading rush. Uncommon; shaded banks above Arcade Creek channel (Coll. No. 469).

Liliaceae

Chlorogalum pomeridianum Wavy-leaved soap plant. Common; growing in both open grassland and beneath the oak canopy (Coll. No. 417).

Poaceae

*Agrostis tenuis Colonial bent. Rare; adventive on sandy banks along Arcade Creek. Native of Europe (Coll. No. 423).

*Arundo donax Giant reed. Extirpated within the study area; formerly known from a few clumps along Arcade Creek; **EXTREMELY INVASIVE** in riparian environments. Naturalized from Europe.

*Avena fatua Wild oats. Common; open grassland areas. Naturalized from the Old World (Coll. No. 330).

*Bromus diandrus Rip gut. Abundant; a dominant species in the grasslands of the study area. Naturalized from Europe (Coll. No. 318).

*Bromus madritensis Spanish brome. Rare; upper banks along Arcade Creek. Native of Europe (Coll. No. 380).

*Bromus mollis Soft chess. Common; open grassland areas. Naturalized from Europe (Coll. No. 320).

*Bromus wildenowii Kunth. Prairie brome. Uncommon; sandy banks along Arcade Creek. Naturalized from South America (Coll. No. 354).

*Cynodon dactylon Bermuda grass. Common; low areas and stream banks throughout the study area. Naturalized from the Old World (Coll. No. 420).

*Cynosurus echinatus Dogtail grass. Uncommon; partial shade on banks of Arcade Creek. Native of Europe (Coll. No. 368).

*Dactylis glomerata Orchard grass. Common; scattered individuals can be found throughout the study area. Naturalized from Europe (Coll. No. 334).

*Digitaria sanguinalis Crab grass. Uncommon in sandy areas along Arcade Creek. Naturalized from Europe (Coll. No. 475).

Deschampsia elongata Slender hairgrass. Very rare; growing in clay soil at the confluence of Arcade and Kohler Creeks (Coll. No. 348).

*Echinochloa crusgalli Barnyard grass. Uncommon; edges of Arcade Creek channel. Naturalized from the Old World (Coll. No. 383).

*Eleusine indica Goosegrass. Very rare; As a weed at margins of turfed areas. Native of Europe (Coll. No. 442).

Elymus glaucus Blue wildrye. Uncommon; sandy banks along Arcade Creek (Coll. No. 366).

Elymus triticoides Creeping wildrye. Common; forming patches in open areas at the upper margins of the riparian zone along Arcade and Kohler Creeks. Creeping wild-rye is a rhizomatous perennial frequently found in riparian settings in the Central Valley. The species should be encouraged in the Nature Area (Coll. No. 397).

Eragrostis diffusa Spreading lovegrass. Rare; sandy banks of Arcade Creek (Coll. No. 381).

*Hordeum leporinum Hare barley. Abundant; A dominant species of the grassland areas throughout the study area. Naturalized from the Old World (Coll. No. 329).

Leersia oryzoides Rice cutgrass. Common; Arcade Creek channel and overflow areas, near the water (Coll. No. 474).

*Lolium perenne L. subsp. multiflorum (Lam.) R. Parnell Italian rye grass. Common; open grassland areas, banks of Arcade Creek. Naturalized from Europe (Coll. No. 325).

Muhlenbergia rigens Deergrass. Very rare; A single individual of this native perennial bunchgrass can be found beneath the oaks along Arcade Creek (Coll. No. 471).

*Paspalum dilatatum Dallisgrass. Uncommon; growing in scattered locations along the channel of Arcade Creek. Naturalized from South America (Coll. No. 365).

*Phalaris tuberosa var. stenoptera Hardinggrass. Abundant; growing throughout the study area. This perennial grass is a valuable forage grass in California and may initially have been seeded in the area for livestock. Naturalized from the Old World (Coll. No. 333).

*Poa annua Annual bluegrass. Common; growing in disturbed areas adjacent to trails, turf areas. Naturalized from Europe (Coll. No. 310).

*Polypogon monspeliensis Rabbit's-foot grass. Very rare; gravel bars and moist areas near the water along Arcade Creek. Naturalized from Europe (Coll. No. 446).

*Sorghum halapense Johnsongrass. Uncommon; sandy banks along Arcade Creek. Native of the Old World (Coll. Nos. 369, 382).

*Vulpia bromoides (L.) S.F. Gray Brome fescue. Common in drier sites above the riparian zone, disturbed areas. Naturalized from Europe (Coll. No. 321).

Typhaceae

Typha angustifolia Narrow-leaved cat-tail. Very rare in the study area; a single clump can be found at the water's edge along Arcade Creek (Coll. No. 439).

* Indicates species that are not native to California.

APPENDIX C. OAK TREE SIZE AND SPECIES DISRIBUTION IN THE AMERICAN RIVER COLLEGE NATURE AREA - 1991

SIZE CLASS IN INCHES	INTERIOR LIVE OAK	VALLEY OAK	BLUE OAK	BLUE/VALLEY OAK HYBRID	TOTALS
3-8	218	137	70	99	524
8-13	139	45	74	23	281
13-18	125	30	52	14	221
18-23	88	13	28	12	141
23-28	47	17	20	6	90
28-33	17	7	2	6	32
33-38	3	1	2	3	9
38-43	6	2	1	2	11
43-48	2	0	0	0	2
48-53	0	1	0	0	1
53-58	0	0	1	0	1
58-63	0	1	0	0	1
TOTALS	645	254	250	165	1314

Appendix C: Tree and Shrub Species from the Arcade Creek Feasibility Study

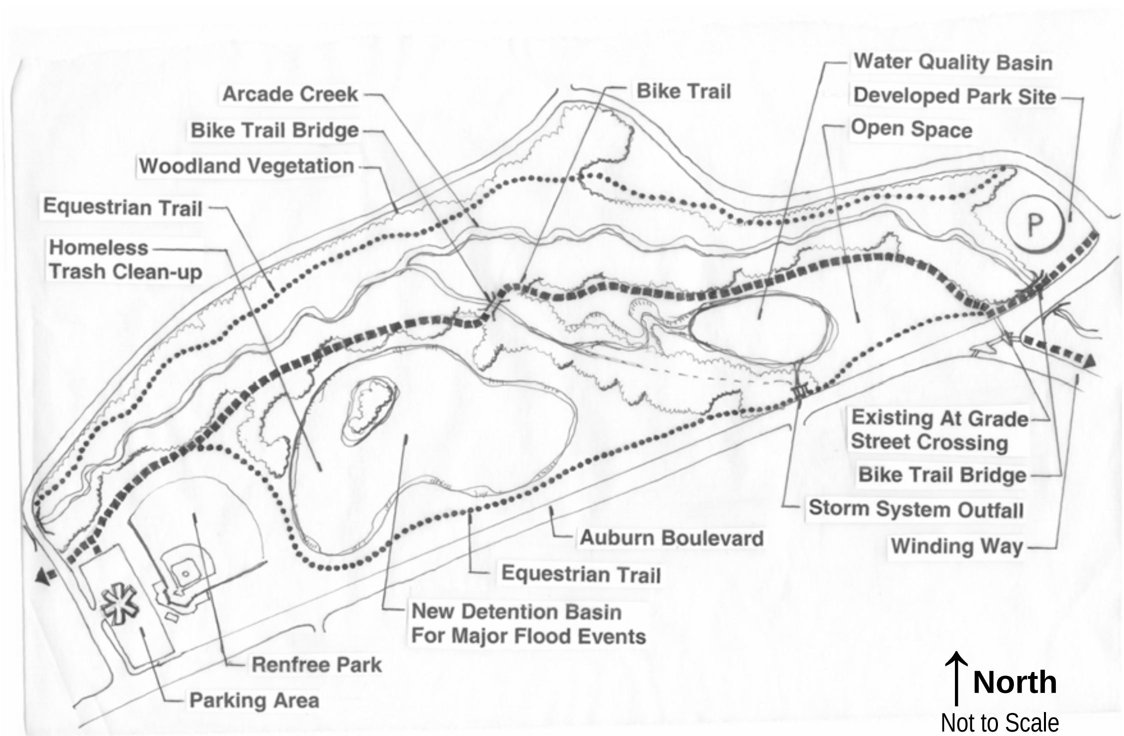
Scientific Name	Common Name	Native
CANOPY SPECIES		
Acer macrophyllum	Bigleaf Maple	yes
Acer negundo	Box Elder	yes
Alnus rhombifolia	White Alder	yes
Fraxinus latifolia	Oregon Ash	yes
Juglans hindsii	California Black Walnut	yes
Platanus racemosa	California Sycamore	yes
Populus fremontii	Fremont Cottonwood	yes
Quercus douglasii	Blue Oak	yes
Quercus lobata	Valley Oak	yes
Quercus wislizenii	Interior Live Oak	yes
Salix sp.	Willow species	yes
Acacia spp.	Acacia	no
Acer saccharinum	Silver Maple	no
Ailanthus altissima	Tree of Heaven	no
Alibizia julibrissin	Silktree	no
Catalpa sp.	Catalpa	no
Chamaecyparis sp.	False Cypress	no
Cinnamomum camphora	Camphor Tree	no
Fraxinus spp.	Ash	no
Gleditsia triacanthos	Honey Locust	no
Morus alba	White Mulberry	no
Pinus sp.	Pine	no
Platanus acerifolia	London Plane Tree	no
Populus alba	White Cottonwood	no
Robinia pseudoacacia	Black Locust	no
Ulmus americana	American Elm	no
Ulmus parvifolia	Chinese Elm	no
Ulmus pumila	Siberian Elm	no
Washingtonia robusta	Mexican Fan Palm	no
MIDSTORY SPECIES		
Aesculus californica	California Buckeye	yes
Celtis reticulata	Hackberry	yes
Cephalanthus occidentalis	Buttonbush	yes
Prunus emarginata	Bitter Cherry	yes
Prunus virginiana L.	Western Chokecherry	yes
Rhamnus spp.	Coffeeberry	yes
Rhus toxicodendron	Poison Oak	yes
Rosa californica	Wild Rose	yes
Vitus californica	Wild Grape	yes
Casuarina equisetifolia	Beefwood	no
Cytisus scoparius	Scotch Broom	no

Eriobotrya japonica	Loquat	no
Ficus carica	Common Fig	no
Koelreuteria paniculata	Goldenrain Tree	no
Ligustrum sp.	Privet	no
Melia azedarach	China Berry	no
Nerium oleander	Oleander	no
Parthenocissus quinquefolia	Virginia Creeper	no
Pistacia chinensis	Chinese Pistache	no
Prunus cerasifera	Myrobalan Plum	no
Prunus sp.	Almond	no
Prunus spp.	Plum	no
Pyracantha coccinea	Scarlet Firethorn	no
Rubus discolor	Himalyan Blackberry	no
Sesbania punicea	Red Sesbania	no
Wisteria spp.	Wisteria	no

Appendix D: Arcade Creek Watershed Recommended Projects

6.1 Auburn Park Detention Basin

In Del Paso Park between Auburn Boulevard and Park Road Arcade Creek flows through approximately 30 acres of open space. On the south side of the open space at the intersection of Auburn Boulevard and Norris Avenue a large storm system outfall provides enough water to create a small stream that flows into Arcade Creek. This recommended project focuses on providing a water quality basin for this storm drainage, a detention area for large flood events, a bike path that transverses Del Paso Park, and equestrian trails that parallel the creek on the north and south sides of the park.

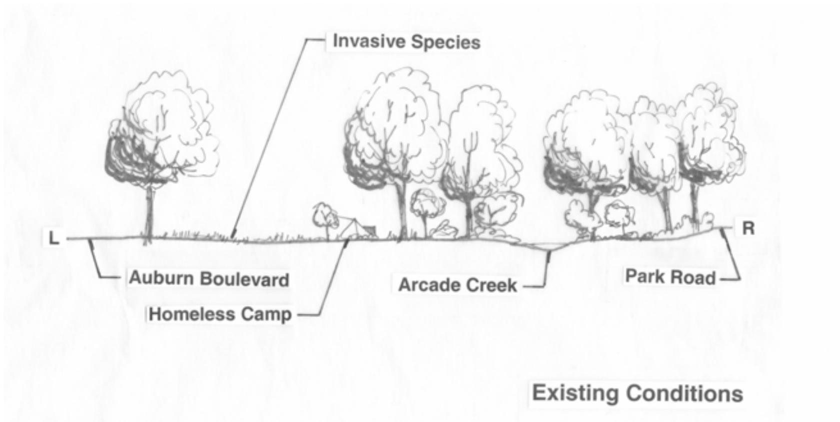


Water Quality

The large storm drain at Norris and Auburn carries mostly runoff from residential neighborhoods. Two of the main pollutants of Arcade Creek that exceed water quality criteria, Diazinon and Malathion, are commonly used household chemicals; therefore, treating residential runoff is critical to improving water quality in the stream. Given the space available on this site, it is a prime candidate for polishing the residential runoff from the outfall using wetland plants.

To create a bio-filtration system, the stream should be diverted near its outfall under Auburn Boulevard into a water quality basin located east of the current stream channel (see diagram above). In the basin, the pollutants and suspended particulates can settle out of the water and be taken up by the vegetation growing in the water. Following the settling pond, the water should flow though a filtration wetland where various plants filter additional pollutants out of the water. This wetland should empty back into the original channel close to the point where the water was initially diverted. The system should be designed to treat first-flush runoff from a storm, and work in conjunction with the detention basin discussed below.

High quality riparian vegetation exists along the subject stream and care should be taken to minimize disturbance to the existing trees and shrubs as well as the existing water course. Native plant species should be planted to replace the existing invasive star thistle field that occupies the site.



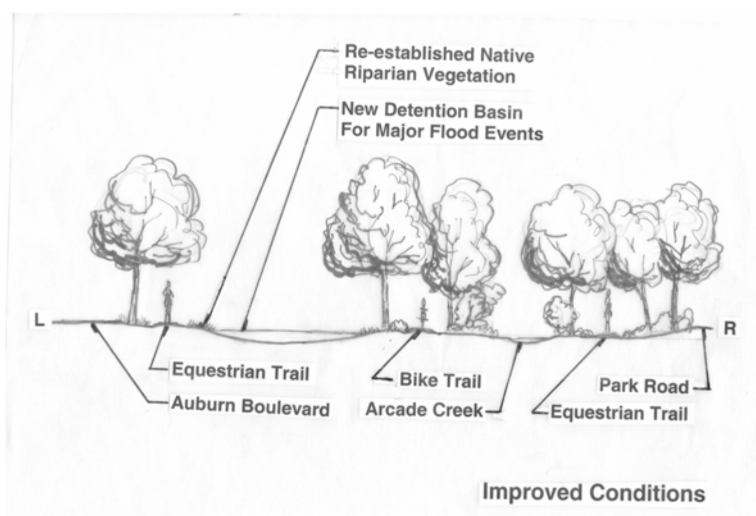
Not to Scale

Flood Mitigation

The large open space along Auburn Boulevard east of Renfree Park and West of the storm outflow channel mentioned in the water quality section is one of the largest undeveloped pieces of land in the Arcade Creek Feasibility Study Area. A large 6-8 acre detention basin could be built on this site. The basin would serve as an overflow area for the water from severe flood events, such as a 100 year flood, and be designed to work in conjunction with the water quality pond, so that the initial flush from a storm would pass into the pond, but additional runoff above a predefined level would flow into the basin. This basin could potentially be collocated with a passive recreation use space. The existing mature oaks within the proposed detention basin site can be saved by excavating around them leaving the trees on top of an island in the future basin.

Habitat

All woodland habitat that currently exists on this site is proposed to remain. The construction of the water quality pond, water quality wetland, and the detention basin will add approximately 14 acres of wetland habitat. Removal of the invasive plant species and the replanting with native plants will help increase biodiversity in plant life which will in turn



Not to Scale

increase the biodiversity in animal life.

Recreation

The existing Softball complex at Renfree Park and the adjacent large parking lot provide an excellent staging opportunity for a trail head for recreation trails that would parallel Arcade Creek. Interpretive signage along the trails and at a trailhead kiosk could explain the functioning of the water quality pond, wetland and detention basin and the impact of household pesticide and herbicide use on the creek system.

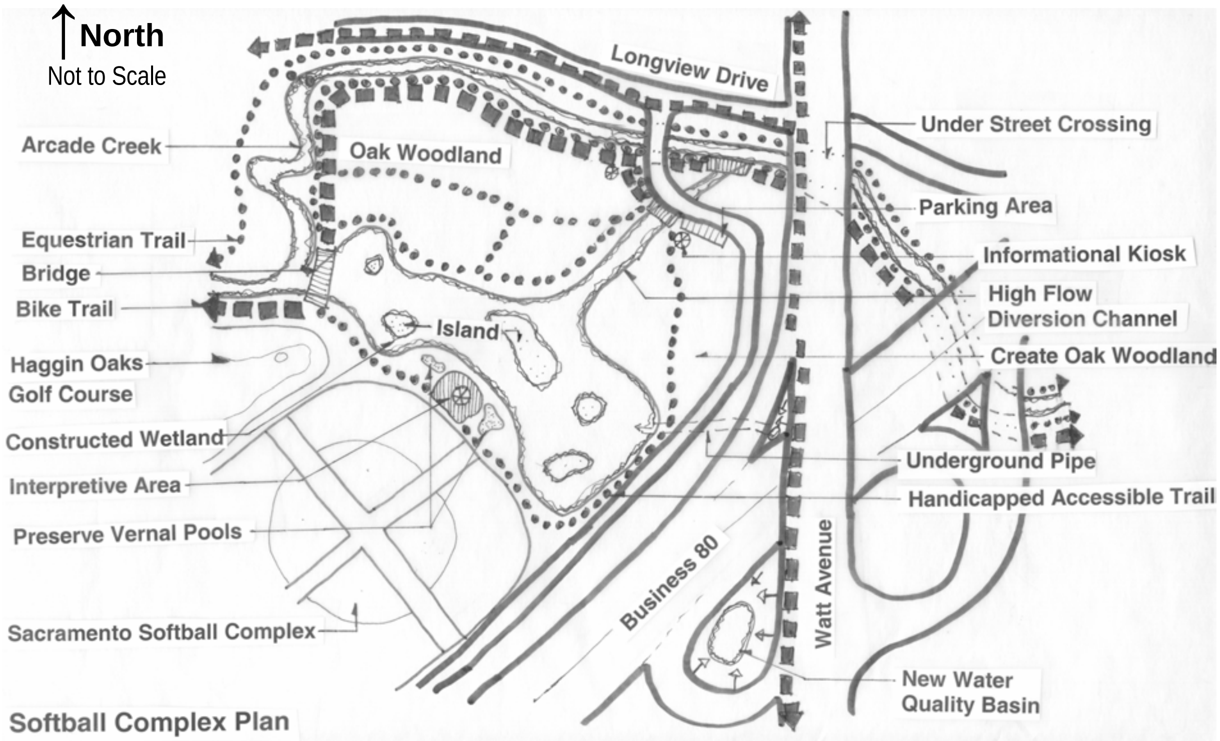
The large number of horses in the neighborhood and the neighborhood's significant historic equestrian ties to the region provide reason for adopting the existing trails in this area as standardized equestrian trails. An equestrian trail on the north side of creek and to the south of the proposed water quality and detention basins would form a loop around this portion of Del Paso Park. The bike trial on the south side of the creek would be part of the continuous trail that this report proposed to run from Marysville Boulevard East to the City of Sacramento City Limits. The bike and equestrian trails should be separated by a buffer strip as much as possible, but in areas where space is limited the users may have to share the trail.

Project Summary

This project is one of the most promising in the study area. The available space, proximity to Renfree Park, and location of the outfall and stream mean that significant issues in water quality, flood damage mitigation, recreation and habitat improvement can be addressed on this site. High priority should be given to further developing a plan for this site.

6.2 Softball Complex Wetlands

The Sacramento Softball Complex adjoins an open space that has the potential to be transformed into a filtration wetland and high water detention basin. This project offers opportunities for mitigating flood control while improving habitat and recreational opportunities. It addresses the goals of the Feasibility Study as follows:



Water Quality

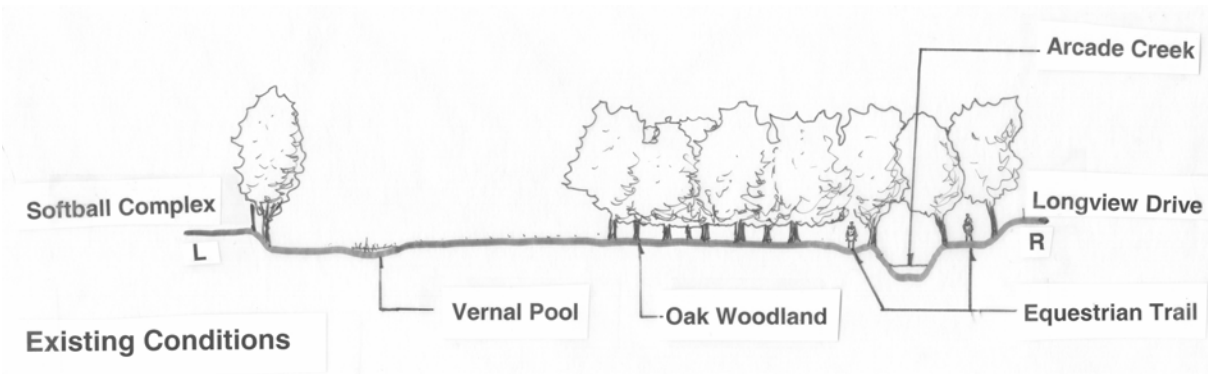
Improving water quality is not the primary goal of this project. Water flowing across this site is already filtered by the many grasses that currently occupy the site, thus the detention basin may not provide significant improvements. Some water quality benefits may be gained by draining the spandrelle between Watt Avenue and the Business 80 west on-ramp into the detention basin. This spandrelle collects runoff from two very busy roads. Directing this water overland and into a detention basin rather than into a storm drain and directly into the creek may improve water quality.

Flood Mitigation

Cutting a high flow channel from Arcade Creek to the wetland may allow it to serve as a floodwater detention structure while not impacting the creek during low flows. A detailed topographic survey of the site is required to determine if this is feasible, but if so, the basin could add new storage capacity to the creek. In addition to storing high flows, the wetlands would intercept runoff from the softball complex and freeway.

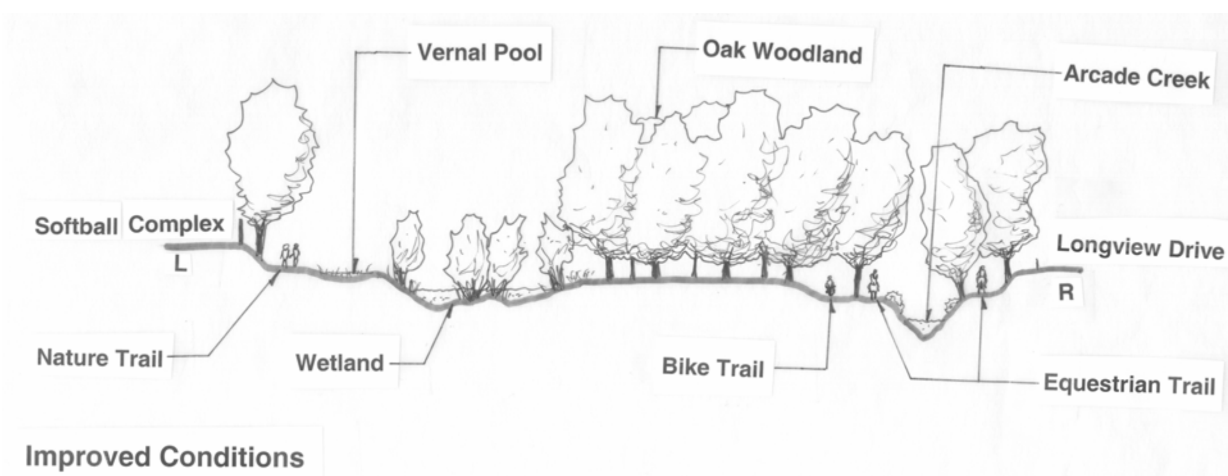
Habitat

This project has been designed to maximize habitat variety and recreation opportunities. The wetland is located away from the creek to preserve an existing oak woodland. Additionally, two existing vernal pools should be preserved. This project would construct a large wetland, a habitat that has been almost completely eliminated within the watershed. Existing annual grasses and starthistle should be replaced by oak woodlands near the softball complex access road.



Recreation

This project would serve as an important recreational node along Arcade Creek. Some parking would be added along the softball complex access road to allow hikers and bikers to park and access the creekside trail. This area currently has a number of equestrian and pedestrian trails winding through it. These trails should be retained wherever possible. The area between the two existing vernal pools, adjacent to the rear gate of the softball complex, would be an important interpretive point with seating and signage. This area could be utilized by visitors along the creek as well as by spectators and competitors at the softball complex. Interpretive elements should also be added at other locations around the wetlands and throughout the oak woodlands.

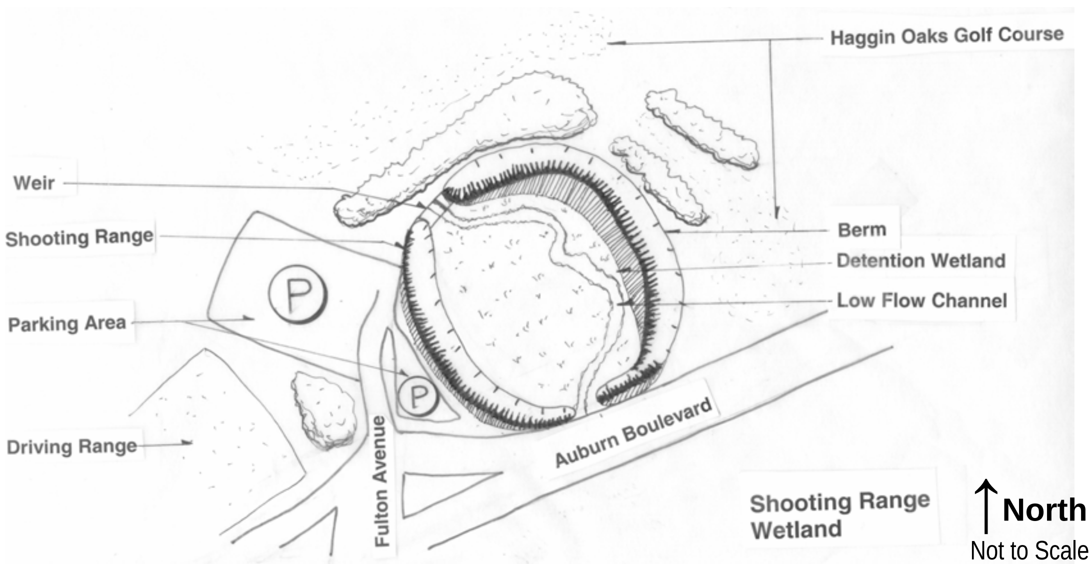


Project Summary

This project provides high quality habitat enhancements and recreation opportunities. The detention basin could be maintained as a perennial pond that would attract migrating waterfowl and provide a place where visitors to the softball complex could relax and stroll. Local schools could also use the site as an educational resource for thematic instruction. If topographically feasible, the basin could also function as an overflow area for the creek, providing additional benefits to flood control, as well as returning flooding to a site that most likely has been disconnected from the creek. This project should be a high-priority in the overall plan for this region.

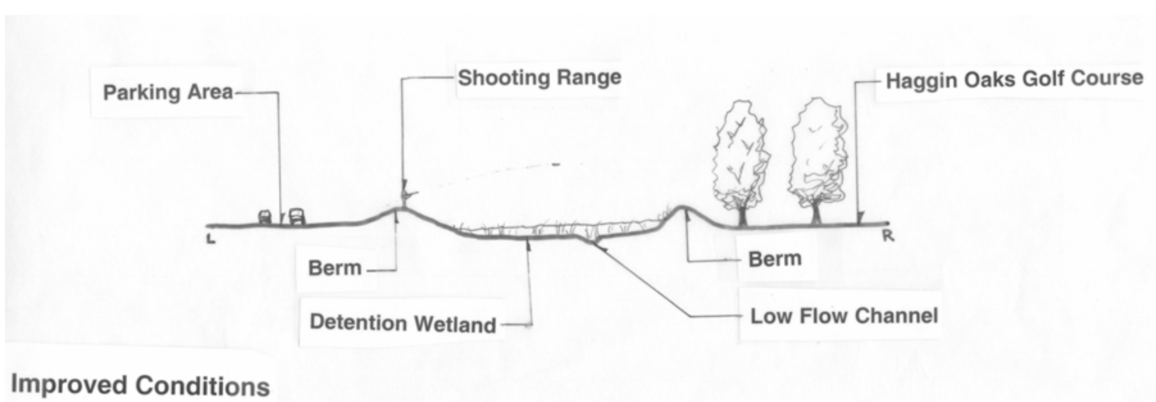
6.3 Shooting Range Detention Wetlands

The creation of detention wetlands at the Sacramento Trapshooting Club shooting range takes advantage of a naturally occurring drainage. A small creek runs through the down range area over which traps are shot. This project would build up the berms that surround this drainage and install a flow regulating structure, such as a weir, to control high flow runoff. Water currently flows into this area from a culvert under Auburn Boulevard and drains overland across the golf course into Arcade Creek. The overall flow of the drainage will remain unchanged.



Flood Control and Water Quality

The primary function of this project is to increase detention capacity during high flows. The drainage, fed by urban runoff, currently flows year-round and would continue to do so in the low flow channel defined in this project. During the wet season water would be detained in the large basin formed by the berms and slowly released to run into Arcade Creek. This drainage currently runs overland for a long distance before reaching Arcade Creek. Thus, many nutrients and pollutants may already be scrubbed from it before it



reaches the creek. The addition of other wetland plants may slightly improve water quality.

Habitat and Recreation

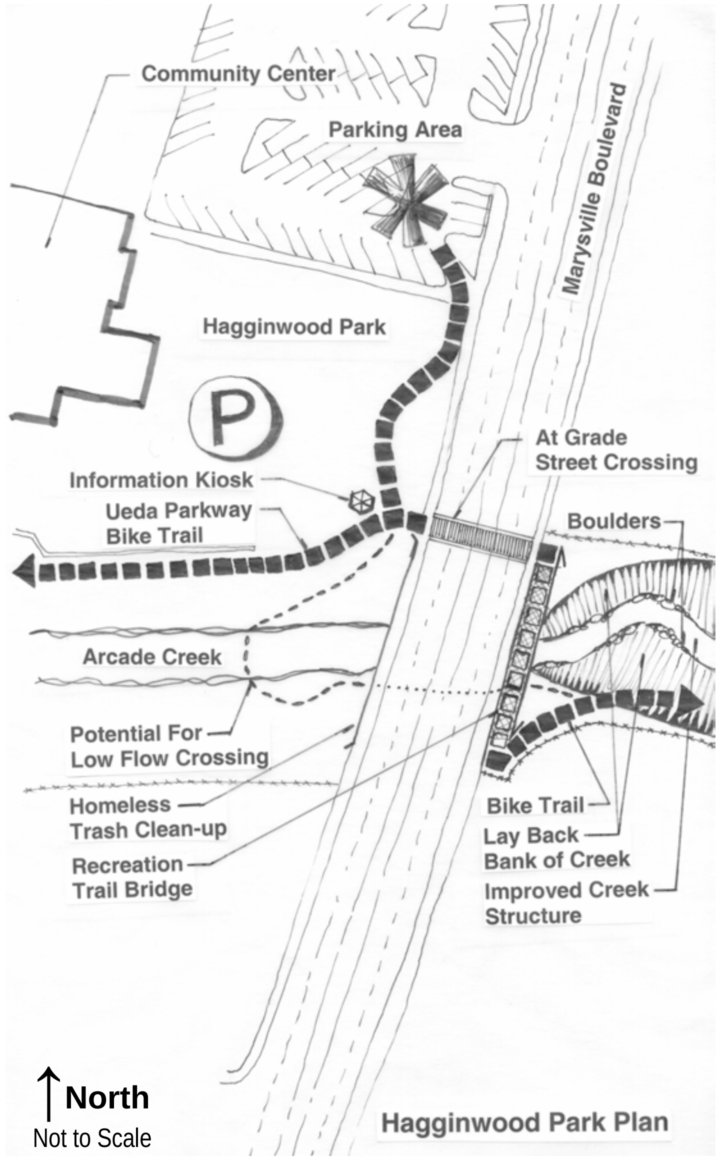
This project will result in the development of seasonal wetlands. However, due to the urban origins of the water entering the wetlands and the fact that they are under the target area for the trapshooting club their habitat value is questionable. The wetlands created may be suitable for reptiles, amphibians, and small mammals, but will probably be only marginal habitat for birds.

The trapshooting club holds shooting competitions throughout the year. One important influence on the habitat value, and water quality, is the type of shot used by its members. The use of lead shot should not be allowed, to prevent its being eaten by wildlife or contaminating the water. Due to the presence of the trapshooting club this wetland will not be accessible to the public or offer other recreational opportunities. It should not interfere with the activities of the club and may offer aesthetic appeal to the members.

Project Summary

This area provides approximately 9 acres of available land for additional detention. It could increase the detention capacity of the area by 9-18 acre-feet, depending upon the topographic variation between the north end of the site and the invert elevation of the outfall. It could also result in quality habitat for non-bird species, as well as an additional polisher for stormwater pollutants in the water. This project should receive a medium priority.

6.4 Hagginwood Park



The Hagginwood Park Project integrates habitat improvement and flood damage reduction through channel modification. The project offers the opportunity to link mass transit, the Ueda Parkway, and northeastern Sacramento neighborhoods together with a recreation trail. The project addresses the overall goals of the Arcade Creek Feasibility Study as follows:

Water Quality:

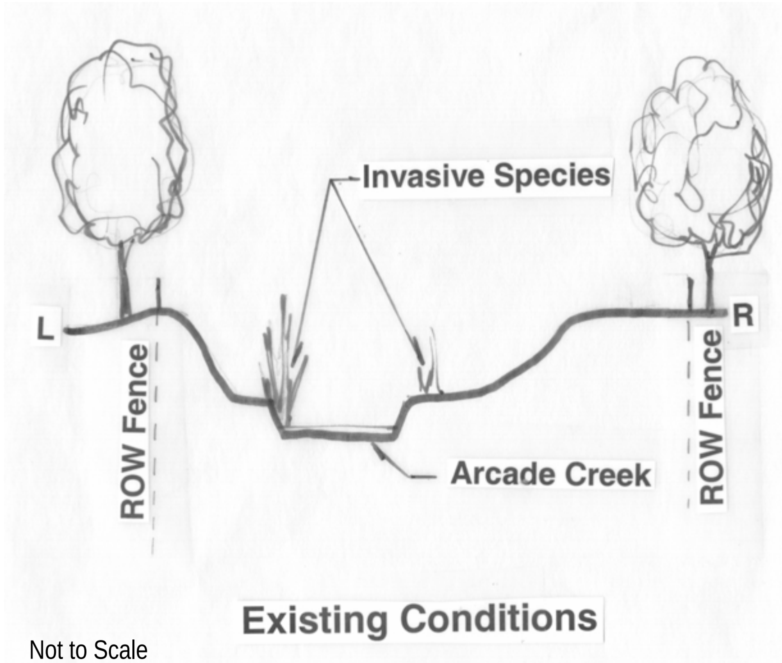
The elevation difference between the large 72" outfall that flows into Arcade Creek underneath the Marysville Boulevard Bridge and the neighboring Hagginwood Park is approximately 10 to 15 feet. Because of the significant grade difference constructing a water quality detention basin in the park to capture the water from the outfall is not realistic without an elaborate pumping system and rerouting of the deep storm water pipe at the bridge. The cost of such an undertaking would be very high, but could improve the water quality from the outfall. Source identification and control is probably a better option for this outfall.

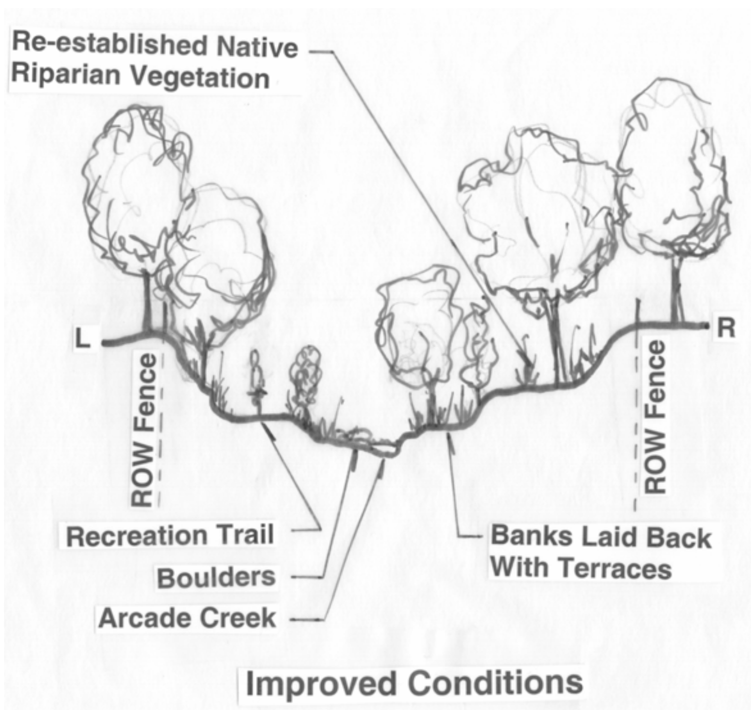
Wildlife Habitat and Flood Control:

Arcade Creek immediately east of Marysville Boulevard flows through a very wide right of way for approximately 800 feet which affords the opportunity for major regrading of the stream banks. The banks could be laid back and in-channel structures such as boulders utilized to narrow the low flow channel which in turn would begin to create structure in the creek. Boulders would also serve as shelter for warm water fish species such as large mouth bass. Laying back the banks also has the advantage of increasing floodwater capacity, which in turn allows the introduction of woody vegetation such as alders and willows to the stream channel (without increasing flood levels). Removal of invasive plant species and replanting with native plants will also help restore a healthy riparian system.

Recreation:

Located at the downstream end of the project, Hagginwood Park provides an excellent staging point for a potential recreation trail that could link up with the Ueda Parkway Bike Trail and follow the creek east to the city limits. Due to the topography and geographic constraints the trail would need to be located on the south bank of the creek in this area. The Ueda Parkway Bike Trail is slated to be on the north side of the creek, therefore a bridge would be required to link the paths. This may utilize the existing bridge at Marysville Boulevard or a separate structure. Alternately, a low flow crossing in lieu of a bridge over the creek is a less expensive option and should be investigated. If this is to be a primary commuter route, however, it should be accessible year-round. Another challenge would be constructing an at grade street crossing across Marysville Boulevard, a major thoroughfare. This crossing may use a traffic light, although a low-flow path underneath the bridge might be possible.



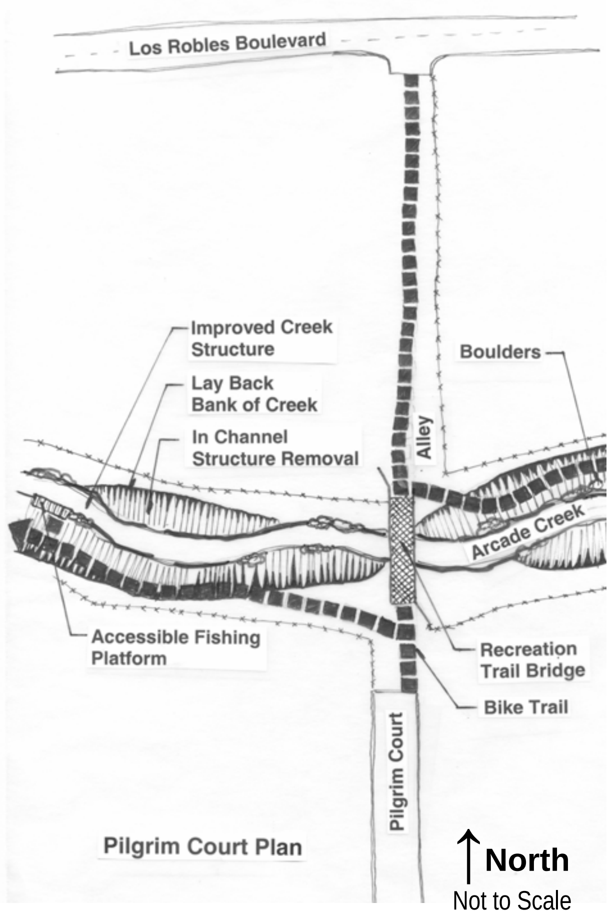


An interpretive kiosk illustrating the current conditions of Arcade Creek and the creek after the proposed improvements would be a great addition to Hagginwood Park. The kiosk could chart the conditions of the creek, historic changes of the region, the impact of development on the creek and provide educational information about urban creeks in general. The kiosk could also serve as a mile marker for the overall Arcade Creek Recreation Trail.

Project Summary

This project combines valuable recreation trail linkages with a node for a trailhead containing interpretive signage. Laying back the creek banks would provide habitat enhancements and greater floodwater capacity as well as increasing educational opportunities and significantly improving the aesthetics of this highly modified and armored section of the creek. The proximity of residential neighborhoods to the creek in this section increases the importance of a natural stream corridor and should ensure the heavy usage of a trail in this area. This project should have a medium to high priority.

6.5 Pilgrim Court



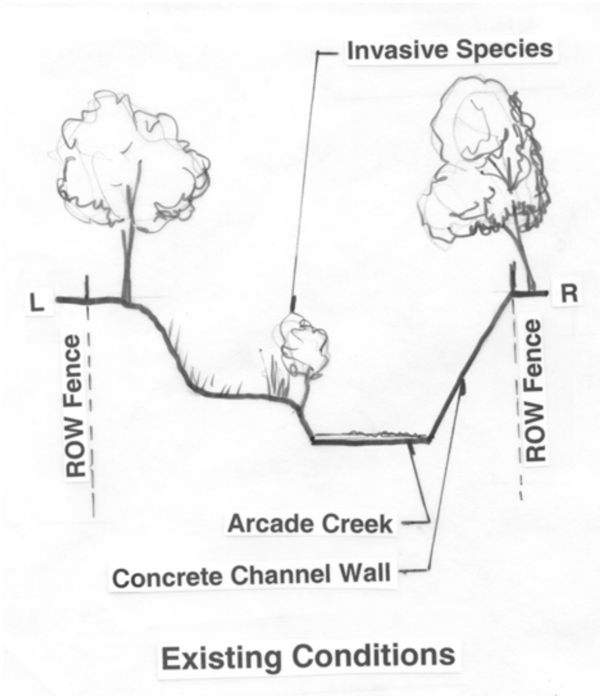
Pilgrim Court is a short residential street located approximately halfway between Marysville and Del Paso Boulevards. This project's main accomplishments would be improved wildlife habitat through removal of the impervious materials on the streambanks and the construction of a bridge for the recreation trail that could also be used by local residents for better pedestrian access within the neighborhood. The goals of the Arcade Creek Feasibility Study are addressed as follows:

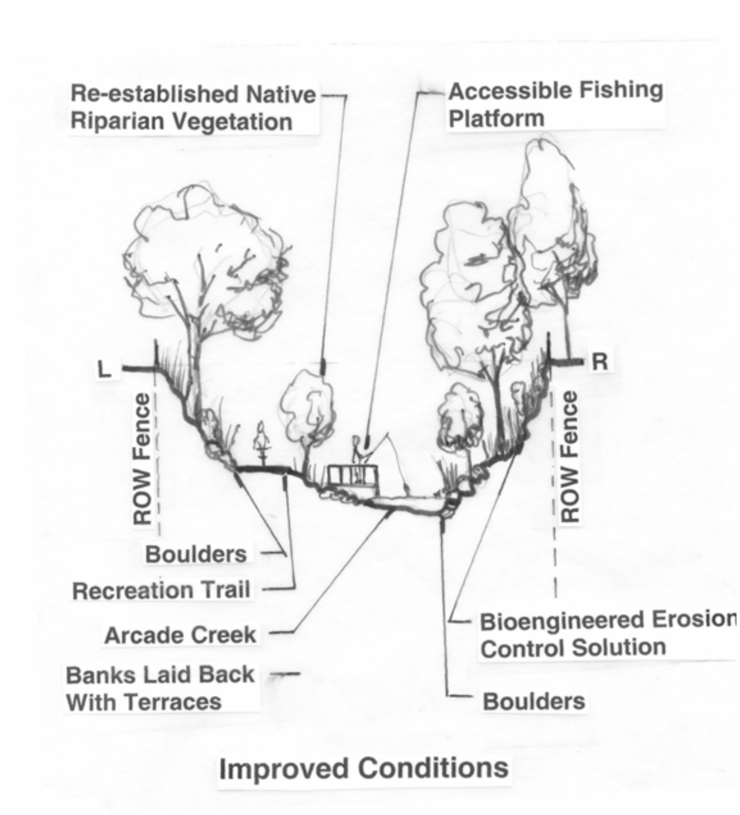
Water Quality

The narrow right of way of Arcade Creek through the Hagginwood Neighborhood physically limits what can be done to improve the water quality in this segment of creek. Perhaps the best way to improve water quality is to develop a program of informing and educating residents in the neighborhood about the effects that common household chemicals and products can have on the creek system. Residents who own property that backs up directly to the creek should be educated not to dump trash over the top of the fence. Additionally, if sufficient room exists, a narrow grassed swale could be built at the top of the slopes to catch runoff coming from the adjacent properties. This swale could be built into the banks of a redesigned stream channel.

Wildlife Habitat and Flood Control:

In the past, flood control along Arcade Creek in the vicinity of Pilgrim Court has been accomplished by paving the channel to reduce erosion and channel roughness. Most of the creek banks up and downstream of Pilgrim Court are completely or partially covered in gunite, concrete, asphalt, and/or other impervious surfaces. Much of the creek in this section is essentially a paved canal. To restore this section of the creek to a more natural state, while maintaining erosion control and floodwater conveyance capacity, the current bank armoring should be replaced with ecologically sensitive erosion control methods. Bioengineered solutions would allow for plant material to grow on the banks of the stream while providing comparable erosion protection. Using environmentally sound





bank stabilization methods, the creek bed could serve as rich habitat for an array of wildlife. In-channel structures and the addition of boulders to the stream banks would provide improved habitat for aquatic life. Removal of invasive plant species from this section of Arcade Creek would help to prevent competition with the existing native vegetation. If not removed, invasive aquatic plant species may eventually replace native species and create a monoculture within the creek – a monoculture of plants that provide little to no habitat value for a diverse community of wildlife.

Recreation:

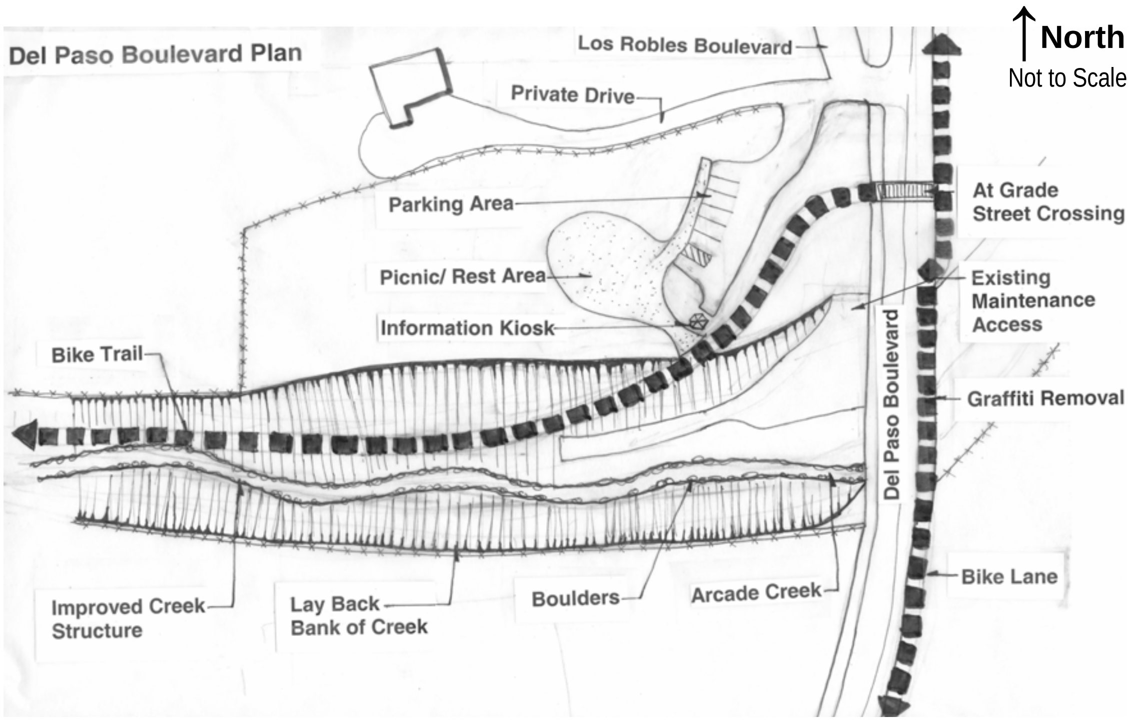
The Arcade Creek right of way should cross the creek at Pilgrim Court. West of where Pilgrim Court dead ends into Arcade Creek the south side of the stream has a wider bank than the north, however, east of the intersection the north side of the stream has the wider bank. Across the stream from Pilgrim court is a wide alley corridor that links up to Los Robles Boulevard. A bridge linking Pilgrim Court to the alley across Arcade Creek would also allow the bike trail to cross at that point while remaining on the side with the widest bank. The bridge crossing would also provide access to the residents on the south side of the creek via Pilgrim Court and to residents on the north side of the creek via Los Robles Boulevard. As the health of Arcade Creek improves following recommendations in this plan and in the watershed plan currently under development, fishing may once again become a viable sport along its banks. Wooden pallets in the stream along the edges of the creek combined with boulders and revegetation would provide shelter from predators to fish and other aquatic life, such as crayfish. Fishing platforms could be constructed along the path that are ADA accessible and close to or overhanging the creek edge. All structures placed in the creek would require engineering to withstand the high water flows.

Project Summary

This project provides key habitat improvements such as replacement of bank armor with connection of recreation trails. It is a moderate to high priority and should be combined with the Hagginwood Park improvements.

6.6 Del Paso Boulevard Staging Area

The intersection of the Del Paso Boulevard Bike Lane and the Arcade Creek Bike Trail is an important recreational node. There is a vacant lot adjoining the creek on the north side with power lines running over it. At this point, the Arcade Creek trail should leave the creekside to bypass the constriction of the corridor at the light-rail bridge and connect to a spur that links the trail system to the light rail station. This project provides these trail linkages, parking, and a picnic and rest area for people using the trails.



Water Quality

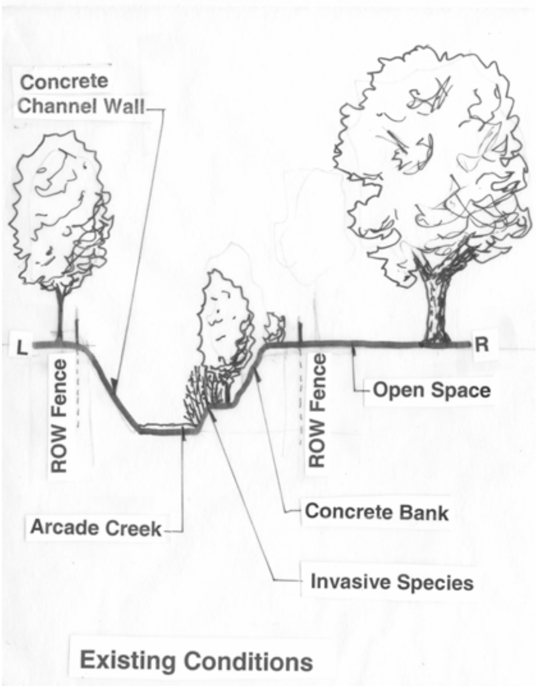
The right of way along this section of the creek is very narrow, limiting the techniques that can be used to improve water quality. As in previous projects, the most effective technique for improving water quality is probably to educate local residents about proper management of household wastes and toxins.

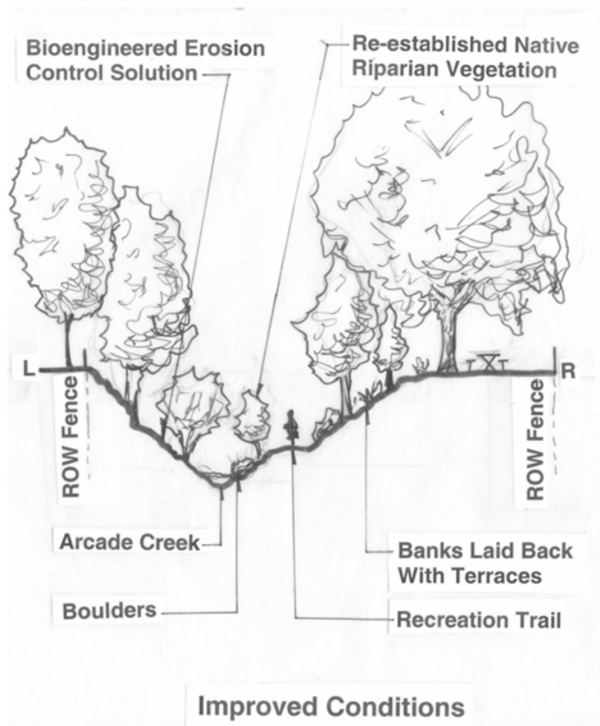
Flood Control and Habitat

As discussed previously, both banks in this area are partially covered in asphalt and concrete, which stabilizes the banks but provides little wildlife or aquatic habitat. Due to the narrowness of the corridor, the creek channel cannot be widened, however, it can be reformed to improve the habitat value and maintain stable banks and flood capacity. A deeper, but narrow low-flow channel should be cut to improve habitat quality for aquatic species. This channel should meander through the creek bottom and around boulders to improve the diversity of aquatic habitat. The banks should be reshaped to create terraces, which would increase biodiversity. These terraces should be planned to flood in high-flow events. This will improve habitat while maintaining flood capacity. The removal of invasive plant species will also help improve habitat quality and biodiversity.

Recreation

This would be an important recreational node on Arcade Creek, because it would serve as a jumping off point for people wishing to use the trails for hiking or biking. A small parking area would allow users to easily access the trails. In addition, this area should have a small picnic area with tables and benches for trail users to rest stop and rest. An information kiosk with maps of the trail system and information on the restoration of Arcade Creek is another important feature that should be located at this site.





Project Summary

While the majority of the benefits of this project come from the recreational linkages, removal of bank armoring and revegetation would have significant habitat value. This project should be planned with the previous two as part of a bike trail improvement plan for this region.

Appendix E: Parks in the Arcade Creek Watershed

NAME	ADDRESS
ELEMENTARY SCHOOLS	
PRIVATE	
American Christian Academy	7412 Hollyhock Ct., CH 95621
Carden Sunrise	7723 Old Auburn Road, CH 95610
Creative Frontiers	6446 Sylvan Drive, CH 95610
Faith Christian Academy	7737 Highland Avenue, CH 95610
Family Christian Academy	6521 Hazel Avenue, Sacramento Co 95662
Holy Family	7817 Old Auburn Road, CH 95610
Kwest Academy	7221 Suncreek Way, Sacramento Co. 95662
Liberty Towers Christian	5132 Elkhorn Boulevard, Sacramento Co 95842
Sacramento Adventist Academy	5601 Winding Way, Sacramento Co, 95608
Saint Albans Country Day	2312 Vernon St., Roseville 95678
Saint John Evangelist	5701 Locust Avenue, Sacramento Co 95608
Saint Marks Lutheran	7869 Kingswood Drive, CH 95610
Trinity Christian	5225 Hillsdale Boulevard, Sacramento Co 95660
PUBLIC	
Arlington Heights	6401 Trenton Way, CH 95621
Cambridge Heights	5555 Fleetwood Drive, CH 95621
Cameron Ranch	4333 Hackberry Lane, Sacramento Co 95608
Carriage Drive	7519 Carriage Drive, CH 95621
Michael J. Castori	1801 South Avenue, Sacramento 95838
Citrus Heights	7085 Auburn Boulevard , CH 95621
Thomas W. Coleman	6545 Beech Avenue, Sacremnto Co 95662
Del Paso Heights	590 Morey Ave, Sacramento 95838
Harry Dewey	7025 Falcon Road, Sacramento Co 95628
Fairbanks	227 Fairbanks Avenue, Sacramento 95838
Foothill Oaks	5520 Lancelot Drive, Sacramento Co 95842
Frontier	6691 Silverthorne Circle, Sacramento Co 95842
Grand Oaks	7901 Rosswood Drive, CH 95621
Hagginwood	1418 Palo Verde Avenue, Sacramento 95815
John Holst	4501 Bannister Avenue, Sacramento Co 95628
Harmon Johnson	2591 Edgewater Road, Sacramento 95815
Thomas Kelly	6301 Moraga Drive, Sacramento County 95608
Kingswood	5700 Primrose Drive, CH 95610
Lichen	8319 Lichen Drive, CH 95621
Leighton Littlejohn	6838 Kermit Lane, Sacramento Co 95628
Mariposa Avenue	7940 Mariposa Avenue, CH 95610
Noralto	477 Las Palmas Avenue, Sacramento 95815
North Avenue	1281 North Avenue, Sacramento 95838
Oakdale	3708 Myrtle Avenue, Sacramento Co 95660
Charles Peck	6230 Rutland Drive, Sacramento Co 95608
Pershing	9010 Pershing Avenue, Sacramento Co 95662
Pioneer	5816 Pioneer Way, Sacramento Co 95841
Roberts	5630 Illionois Avenue, Sacramento Co 95628
Skycrest	5641 Mariposa Avenue, CH 95610
Sunrise	7322 Sunrise Boulevard, CH 95610
Trajan	6601 Trajan Drive, Sacramento Co 95662
Woodridge	5761 Brett Drive, Sacramento Co 95842
Woodside	8248 Villa Oak Drive, CH 95610
MIDDLE SCHOOL (PUBLIC)	
John Barrett	4243 Barrett Road, Sacramento Co 95608

NAME	ADDRESS
Andrew Carnegie	5820 Illinois Avenue, Sacramento Co 95662
Will Rogers	4924 Dewey Drive, Sacramento Co 95628
Sylvan	7137 Auburn Boulevard, CH 95621
JUNIOR HIGH (PUBLIC)	
Foothill Farms	5001 Diablo Drive, Sacramento Co, 95842
Martin Luther King Jr.	3051 Fairfield Street, Sacramento 95815
INTERMEDIATE (PUBLIC)	
Arcade Fundamental	3500 Edison Avenue, Sacramento Co 95821
HIGH SCHOOL	
PRIVATE	
American Christian Academy	7412 Hollyhock Ct., CH 95621
Family Christian Academy	6521 Hazel Avenue, Sacramento Co 95662
Sacramento Adventist Academy	5601 Winding Way, Sacramento Co, 95608
Kwest Academy	7221 Suncreek Way, Sacramento Co. 95662
PUBLIC	
Bella Vista	8301 Madison Avenue, Sacramento Co 95628
Del Campo	4925 Dewey Drive, Sacramento Co 95628
El Sereno Alternative Education	8301 Madison Avenue, Sacramento Co 95628
Foothill	5000 McCloud Drive, Sacramento Co 95842
Grant Union	1400 Grand Avenue, Sacramento 95838
La Entrada	5320 Hemlock Street, Sacramento Co 95841
La Vista	5843 Almond Avenue, Sacramento Co 95662
Mesa Verde	7501 Carriage Drive, CH 95621
Mira Loma	4000 Edison Avenue, Sacramento Co 95821
Palos Verde Continuation	7501 Carriage Drive, CH 95621
San Juan	7551 Greenback Lane, CH 95610
Via Del Campo	4925 Dewey Drive, Sacramento Co 95628
COLLEGES	
American River College	4700 College Oak Drive, Sacramento Co 95841
GOLF COURSES	
Foothill Gold Course	7000 Verner Avenue, CH 95621
Haggin Oaks Municipal Golf Course	3645 Fulton Avenue, Sacramento 95821
Northridge Community Course	7600 Madison Avenue, Sacramento Co 95628
PRIVATE RECREATION FACILITIES	
Foothill Farms Cabana Club No. 1,	6303 Shenandoah Dr., Sac, 348-4329
Foothill Farms Cabana Club No. 2,	6300 Matterhorn Dr., Sac, 344-6760
Scandia Family Fun Center,	5070 Hillsdale Blvd., Sacramento, 331-0115
PARKS	
Sunrise Recreation and Park District (Citrus Heights) 916-725-1585	
Foothill Park,	5510 Diablo Drive, Sacramento
William T. Mason Park,	5601 Andrea Blvd., Sacramento
Tupelo Park,	8126 Quiet Knolle Drive, Antelope
Foothill Golf Center,	7000 Verner Avenue, Citrus Heights
Greenback Wood Park,	6855 Flaming Arrow Drive, Citrus Heights
Twin Creeks Park,	7201 Starflower Drive, Citrus Heights
Westwood Park,	8100 Butternut Drive, Citrus Heights
Antelope Station Park,	Outlook Drive and Villaview
Rusch Community Park,	7801 Auburn Boulevard, Citrus Heights
Rusch Swimming Pool	7801 Auburn Boulevard, Citrus Heights
Madera Park,	8046 Wonder Street, Citrus Heights
Macdonald Field Park,	Antelope Road and Old Auburn Road, Citrus Heights

NAME	ADDRESS
C-Bar-C Park,	8275 Oak Avenue, Citrus Heights
Northwoods Park,	8236 Old Ranch Road, Citrus Heights
Sunrise Oaks Park,	Sunrise Boulevard, South of Oak Avenue
Tempo Park,	13125 Fair Oaks Boulevard, Citrus Heights
Tempo Swimming Pool,	6600 Clear Creek Court, Citrus Heights
Crosswoods Community Park,	6742 Auburn Boulevard E., Citrus Heights
Shadow Creek Park,	6250 Woodcreek Circle, Citrus Heights
Park Oaks Park,	5820 Parkoaks Drive,Citrus Heights
Brooktree Park,	6800 Dunmore Street, Citrus Heights
Cherry Creek Manor Park,	6011 Brooktree Drive, Citrus Heights
San Juan Park,	5509 Mariposa Avenue, Citrus Heights
Eugene H. Anher Park,	5517 Manzanita Avenue, Carmichael
Rushmore Jeanine Park,	6116 Rushmore Drive, Sacramento
Pioneer Park,	5100 Verner Avenue, Sacramento, CA
Pioneer Elementary School Park,	Shenandoah Drive, Sacramento
Walerga Park,	4901 Palm Avenue, Sacramento
Manzanita Park,	5517 Manzanita Avenue, Sacramento
Antelope Park Site (undeveloped),	North Antelope Road and Eagle Point Way,
Cripple Creek Park (undeveloped),	b/w Crestmont Ave. and Old Auburn Rd., Cit. Hts.
Orangevale 916-988-4373	
Orangevale Youth Center Park	6745 Hazel Avenue, Orangevale
Coleman School Park	6545 Beech Avenue, Orangevale
Almond Park	5901 Almond Avenue, Orangevale
Pecan Park	5945 Pecan Avenue, Orangevale
Sundance Park	13120 Fair Oaks Boulevard, Orangevale
Fair Oaks 916-966-1036	
Fair Oaks Park,	11549 Fair Oaks Blvd, Fair Oaks (borderline)
North Highlands 916-332-7440	
Chardonnay Park,	Cherbourg Drive and La Tour Drive, North Highlands
Carmichael 916-485-5322	
Del Campo Park,	Oleander Drive, Carmichael
Bird Track Park,	Pheasant Road, Fair Oaks
O’Donnell Heritage Open Space,	Charleston Drive, Carmichael
Palm Avenue Open Space,	Palm Avenue, Carmichael
Jan Drive Park,	Jan Drive, Carmichael (planned)
Barrett School Park,	Barrett Road, Carmichael (planned)
Arcade Creek 916-482-8377	
Arcade Creek Park,	end of Ami Drive, Sacramento
Hamilton Street Park,	4855 Hamilton Street, Sacramento
Holyoke Nature Area,	Myrtle Avenue, Sacramento
Oakdale Park,	3708 Myrtle Avenue, North Highlands
Mission Oaks 916-488-2810	
Gibbons Park,	4701 Gibbons Drive, Carmichael,
Fulton-El Camino 916-927-3802	
Bohemian Park,	Yellowstone and Wright Street, Sacramento
City of Sacramento 916-277-6060	
Del Paso Park,	3565 Auburn Boulevard, Sacramento
Hagginwood Park,	3271 Marysville Boulevard, Hagginwood
Hagginwood School Park,	1418 Palo Verde Avenue, Hagginwood
Johnston Park,	231 Eleanor Avenue, North Sacramento
Mama Marks Park,	1140 Roanoke Way, Del Paso Heights

NAME	ADDRESS
Manor Park,	200 Danville Way, Del Paso Heights
Nuevo Park,	Hayes Avenue and Silver Eagle Road, Del Paso Heights
Redding Park,	Rio Linda Blvd and Roanoke Ave, Del Paso Heights
Richardson Village Park,	2995 Altos Avenue, North Sacramento
Robertson Park,	3525 Norwood Avenue, Del Paso Heights
Kenwood Oaks Park (unbuilt),	1910 Kenwood St., Hagginwood
Sacramento Northern Bikeway	
Sacramento Softball Complex,	3450 Longview Drive, Sacramento
Equestrian Trails, (leased to Sacrament	Longview Dr.
Ueda Parkway	
City of Roseville 774-5242 (Mike Shellito)	
Cresthaven Park,	401 Community Drive, Roseville 95661
Crestmont Park,	1500 Champion Oaks Drive, Roseville 95661
Sunrise Corridor Open Space	Sunrise Boulevard at Kensington Drive, Roseville 95661

Appendix F: Arcade Creek Watershed Stakeholders

ORGANIZATION	P.O.C.
PARK AND RECREATION AGENCIES	
Sunrise Parks and Recreation District	Terry Jewell
Orangevale Parks and Recreation District	Tim Mero
Fair Oaks Parks and Recreation District	Sam Crawford
North Highlands Parks and Recreation District	Kay Dahill
Carmichael Parks and Recreation District	Ken De Young
Arcade Creek Parks and Recreation District	Jane Steele
Mission Oaks Parks and Recreation District	Debora Walker
Fulton/El Camino Parks and Recreation District	Jeff Dubchansky
City of Sacramento, Dept. of Parks and Recreation	Teresa Haenggi
Sacramento County Parks	Jill Ritzman
LOCAL GOVERNMENTAL AGENCIES	
SAFCA	Peter Buck
SAFCA	Tim Washburn
SAFCA	Butch Hodgkins
American River Flood Control (ARFCD)	Paul Devereaux
Sacramento Flood Control	Kay Ceragioli
City of Sacramento Parks	Karolyn Simon
American River Flood Control (ARFCD)	Richard Marck
City of Sacramento, Dept. of Parks and Recreation	Christie Benavides
Parks & Rec CAC	John Andrew
City of Sacramento, Del Paso Park	Bill Hall
City of Sacramento, Dept. of Utilities	Bill Busath
City of Sacramento, Neighborhood Services	Robi Holmen
City of Sacramento Stormwater	Patrick Sanger
Russick Environmental Consulting	Kathy Russick
City of Sacramento, Dept of Util, Field Services	Ward Cox
City of Sacramento, Landscape Architecture Section	Dennis Day
City of Sacramento, Capital City Golf	Ann Weaver
City of Sacramento, Haggin Oaks Golf Course	Sam Samuelson
City of Sacramento, Maintenance	Bob Fleming
City of Sacramento, Councilmember Sheedy’s office	Terry Schanz
City of Sacramento, Environmental	Susanne Tam
County of Sacramento, Stormwater Program Manager	Cecilia Jensen
American River College	Tim Nosal
Regional Water Quality Control Board	Lori Webber
Cal Trans	Amarjeet Benipal
City of Citrus Heights	Kristen Crane
City of Citrus Heights	Diane Nakano
City of Citrus Heights	Kevin Becker
Sacramento County, Public Works/WQCB	Janet Parris
County of Sacramento, Public Works	George Booth
Mira Loma High School	Cindy Suchanek
U.S. House of Representatives, 3rd District of California, Congressman Doug Ose's office	Kim Vann
LOCAL NON-GOVERNMENTAL AGENCIES	
American River Natural History Association	
American River Parkway Foundation	
Environmental Council of Sacramento	Al Freitas
Sacramento Valley Open Space Conservancy	Aimee Rutledge
Urban Creeks Council	Alta Tura
Sacramento Tree Foundation*	Tammy Mebane
California Native Plant Society	Paul Townsend
California Native Plant Society	Nancy Thompson

ORGANIZATION	P.O.C.
Sacramento Discovery Museum Science and Space Center	Susan Douglas
Sacramento Horseman's Association	Deborah Goldstein
Sacramento Horseman's Association	Teri Burns
Arcade Trail and Community Association	
Sacramento SPLASH	Greg Suba
Senior Gleaners	
Dry Creek Conservancy	Gregg Bates
Del Paso Housing Redevelopment Agency	Carly Velez-Daley
STATE AGENCIES	
California Dept. of Fish and Game	Terry Roscoe
California Dept. of Fish and Game	Frank Gray
State Department of Water Resources	Susan Oldland
Department of Water Resources, Environmental Services Office, Municipal Water Quality Investigations	Mike Zanoli
Department of Water Resources, Division of Flood Management	Bonnie Ross
State Water Resources Control Board, Division of Water Quality	Mary Tappel
State Water Resources Control Board, Division of Water Quality	Melence Emanuel
California Integrated Waste Management Board	Ken Decio
Natural Resources Conservation Service	Rich Gresham
FEDERAL AGENCIES	
USGS	Joe Domagalski
USDA	Toor Surjit
US Bureau of Reclamation	Sandi Richerson
US EPA	Tim Vendlinski
US Army Corps of Engineers	Sandy Britzman, et al.
Federal Emergency Management Agency	
PRIVATE INDIVIDUALS	
Sackheim Consulting	Kelly Sackheim
HOMEOWNERS	
Homeowner	Milt Henderson
Homeowner	Tom and Mildred Logan
Homeowner	Pauline Presher
Homeowner	Eric and Kathleen Ohlson
Homeowner	Gary and Cindy Taylor
CITRUS HEIGHTS NEIGHBORHOOD ASSOCIATION	
Area 1: Northwest Neighborhood Association	John Taylor, President
Area 2: Rusch Park	David Briggs, Public Information Officer
Area 3: "CHANT"	Cindy Carleton, President
Area 4: Arcade Creek	Chuck Engvall, President
Area 5: Park Oaks	Kelly Holmes, President
Area 5: Park Oaks	Jerry Wilson, Director
Area 6: Sunrise Ranch	Jerry Dodge, Public Information Officer
Area 7: Oak Creek	Dave Dais, Area Coordinator
Area 8: Woodside Oaks	Bob Evans, Reach Representative
Area 9: Sunrise Oaks	Janet Kivinen, President
Area 10: Sylvan Old Auburn Road ("SOAR")	Jayna Karpinski Costa, President
Area 11: Birdcage Heights	Jane Daly
REACH	Bob Weston, Public Information Officer
SACRAMENTO NEIGHBORHOOD ASSOCIATIONS	
Terrance Manor, CD2	Lewis Garrett
Hagginwood, CD2	Charles Hammitt, Jr.
South Hagginwood, CD2	Marion Ratcliff
McClellan Heights, CD2	Bill Maynard

ORGANIZATION	P.O.C.
Del Paso Height, CD2	Fran Baker
Heights Residents Working Together (HRWT), CD2	Carolyn Moore
Heights Residents Working Together (HRWT), CD2	Hazel Tell
Neighbors Aware Communties, Inc., CD2	Clara Green
Oak Knoll and Johnson Heights, CD2	Leonard Williams
Association for Community Organizations for Reform Now (ACORN), Del Paso Chapter, CD2	Brian Kettering
BORDER LINE NEIGHBORHOOD ASSOCIATIONS	
Parker Homes Neighborhood Improvement Association, CD2	Gary Collier
Village Green Mobile Home Park Association, CD2	Russell Schroeder
Robla Neighborhood Association, CD2	C. Jeffery Evans
OTHER NEIGHBORHOOD ASSOCIATIONS	
Sacramento County Alliance of Neighborhoods (SCAN)	Mary Brill
OTHER INTEREST PARTIES	
Union Pacific Railroad Company	James Smith
Urban Creeks Council	Gene Peshette
Homeowner/RWQCB	Michelle Wood
Arcade Flood Wall Project (Senior Civil Engineer)	Brett Forrester
SWRCB/Resident	Rebecca Smith
Citizen	William Connelly
Citizen	Randy Smith